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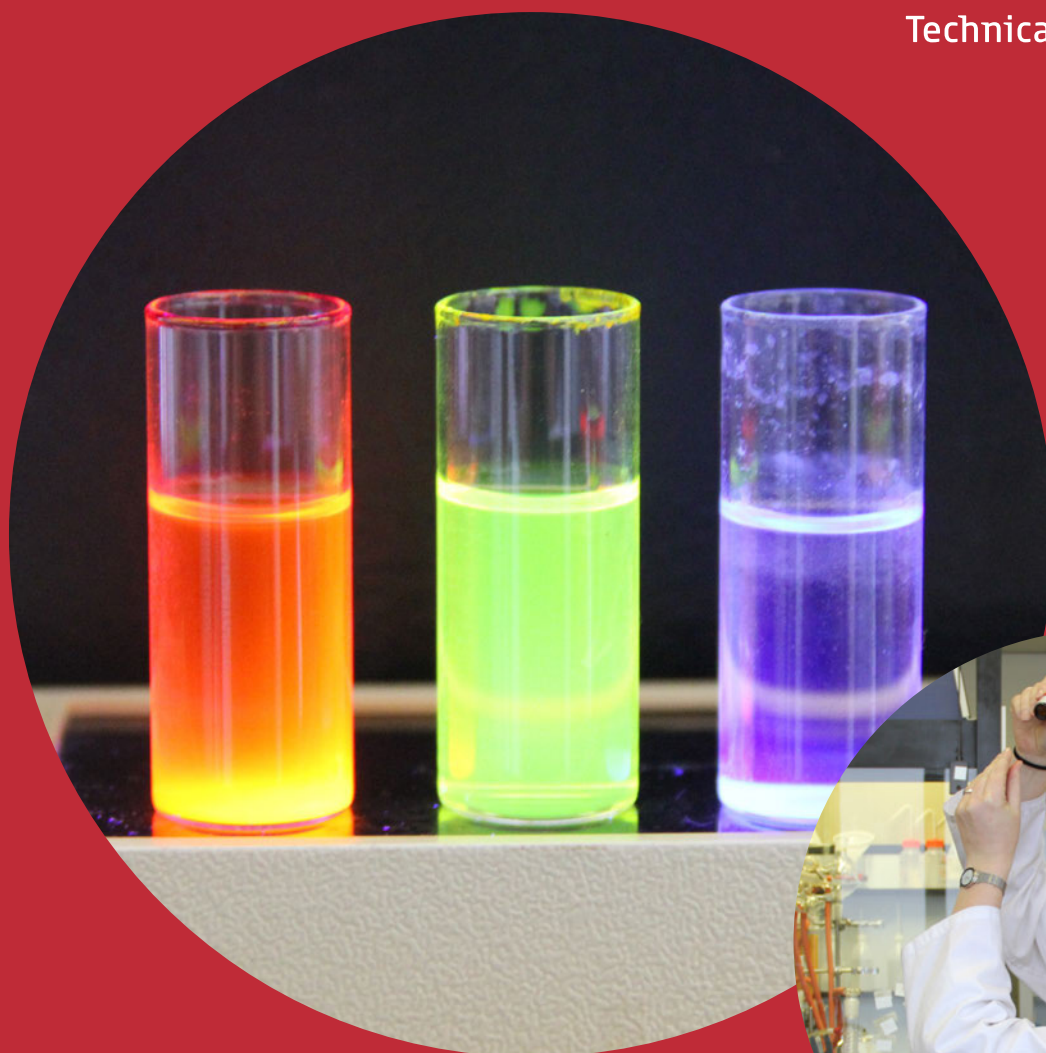
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Foreword

Markku Markkula

President

European Committee of the Regions

The EU and its Member States have faced unprecedented challenges in recent years. Citizens rightly demand more jobs and long-term sustainable growth. They expect a more effective response to migration. They want to see all governments maintain stability in and outside EU borders. These issues directly affect Europe's local and regional governments and the communities they serve which is why they are priorities for the European Committee of the Regions. The answers lie in deepening cooperation among all spheres of society and delivering a new entrepreneurial mind-set. We need to engage all levels of government and strive to create a Europe that meets these 21st century challenges.

Realising this change in mind-set must start by making better simpler EU legislation that delivers jobs and demonstrates the added value of the EU. Unemployment has fallen from 11.5% in 2014 to 10.5% in 2015 but this is not enough. This is why first and foremost economically profitable, socially inclusive and sustainable growth is the priority for local and regional governments. We recently held a Europe-wide survey with the OECD which showed that public investment has fallen in over 40% of local and regional governments since 2010. Recovering from the crisis and creating a prosperous Europe must start by closing this development gap. Investment has fallen due to increased social burden and falling tax-income, but also due to the inability to deliver innovative collaboration between all levels of government.

Sustainable growth can only be delivered by pulling resources from all sectors and through joint collaboration between the public, private and civil sectors. The EU must listen to the knowledge, experience and understanding of those delivering legislation on the ground to progress and move forward. Given three-quarters of EU laws are implemented by local and regional governments, creating an EU that works must take into account the territorial impact of its policies and initiatives.

The Committee – the EU's institution of local and regional leaders – is committed to supporting entrepreneurialism, investing in start-ups, growing industries and driving partnerships based on smart specialisation. As local and regional leaders we know what works and what investment is needed. For many regions and cities the €350bn of EU structural funding and the recently launched EU Investment Plan are lifelines that can make the difference in delivering

services and attracting private investment. This is why the Committee is working in partnership with the European Commission and the European Investment Bank to exploit the opportunities offered by these 2 financing tools.

“Sustainable growth can only be delivered by pulling resources from all sectors and through joint collaboration between the public, private and civil sectors.”

Given the impact on communities and public services, managing migration in Europe is high on the political agenda. Part of the response must be through building ties across borders. The Committee is continuing to work through platforms, such as the Euro-Mediterranean Regional and Local Assembly (ARLEM), where local and regional leaders from in and outside Europe meet to share challenges and co-create solutions. Only in January we agreed during our ARLEM meeting in Cyprus to co-create “The Nicosia Platform” which will assist Libyan cities.

What is clear is that we must try new methods to build a better Europe. We need more open innovation. We need more experimenting, piloting and rapid prototyping. We need to use the knowledge and expertise in all sectors to create new jobs, drive prosperity and create sustainable communities. The EU needs to reinvent itself to reflect the changing times of our world and show it can reform. It needs to reassert the fundamental principles it was founded upon – a progressive Europe built on aspiration, social cohesion, liberty, democracy, equality, the rule of law and respect for human rights, guided by subsidiarity. We must always ask ourselves before introducing new EU laws or deciding how to spend our precious resources: how does it benefit citizens. ■

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Introduction

Welcome to the first edition of 2016. As we head into a New Year, growth and jobs remain the key priority for the European Commission – despite the European Union managing a number of crises, such as climate change.

In the President's New Year Conference, President Jean-Claude Juncker underlined his determination to focus on this priority within the Commission. Juncker called on Member States to pursue the strategy set out by the Commission a year ago and announced major progress from the €315bn Investment Plan.

The edition kicks off with a Foreword from President of the Committee of the Regions Markku Markkula, who outlines challenges that Member States have faced over the years and the importance of sustainable growth and investment to build a better Europe.

Other areas of crisis in Europe at the moment include the refugee crisis and climate change. In this February edition we look at the COP21 Paris conference and hear from organisations as to whether opportunities were missed at the December conference.

We shine the light on COP21 in the energy section, with articles from the European Economic and Social Committee (EESC) and the European Geothermal Energy Council looking at

what needs to be done now to turn promises into actions.

The security section focuses on another key crisis. Paris and Brussels saw unprecedented violence last year with terrorist attacks affecting both cities. Adjacent Government looks at The European Agenda on Security and how biometrics can help in the fight against crime and terrorism.

An article from EUROPOL outlines how the internet has become a powerful tool for terrorists and how the organisation is combating this problem through the European Union Internet Referral Unit (EU IRU). A piece by INTERPOL similarly highlights how biometrics can be used globally to investigate and tackle terrorism.

Other areas of focus in this early edition include: the circular economy; ocean research & climate change; fire safety management; the obesity crisis; digital health for the ageing; and the value of vaccines worldwide.

As always, I hope you find the articles featured informative and useful, and welcome any feedback you may have. ■

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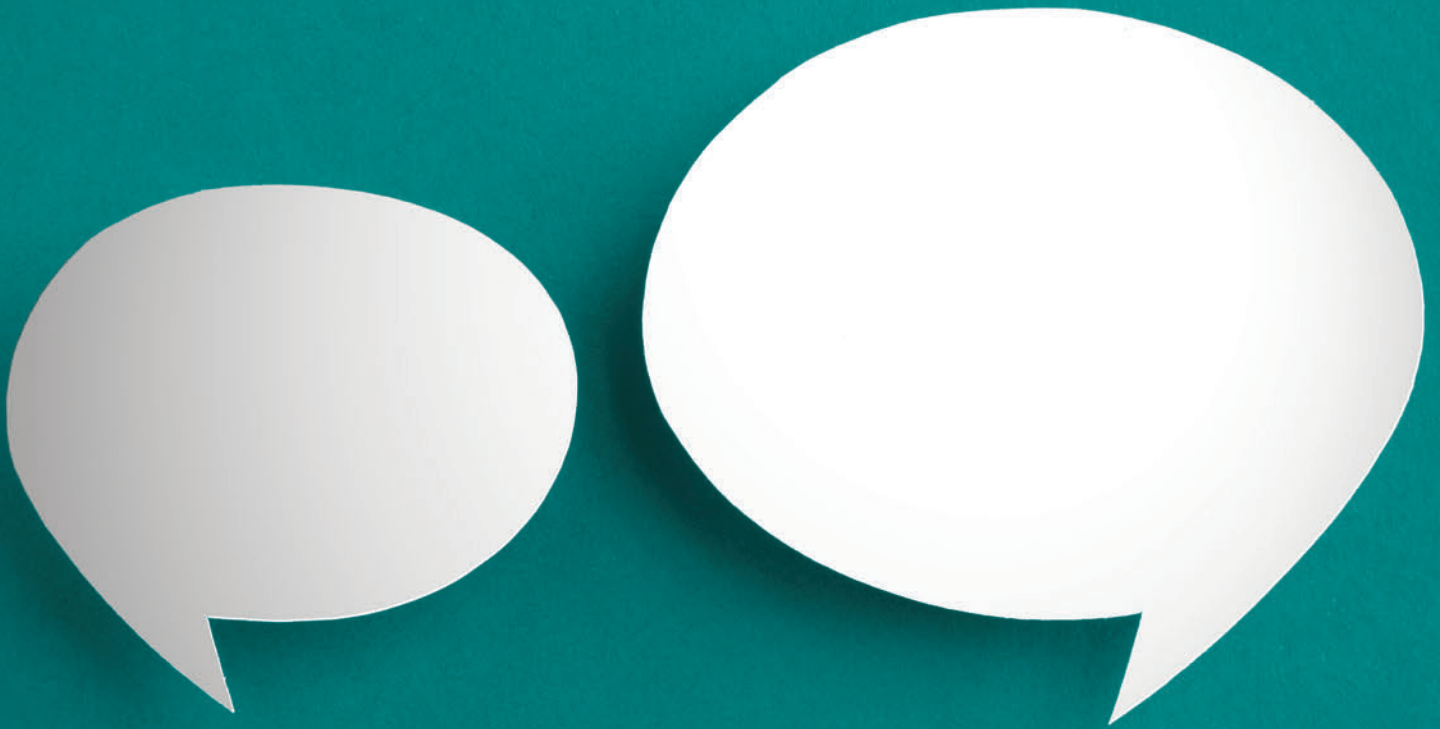
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YOUR OPINION MATTERS

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Leaving a comment on any item on our website is easy, so please engage and join the debate today.



Key health priorities for Europe

Adjacent Government highlights a speech by the EU Commissioner for Health, Vytenis Andriukaitis at the Bulgarian Parliament in December 2015...

The definition of health as proposed by the World Health Organization is: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

So it is not only about the disease and the cure. Unfortunately for too long we have been focusing on care and cure, while most of the harm related to risk factors – alcohol, tobacco, salt, sugar, trans-fatty acids, physical inactivity, stress, air pollution and others – is preventable.

These risks are like this invisible hand which makes our healthy citizens sick. It is high time we take care of this hand. Otherwise we will never manage to face the rising costs for our healthcare systems whatever we do. This is a very important message and I wanted to say this first thing.

The risk factors shorten lives of our citizens, reduce our health resources, provoke chronic diseases and

pressure our healthcare systems and our economies.

Yet we forget that public health plays a central role in a vibrant social market economy. It is always underestimated, yet it is vital.

Public health is a prerequisite for economic growth – a healthy population is more productive – and the health sector is a key tool to support this.

The sector already amounts to up to almost one tenth of the EU's economy yet it has huge potential to stimulate growth and investment, to generate innovation, new products, technologies, services and jobs.

Yet health expenditure as a percentage of GDP varies significantly across Member States – in Bulgaria, it was in 2013 clearly below the EU average.

I would like to stress that without socially responsible structural reforms in healthcare, fiscal sustainability in

the medium and long term cannot be ensured – not anywhere in Europe.

We all know that improving access to healthcare, including pharmaceuticals, better planning based on assessment of health needs and integration between health and social care are not easy to implement in short-term.

That is why strong political commitment of all parties to an agreed direction of reforms is needed to make change happen. Staying with economic matters, as regards employment, the health sector is also highly significant.

About 11% of the EU's workforce is active in the health and social sector, most of whom – 8% – work in healthcare.

Issues such as the training, recruitment and retention of health workers are within national rather than European competence. Nevertheless, I would like to support the Member States and promote the exchange of knowledge and expertise.

The Joint action on workforce planning will end in June 2016 and it will put forward a set of recommendations. I invite you to use them.

To ensure the access to effective healthcare for our citizens, we need strong, resilient, accessible and effective health systems. The European Commission's President, Jean-Claude Juncker, was elected on his jobs and growth agenda, stating that the EU must aim for a "triple A" status on social issues. For me, this means we must:

- Promote access to good quality healthcare;
- Support healthcare systems reform; and
- Cooperate on the health challenges shared by Member States, in particular health system management and cross-border health threats.

My work consists of developing an agenda for health systems' reforms as part of the European Semester

process, as well as the analytical and cooperation tools that can help Member States to reinforce their health systems.

This is why I launched at the beginning of my mandate a group of Member States' experts on Health Systems Performance Assessment, which is chaired jointly by Sweden and the European Commission.

My goal is to strengthen our analytical capacity and country expertise; to work closely with stakeholders and Member States; and to offer the best possible EU coordination and support to national governments.

Member States in today's European Union share many similar health challenges. There is clearly scope to benefit from increased co-operation.

And I invite all Member states to do so especially because as EU Health Commissioner I have an overview of the public health situation in the EU Member States.

I can see striking inequalities in health status both across and within EU Member States. For instance, in life expectancy: The EU average is 79.2 years, but there are marked differences.

Whereas one might expect to live about 82 years in Spain, or Italy or 81 years in Cyprus, the figure for Bulgaria is 74.4 years.

There remains a gap of more than eight years in life expectancy between the Member States with the highest level and lowest levels

This is why I encourage all the Member States in the EU to work together, learn from each other and develop public health strategies together.

An area I would like to mention to explain the added value of EU-wide cooperation in the health area is cross-border healthcare.

The Directive on patients' rights in cross-border healthcare establishes the right of citizens to go to another EU country for treatment and get reimbursed



Vytenis Andriukaitis,
Commissioner for Health &
Food Safety

for this. It also creates new ways of cooperating at EU-level in the way we deliver healthcare.

For instance, it gives more opportunities to share knowledge and pool expertise. It foresees the creation of European Reference Networks, to bring together highly specialised healthcare providers from different EU countries. I would like to encourage Bulgarian providers to participate in these networks.

On the basis of this Directive, I also want to expand cooperation among Member States on eHealth and on Health Technology Assessment. The latter could help Member States avoid duplication of efforts and enable an effective exchange of information among national authorities.

Furthermore, I would also like to remind you of a very important measure enabling Member States to join together to procure pandemic vaccines and other medicines for infectious diseases.

We also must be ready to address unexpected challenges.

Last year, Ebola struck. Today, we have a refugee influx of enormous magnitude. This calls for resolute EU action, solidarity and a coordinated EU response. President Juncker has rightly identified migration as an immediate priority.

Greater efforts are needed to ensure adequate access to healthcare for migrants and refugees, especially those most in need. The Commission is doing everything it can within its competences to help Member States under particular pressure from migration.

In particular, financial support is available through the Asylum, Migration and Integration Fund, the Internal Security Fund, and the Union Civil Protection Mechanism. Besides these, the European Structural and Investment Funds can be mobilised to address the current migration challenges.

In addition, I have already channelled €5m from the Health Programme to support Member States in addressing the health needs of migrants.

The Commission also supports the implementation of “hotspots”. The first of these have already been established in Lampedusa in Italy and Lesvos in Greece.

I visited the Lesvos hotspot in Greece a few weeks ago and I saw that greater efforts are needed in order to provide appropriate emergency care and healthcare.

For such “hotspots”, the Commission has prepared a personal health record to help reconstruct the medical history of the refugees and detect immediate needs.

Finally on migration, the Commission is working through the EU Health Security Committee to coordinate health-security measures to address the immediate health needs in frontline Member States. Vaccines, for instance, are urgently needed and I am currently discussing with Member States how to collaborate better.

Let me finally mention an issue which relates to human health as well as to food safety: antimicrobial resistance (AMR).

Fighting AMR is one of my key priorities and I intend to do all I can to keep action in this field very high on the political agenda.

25 000 patients die in the EU each year as a result of infections caused by resistant bacteria. The costs incurred amount to an estimated €1.5 billion annually, due to increases in healthcare expenditure and productivity losses.

Resistance is growing: AMR is fast becoming an EU and worldwide emergency. As Commissioner responsible for both food and health, I believe we can fight AMR with a fully co-ordinated approach which encompasses action on human and veterinary health as well as food safety – a ‘one health approach’.

I am keen to work with the Bulgarian authorities to help combat antimicrobial resistance. Sadly, the

number of infections by bacteria which are resistant to key antibiotics tends to be higher in Bulgaria than the EU average.

It is crucial for Bulgaria to improve the way it uses antimicrobials and tackles high levels of antimicrobial resistance – otherwise the situation might become much worse.

My mantra is simple:

- Prevention – fighting the risk factors to prevent diseases;
- Promotion – encouraging good health;
- Protection – recognising measures that save lives.

Acting now – investing now – will ultimately lead to savings.

Finally, I want to underline that our successes depend on the direct and active involvement of all interested parties. We all need to play our part if we want to achieve real progress.

This is why I have recently added ‘Participation’ to the 3 priorities I have just described.

I am not just sitting somewhere in Brussels and taking decisions from my ivory tower. The EU is all of us – I am here to do my part of work and I invite you to do yours. ■

This is an edited version of the original speech which can be found here – http://ec.europa.eu/commission/2014-2019/andriukaitis/announcements/speech-bulgarian-parliament_en

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Vytenis Andriukaitis
Commissioner for Health & Food Safety
 European Commission
http://ec.europa.eu/commission/2014-2019/andriukaitis_en

The European Confederation of Pharmaceutical Entrepreneurs AISBL

The European Confederation of Pharmaceutical Entrepreneurs ([EUCOPE](#)) is Europe's principal trade body for small to medium sized innovative companies working in the field of pharmaceuticals. Via its company members and national member associations such as the British Ethical Medicines Industry Group (EMIG), the German Pharmaceutical Industry Association (BPI), BioDeutschland, the Pan-Hellenic Union of Pharmaceutical Industries (P.E.F.) and France Biotech, EUCOPE represents more than 900 member companies in Europe ([full members list](#)). EUCOPE membership includes family owned (bio)pharmaceutical companies such as B.Braun, Biotest, Ferring, Grifols, Norgine, and Vianex as well as many companies active in the field of rare diseases, such as Achillion, Actelion, Alexion, Ariad, Biogen, BioMarin, Celgene, CSL Behring, CTRS, Intercept, Medac, Orphan Europe, Otsuka, PTC, Sarepta, SOBI, and Vertex. This EUCOPE Orphan Medicinal Products (OMP) Working Group is the voice of innovative (bio)pharmaceutical companies with their unique dedication to orphan diseases.

It is widely acknowledged that small and medium enterprises contribute significantly to the development of the innovative pharmaceutical industry. At the same time, this part of the pharmaceutical industry faces considerable challenges. This particularly holds true for OMP dedicated companies. Companies investing in highly innovative ther-

apies targeting rare diseases are both at the forefront of (bio)pharmaceutical research, yet also at the forefront of debates relevant to patient access, healthcare rationing, and reform. Significant challenges exist for these therapies in achieving swift and predictable regulatory authorisation, funding, and ultimately access for patients. Very often, such companies have only one or two products in the market and are therefore not able to diversify due to their focused business model. Consequently, these companies are highly dependent on stable regulatory and HTA frameworks, which need to sufficiently differentiate between the different types of industries and their needs:

- Rare disease research has a high grade of complexity due to a limited number of patients which can lead to a lack of investment in R&D (higher cost per patient for development). Thus, investing in R&D of OMPs bears a higher risk to investors.
- Expenditure for rare diseases is only a minimal fraction of the total drug expenditure in the EU. However, national availability of authorised OMPs is uneven due to different pricing and reimbursement systems and societies' willingness to pay.
- Due to OMPs specificities pricing/reimbursement decisions should not be based on traditional cost-effectiveness analysis (CEA). The traditional HTA approach cannot fully capture the value of OMPs.

- The OMP designation underlines that there is significant clinical benefit, which should not be put in question in HTA procedures. Any HTA decision needs to take into account the social value, severity of the disease, and unmet medical need rather than focussing on CEA only.

As far as the regulatory framework at EMA level is concerned, the incentives defined in the Orphan Drug Regulation (EC) 141/2000 have stimulated research and development of drugs to treat rare conditions and successfully led to an increase in research investment in this field. Until then, research in the rare disease space was rather low given the limited number of patients and little commercial attractiveness. As a positive result of the OMP Regulation, in 2015, the number of OMPs approved in the European Market was more than 120, providing patients with continuous treatment improvements in various disease areas such as Cystic Fibrosis, Duchene disease, Gaucher disease, Fabry disease, Multiple Myeloma, Leukaemia conditions, etc. Nevertheless, while there is broad consensus among the stakeholders that the OMP Regulation shall remain unchanged, the Commission guidelines that are defining and explaining the criteria that lead to an OMP designation are currently under review.¹ The above-cited increased number of OMPs is also a testimony to the fact that these guidelines have overall provided the right level of predictability needed for new OMPs to be



“It is widely acknowledged that small and medium enterprises contribute significantly to the development of the innovative pharmaceutical industry. At the same time, this part of the pharmaceutical industry faces considerable challenges.”

authorised. However, given that these guidelines have remained unchanged for several years while the number of OMP designation applications has significantly risen and new regulatory schemes such as adaptive pathways have been introduced, certain adjustments are appropriate. In this context, it is of utmost importance that, during the revision process, the positive results already achieved with regard to the approvals of OMPs in Europe are not being jeopardised through restrictions on the designation and marketing authorisation level.

One of the key points to be reviewed is the concept of significant benefit. The sponsor has to prove this significant benefit in comparison to existing methods when applying for the OMP designation and it will be reassessed during the marketing authorisation procedure for the product in question. The Commission is in particular committed to simplify the procedure for the reassessment of orphan criteria when two authorisation applications are pending in parallel for two

OMP designated products. It is important that sponsors should use the opportunity to take advice at protocol assistance to identify the relevant comparators to be used to develop clinical trial data. Moreover, predictability is needed and any new marketing authorisation granted after the authorisation process of the first product has started should not lead to additional data requests. The Commission also indicates in the consultation that for a conditional marketing authorisation, it might not be feasible to confirm orphan designation at the time of marketing authorisation due to the limited data package. This provision, if put in practice, will discourage sponsors from applying for conditional marketing authorisation and may jeopardize the possibility to provide therapies at an early stage to patients with a high unmet medical need. In the context of evolving adaptive pathways policies and practices to ensure patient access to therapies more rapidly, sponsors should be further encouraged to follow these routes.

Altogether, the review of the OMP guidelines should primarily focus on encouraging and enabling research in the field of rare diseases. It is important that criteria for OMP designation and approval are applied in the context of evolving adaptive pathways projects and policies, to ensure a timely patient access to new and innovative therapies.

¹ Consultation Document: COMMISSION NOTICE ON THE APPLICATION OF ARTICLES 3, 5 AND 7 OF REGULATION (EC) NO 1411/2000 ON ORPHAN MEDICINAL PRODUCTS



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Translating basic immunology to innovative and sustainable solutions for animal health and welfare

Infectious diseases are a major cause for animal suffering and production losses in livestock and at the same time, often being zoonotic, represent a serious hazard for food safety. Combating infectious diseases of livestock is therefore a top priority on the veterinary and public health agenda. Mass use of antibiotics, antiparasitic drugs and vaccines have been employed, but this practice alone was unable to provide solutions to many of the multifactorial disease complexes. The increasing threat of multidrug resistance caused by inappropriate employment of antibiotics is a serious concern. Although vaccines are a great success story they are lacking efficacy against difficult pathogens and against certain disease complexes caused by multiple pathogens typically found in the field. In fact, major problems are antigenic variability of the pathogens and the multifactorial nature of the diseases being caused by complex combinations of pathogens, environmental and husbandry factors.

Why can immunology contribute to solving these problems?

The mammalian immune system has evolved to control pathogenic infections and in most cases is able to perform its tasks with remarkable efficacy. The immense variety of pathogens has driven the evolution of a very complex immune system, which nevertheless

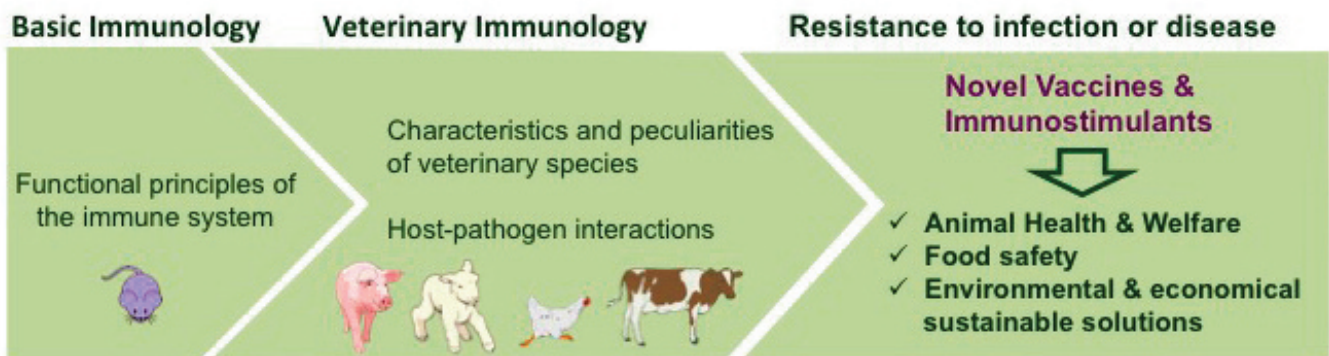
follows relatively simple principles. The immune system needs to recognize invading pathogens and trigger an immediate response limiting the further spread of the pathogen. This is initiated by receptors recognizing structures specific to different classes of pathogens. This “innate immune response” can be an inflammatory or antiviral response. An important feature is that it needs to be controlled to avoid excessive collateral damage of host tissues. Pathogens reaching a certain threshold of infection will also stimulate “adaptive immune responses” by T- and B-lymphocytes, responsible for cellular and humoral responses, respectively. Their receptors are highly specific for a given pathogen and are able to recognize virtually any structure. The price for this enormous diversity in antigen recognition is that lymphocytes expressing these specific receptors need to be amplified before being effective against the invading pathogen, and this process takes several days. With these fundamentals there are principally two strategies how the immune system can be made more protective. First, the innate immune system can be boosted to a higher level for early pathogen control. Second, the adaptive immune system is targeted, which is typically achieved with vaccines. So, the main argument to target the immune system for improving animal health is that nature itself is demonstrating this to be most successful.

Stimulating the innate arms of the immune system

The innate immune system can protect the body from infection, reduce the ability of a pathogen to proliferate and spread in the host, and importantly trigger adaptive immune responses. With respect to the latter, it will direct the type of adaptive immune response, for instance promote the response required against extracellular pathogens colonizing mucosal surfaces or alternatively promote responses against intracellular pathogens. For these reasons there is a great potential in stimulating the innate immune response.

The crisis of translating basic immunological research into new therapeutics and vaccines

Basic research has mostly used the mouse model to discover fascinating details of the functioning of the mammalian immune system. But the amount of new prophylactic and therapeutics solutions to human and animal health has been disappointing. In fact a deep canyon between basic research and clinical solutions has established. There are many reasons for this. While the murine model is excellent to discover and explain basic principles of the mammalian immune system, details in the distribution and functioning of certain immune cells and immunological receptors and



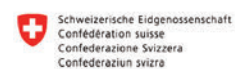
Veterinary Immunology is bridging the translational gap between basic immunology and the development of novel, efficacious and sustainable solutions for veterinary infectious diseases.

their ligands can differ. These differences have been driven by evolution as different species inhabit a different environment with for instance different food and pathogen exposure. Also major differences in the commensal microbiome colonizing mucosal surfaces are noted. This is known to have an important impact on the immune system. In addition, major anatomical differences, for example in the skin, the mucosa, and the gastrointestinal tract, have a strong influence on the functioning of the immune system. A further drawback of murine models can be the employment of inbred mice in highly controlled environment, not reflecting real life. As a consequence, extrapolations from the murine model to other species can be wrong. A final point amongst the many that could be made is the limitations of many models for infectious diseases simply caused by the fact of evolution-driven pathogen-host interactions resulted in fine-tuned adaptation processes at the molecular and cellular levels. In rodent animal models this can often not be recapitulated resulting in misleading results and failure of translational research.

Bridging the gap

Veterinary immunology focuses on the immune system of the target species of particular pathogens and is dedicated to understand the functioning of immunity in pigs, cattle, small ruminants, chicken and other relevant species. This research has demonstrated important species-specific differences in the immune system. In our laboratory we are focussing on mononuclear phagocytes including dendritic cells of pigs, dogs and cattle. These represent central cells in the innate immune response and are also absolutely essential to induce adaptive immune responses. They therefore represent excellent target cells for immunostimulation or immunomodulation. With the tools available we are developing new vaccine adjuvants designed to induce specific types of immune responses in pigs to improve antibody and T-lymphocyte responses, both systemically and at mucosal surfaces. In addition to this application, our research contributes to understand the mechanisms of how pathogens induce disease and evade the host immune response. Finally, the specific knowl-

edge and tools are applied to develop possibilities of enhancing the resistance of animals against infections by stimulating the innate immune system. Of particular importance is the protection of mucosal surfaces, which represent the entry port for many pathogens. Current and future research is thus addressing how enhanced resistance of mucosal surfaces can be achieved without using antibiotics but instead promoting natural defence mechanisms – a clearly sustainable approach compatible with the ideas of the One Health Concept.



Institute of Virology and Immunology

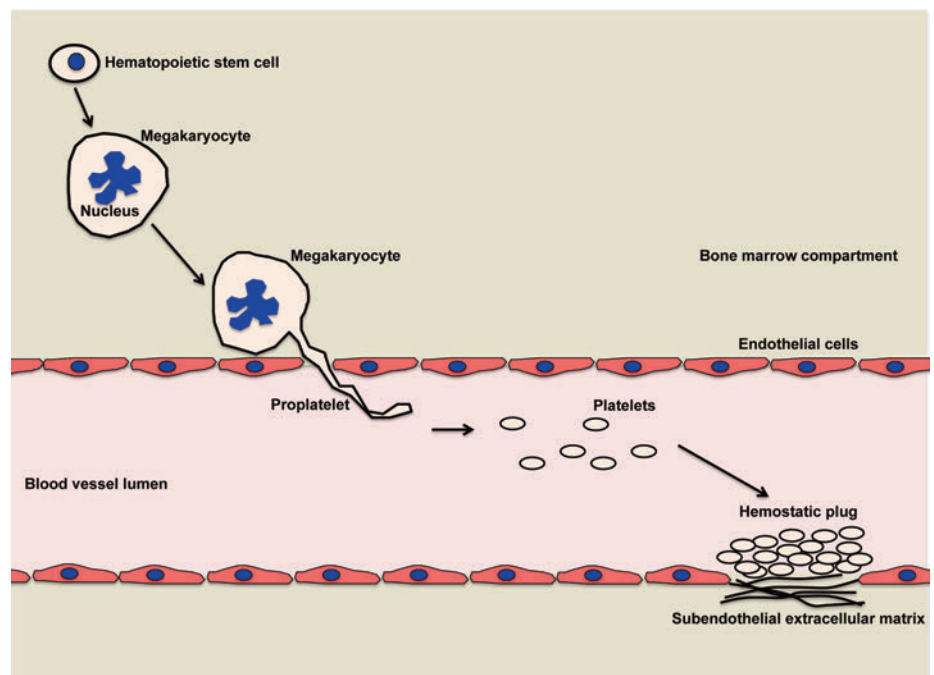
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Platelets in hemostasis and thrombosis – finding the right balance

Anucleated blood platelets are produced by their bone marrow resident precursors, the megakaryocytes, in a unique process in mammalian physiology. Terminally differentiated, polyploid megakaryocytes are the largest cells in the bone marrow evolving from hematopoietic stem cells. Megakaryocytes are localised in close proximity to sinusoidal blood vessels and convert their cytoplasmic, membranous network, the demarcation membrane system, into long, cytoplasmic protrusions (proplatelets)¹, which extend into the lumen of bone marrow sinusoids and finally platelets are sequentially released from their ends². Thus, the terminal stage of platelet production occurs in the bloodstream, where platelets attain their final shape and size.

At sites of vascular injury, circulating platelets come into contact with exposed subendothelial components (e.g. collagens), and form a plug to prevent excessive blood loss (hemostasis)³. 10^{11} platelets are produced daily in the human body to fulfill the normal hemostatic function⁴. The individual's platelet count is maintained in a range of approximately 150.000-400.000/ μ L, requiring a constant balance of platelet production and clearance. Conditions that cause insufficient platelet production or accelerated platelet clearance pose a risk for death from bleeding. This is of major clinical significance when



patients acquire a low platelet count (thrombocytopenia) resulting from radiation exposure, chemotherapy, transplants, surgery, or other causes as well as for patients suffering from inherited thrombocytopenias due to mutations in specific genes that play an important role in megakaryocyte or platelet development. Platelet transfusion is a very important option for treating thrombocytopenia, however, an ever-expanding demand for platelets and an inadequate response of patients to transfused platelets requires alternative strategies, such as donor-independent sources, to treat patients suffering from thrombocytopenia associated with bleeding complications⁵.

On the other hand, however, if platelet aggregation occurs in an

uncontrolled manner it may also lead to thrombotic events causing life-threatening disease states such as myocardial infarction or ischemic stroke, which are the leading causes of disability and mortality in the Western world. Therefore, there is still a strong demand for the development and production of selective, powerful, yet safe antithrombotic drugs.

Despite recent advances, a more detailed understanding about the complex process of platelet production and function is crucial to better treat patients with bleeding complications without increasing the risk of thrombotic events.

Consequently, in order to better understand the underlying mechanisms, our group capitalises on genet-

ically-modified mouse lines to identify key molecules involved in these processes. Mice are the most frequently used species in thrombosis research because of their small size, high fertility, exceptional reproductive capacity and the similarity to humans in anatomy, physiology, and genetics.

How animal models can serve to study the complex world of human diseases will be shown as follows: we were recently able to show⁶ that a hitherto unsuspected protein, the cytoskeleton-regulatory protein Profilin 1, is involved in the development of the Wiskott-Aldrich syndrome, a rare and severe hereditary disease, caused by mutations in the Wiskott-Aldrich syndrome protein (WASp). This disease is characterised by the triad microthrombocytopenia (small and few platelets) with increased risk of bleeding, immune deficiency and eczema⁷. We revealed⁶ that mice with a megakaryocyte/platelet-specific Profilin 1 deficiency also displayed a microthrombocytopenia, thereby reproducing a central hallmark of the Wiskott-Aldrich syndrome in humans. Profilin 1-deficient mouse platelets contained misarranged and hyperstable microtubules (a component of the cell skeleton) that was causative for the smaller platelet size, a defect that we also found in platelets from Wiskott-Aldrich syndrome patients. Based on our findings, we speculate that WASp acts as a modulator of Profilin 1 function in megakaryocytes, and that this process is disturbed in Wiskott-Aldrich syndrome patients. These results point to a previously unrecognised mechanism underlying the platelet formation defect in Wiskott-Aldrich syndrome patients.

Moreover, identification of misarranged/hyperstable microtubules in human platelets by immunostaining can now be used as a quick diagnostic marker to identify humans suffering from this disease.

Taken together, our group seeks to understand (I) which proteins are key regulators in platelet formation, (II) how a mutation in a gene leads to impaired platelet production, (III) how we can manipulate this process to ultimately increase the platelet count in thrombocytopenic patients, and finally (IV) what kind of new strategies can be developed to avoid platelet transfusion shortages. Similarly, we have spent much effort on identifying key molecules involved in hemostasis and pathological thrombus formation. Therefore, mice deficient in various proteins have been subjected to bleeding time assays and different experimental *in vivo* arterial thrombosis models. A major goal is to find new suitable, powerful antithrombotic targets that have no or only a minor impact on sealing a wound.

Interestingly, an emerging body of evidence over the last few years shows that blood platelets are not only important as the “band-aids” of the bloodstream but also play various roles beyond hemostasis and thrombosis. Platelets have been increasingly recognised to be involved in processes such as inflammation, tumor metastasis and lymphatic-blood vessel separation.

Thus, intensive platelet research is necessary to better diagnose and treat platelet-related diseases affecting lives of many human beings.

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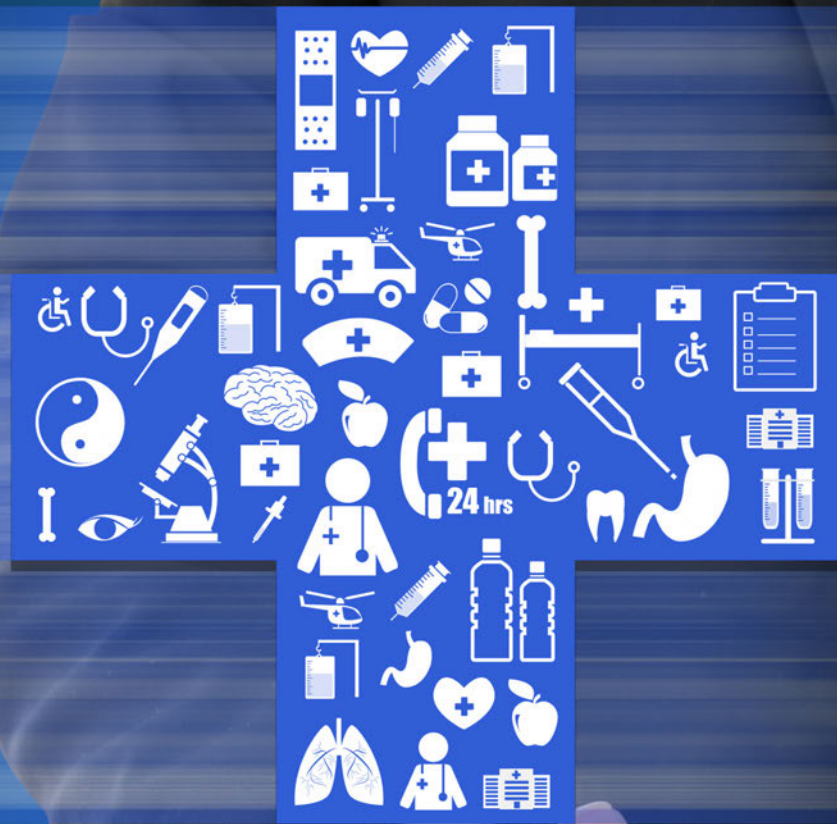


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- Tobacco Harm Prevention Index 2011
- Euro Headache Index 2011
- Euro Hepatitis Index 2012
- Euro Vision Scorecard 2013
- Euro Pancreatic Cancer Index 2014

Sweden, others

- Health Consumer Index Sweden 2004, 2005, 2006
- Diabetes Care Index Sweden 2006, 2007, 2008
- Breast Cancer Index Sweden 2006
- Vaccination Index Sweden 2007, 2008
- Renal Care Index Sweden 2007, 2008
- Smoke Cessation Index Sweden 2008
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Point-of-care ultrasound in shortness of breath and intravenous access in emergency department patients

BRIPPED Protocol:

The BRIPPED scan is an effective screening tool for shortness of breath that evaluates pulmonary B-lines, Right ventricle size and strain, Inferior Vena Cava (IVC) collapsibility, Pleural and Pericardial Effusion, Pneumothorax, Ejection Fraction of the left ventricle, and lower extremity Deep Venous Thrombosis.

B-lines: Sonographic pulmonary B-lines have been shown to correlate with congestive heart failure.^{1-4, 7, 8} A high frequency linear probe is used to evaluate at minimum 2 mid clavicular apical lung windows.

RV strain: Right ventricular (RV) enlargement can be caused by a Pulmonary Embolus (PE), acute RV infarct, Congestive Heart Failure (CHF), pulmonary valve stenosis or pulmonary hypertension, and is a risk factor for early mortality in PE.⁹ A low frequency phased array probe is used to evaluate RV strain in an apical 4 chamber view.

IVC-size and collapsibility: Using an IVC size cutoff of 2.0 cm has been shown to have a sensitivity of 73% and specificity of 85% for a Right Atrial Pressure (RAP) above or below 10 mmHg. The collapsibility during forced inspiration of less than 40% has even greater accuracy for elevated RAP (sensitivity 91%, specificity 94%, NPV 97%).¹⁰ A low frequency phased array or curvilinear probe is used to visual-

ize the IVC long axis, and dynamic imaging is used to assess collapsibility as either complete or less than 40%.

Pneumothorax: Bedside ultrasound is more accurate than supine chest x-ray with diagnostic ability approaching that of CT.^{11, 12} The same windows for B-lines are utilised for pneumothorax screening. Additionally any area of decreased breath sounds, or crepitus palpated along the chest wall is evaluated for pneumothorax with a high frequency linear probe.

Pleural effusion: EUS has been shown to have an accuracy similar to a CXR for evaluation of pleural effusion.^{6, 7} A low frequency phased array or curvilinear probe is used to evaluate each mid axillary line at the costophrenic angle in the sitting patient.

Pericardial effusion: EUS has a sensitivity of 96% and specificity of 98% compared to formal echocardiography.¹³ A low frequency phased array probe is used to evaluate pericardial effusion from an apical 4 chamber view and a parasternal long axis view of the heart.

EF: The qualitative assessment of left ventricular ejection fraction by emergency physicians has been shown to correlate well with an assessment by a cardiologist.¹⁴⁻¹⁷ The same low frequency probe and parasternal long axis used to evaluate pericardial



Virginia M Stewart

effusion is used to evaluate ejection fraction. Dynamic qualitative assessment of ejection fraction is classified as normal, depressed, or severely depressed.

“Patients presenting to the Emergency Department (ED) with shortness of breath may have characteristics that impede intravenous (IV) access. Such characteristics may include hypotension, dialysis dependence, morbid obesity, or histories of diabetes, sickle cell disease, or IV drug use.”

DVT in lower extremities: Ultrasound was performed by emergency physicians using a two point compres-



sion venous ultrasound on patients with suspected lower extremity DVT. This approach had a 100% sensitivity and 99% specificity in diagnosing DVT, compared to a reference venous ultrasound in radiology.¹⁸ A high frequency linear probe evaluates compressibility of the common femoral and popliteal veins with dynamic scanning. If pretest probability is higher for DVT, then additional fields are included, starting below the inguinal ligament at the common femoral vein, and each segment of vessel is compressed every 2 cm to the trifurcation of the popliteal artery distally.

The BRIPPED protocol can be performed in its entirety from a head to toe approach, switching between transducers, or completing the exam

with one transducer then switching to the next. An example of the latter would be to first use the low frequency probe to evaluate the parasternal long axis and apical 4 chamber, noting the presence or absence of pericardial effusion, ejection fraction, and RV strain. Then the long axis of the IVC is evaluated for dynamic collapsibility. Moving laterally, the costophrenic angles are evaluated bilaterally for pleural effusion. The probe is switched to the high frequency probe to evaluate each lung apex is evaluated in the mid clavicular line for the presence of pneumothorax and B lines. Lastly, the dynamic 2 point DVT screening is performed with compression ultrasound. The BRIPPED protocol and other bedside ultrasound resources can be viewed here:

<http://www.anatomyguy.com/b-ripped-scan-for-evaluation-of-emergency-department-patients-with-shortness-of-breath/>

Intravenous Access

Patients presenting to the Emergency Department (ED) with shortness of breath may have characteristics that impede intravenous (IV) access. Such characteristics may include hypotension, dialysis dependence, morbid obesity, or histories of diabetes, sickle cell disease, or IV drug use. One prospective observational study identified nearly one in every 9 to 10 adults presenting to an urban ED had difficult venous access requiring 3 or more IV attempts.¹⁹ If peripheral IVs are not established, patients may need a central venous catheter placed for life saving medications administered. In addition to requiring



physician skill, central venous catheter insertion carries a risk of complications including infection, arterial puncture or aneurysm, and pneumothorax. Ultrasound-guidance for peripheral IV placement (UGPIV) has prevented the need for central venous catheter placement in 85% of patients with difficult IV access.[20] UGPIV has been performed by Emergency Medical Technicians (EMTs) in prehospital settings, as well as nurses and physicians. Patients who have been identified as having difficult access, have higher patient satisfaction scores when ultrasound is used in peripheral IV access attempts.²¹

Frequently, the large veins of the antecubital fossa are sufficient to place large bore peripheral IVs needed for resuscitation. The brachial and basilic

veins are easy to locate. The brachial artery is generally flanked by 2 smaller veins and the median nerve. Anatomically, these structures are medial to the insertion of the medial biceps tendon. This tendon is palpable in the antecubital fossa as the patient flexes then extends the elbow. The basilic vein is located medial to the brachial vessels. Generally, it is more superficial, larger, and does not have an accompanying artery or nerve at the level of the antecubital fossa. As you move proximally up the arm (towards the head) the basilic vein dives deeper toward the humerus, and longer angi catheters may be required for cannulation.

When considering vascular access, there are 2 views, a short and long axis view. Cannulation from the short

axis is considered “out of plane” since the needle is perpendicular to the probe. A short axis approach “looks” at a cross section of the vessel. Long axis uses an “in plane” approach with the needle entering from the probe marker end, and “looks” along the length of the vessel. While both approaches may be used for UGPIV placement, the benefit for the short axis is the ability to identify target veins as well as accompanying non-target (arteries and nerve) structures.

Identify the Vein: Remember the C’s

The two C’s to remember for UGPIV access or for central venous cannulation are Compression and Color (or Power) Doppler. Veins are thinner-walled and more easily compressed than arteries. This author advocates

for finding a vessel first in the short plane, and compressing the vessel to ensure it is indeed a vein, rather than a less or non-compressible artery. Color or Power Doppler may be utilised to determine if pulsatile flow is consistent with an artery or vein. Color Doppler uses red and blue to determine flow towards or away from the probe respectively. Power Doppler detects flow without concern for direction. Color should not be relied on alone to determine arterial or venous flow due to the color scale setting can be flipped or reversed, or aliasing can occur. Arterial flow is more pulsatile than venous. Venous flow may require distal augmentation (by squeezing the forearm distal to the probe) to appreciate the blush of color.

Once the target vein is identified, the depth from the skin surface should be noted. A common mistake is to use an angiocatheter that is too long or too short. A general rule of thumb is to use a catheter length that is more than twice the depth of the vessel to ensure at least half the catheter lies within the vein. Sterile ultrasound gel should be used, with a covered probe to prevent infection. To prevent the risk of multiple punctures, this author advocates for first bouncing the needle on the skin over the point of entry. The tissue should deform at the top of the screen, and confirm the needle is over the target vessel. Once the skin is punctured, the needle tip is kept in view by angling the ultrasound probe until the target vessel is punctured.

To confirm placement, either a “bubble study” with agitated saline

may be performed or Color (or Power) Doppler utilised to visualise saline flow through the cannulated vessel. A vessel that is not properly cannulated will demonstrate extravasation of saline around the vessel into the tissue before the tissue swells to a degree which is palpable on the surface of the skin.

For further information about UGPIV placement, visit: <http://rmgultrasound.com/piv-access/>

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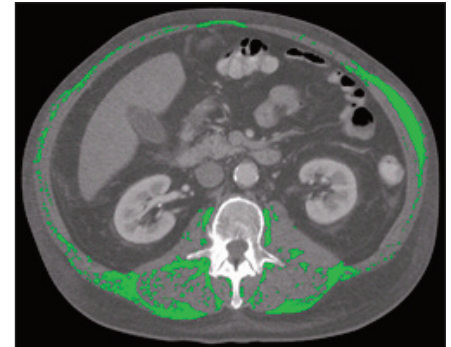


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Disease-associated myosteatorsis in people with cancer: Can it be treated?

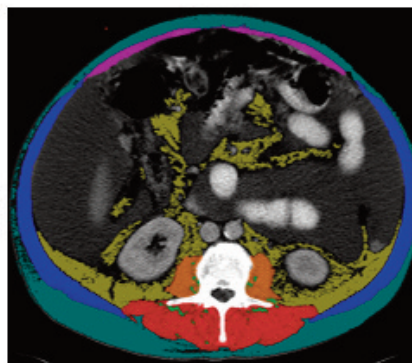
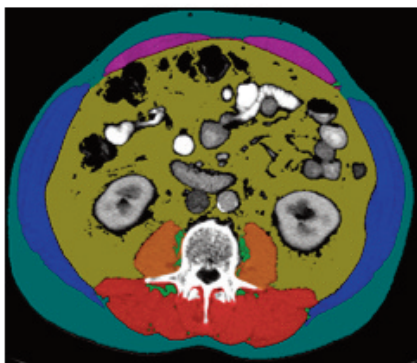
Pathological fat infiltration into muscle is a feature of disease-induced muscle loss that significantly associates with shorter survival in people with cancer. Fat is associated with skeletal muscles in the form of intra-myocellular lipid droplets within the cytoplasm of myocytes as well as intermuscular adipocytes. These lipid stores are thought to provide fuels for skeletal muscle contraction, however, excess deposition of triglycerides within cells and organs that normally contain only small amounts of fat (such as liver, pancreas, skeletal and cardiac muscle) is defined as steatorsis. Myosteatorsis (steatorsis of the muscle) is a pathological phenomenon reflecting an impairment of synthesis and elimination of triglyceride.

Myosteatorsis is revealed in vivo by computed tomography (CT) imaging as muscle with low radiodensity combined with presence of intermuscular adipose tissue. The evidence for a relationship between low muscle radiodensity and shorter survival in people with cancer is building. Loss of skeletal muscle mass appears to generally occur with accumulation of adipose tissue into muscle. We reported that patients undergoing treatment for lung cancer lost muscle mass and concurrently gained intermuscular adipose tissue during treatment for cancer, whereas patients who supplemented their daily intake with fish oil containing eicosapentaenoic acid and docosahexaenoic acid [EPA+DHA (2.2 g/day)] maintained or gained muscle



This slide shows a CT image from a cancer patient who underwent 16 weeks of first line platinum doublet chemotherapy for lung cancer. Only the intramuscular adipose tissue is shown in color

mass and experienced a decline in intermuscular adipose tissue over the same time period. This intervention also resulted in a greater response by the tumor to the drugs being used to



Skeletal Muscle

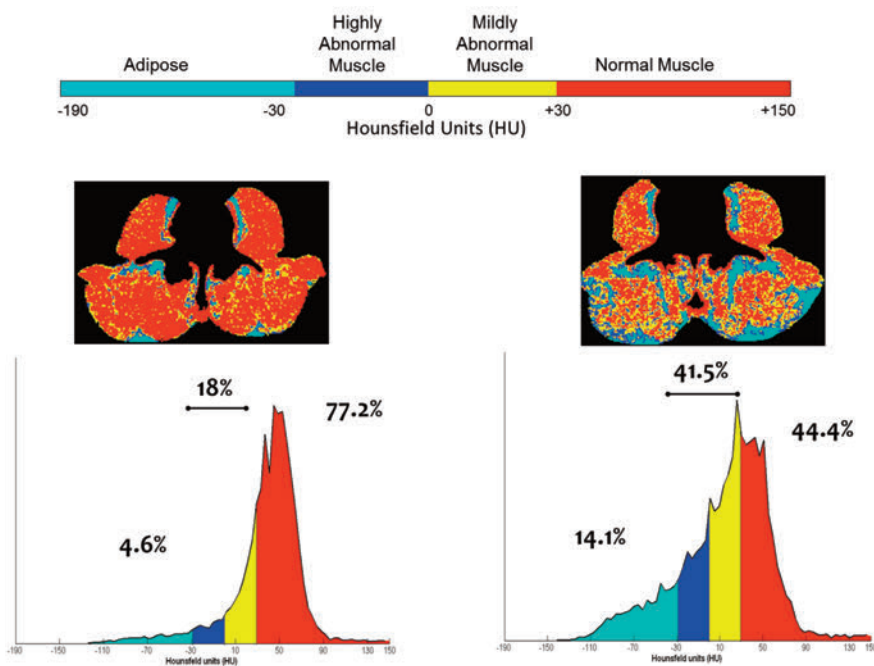


Adipose Tissue



To quantify different tissues for body composition analysis using computed tomography imaging, a bony landmark is used to consistently measure the same region of the body across patients. The 3rd lumbar vertebrae is an established landmark in body composition analysis that correlates with amount of whole body muscle and fat. Each tissue attenuates radiation in a specific way which is recognised by a software program to enable skeletal muscles and different types of adipose tissues to be identified. Each tissue of interest is then color coded (see legend). When more than one CT image exists in the patient record, tissue changes over the trajectory of the disease can be determined. This image presents 2 scans taken approx 6 months apart at the same region within the same patient. The marked decline in muscle and adipose tissue is evident, concurrent with deposition of adipose tissue into muscle

Illustration of Variation in Muscle Radiodensity



An illustration of annotated CT images, and accompanying histograms of radiation attenuation showing the percentages of total tissue cross-sectional area within the ranges of adipose tissue in paraspinal/psoas muscles is useful to understand the problem of myosteator. This illustration shows the percentages of total tissue cross-sectional area within the typical attenuation ranges determined for the respective tissues for 2 subjects. Subject 1 is a 63 year old male with muscle characteristics at the median values for male cancer patients with a diagnosis of solid tumor at our centre. For Subject 2 there is extensive macroscopic adipose tissue and less than half of the cross sectional area of his muscles falls within the normal attenuation range. Overall, Patient I has a greater proportion of fat and low attenuation muscle, than muscle with normal characteristics. Patient II is remarkable in several respects, including extensive visible fatty infiltration and extremely high proportion of total muscle area falling within a range of attenuation values generally recognized to be abnormally low (adapted from Aubrey et al 2014)

treat the cancer. Therefore there may be multiple benefits of dietary fish oil to the cancer patient undergoing treatment.

To explore these observations that cancer patients supplementing with EPA+DHA experience an improvement in myosteator, we established a pre-clinical model to enable intervention with EPA+DHA at various time points in the cancer trajectory. We used an rat model bearing the Ward colorectal tumor and treated in a manner that mimics standard clinical care for this disease in humans with respect to the types of drugs used and the toxicities they evoke. Using this model we have demonstrated that the results align with our human data suggesting an improvement in muscle condition concurrent with a better response by the tumor to the anti-cancer drugs.

Using this as the rationale for the next step of this line of questioning, we have planned a clinical trial upon which to test the biological efficacy of fish oil to reverse cancer-associated myosteator in a cancer population known to exhibit myosteator, verified by in vivo imaging of muscle features by CT scan. At the time of diagnosis and treatment planning, patients will be randomized and consented to consume EPA+DHA (2.2 g per day) until day of surgery (at least a 4 week period) or receive standard of care (no intervention). Muscle from the subjects will be collected at the time of surgery and prepared for analysis. Analysis of the muscle tissue will enable determination of differences in Triglyceride-fatty acid content (a hallmark of myosteator). We expect that this research will verify the tantalizing evidence we have in hand

that suggests an improvement in pathological features of myosteator by dietary EPA and DHA. If so demonstrated, this work will provide critical translational knowledge required to effectively plan treatment interventions that have significant potential to impact the lives of people diagnosed with cancer, a major cause of death globally.



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Vaccinating against seasonal flu

Caroline Brown, Head of the Influenza & Other Respiratory Pathogens Programme at the World Health Organization (WHO) Regional Office for Europe tells Editor Laura Evans the reasons why vaccinations are so important to help reduce influenza cases...

Seasonal influenza, an acute viral infection that spreads easily from person to person, is a serious public health problem which can cause severe illness and even death. According to the World Health Organization (WHO) annual epidemics of influenza can result in 3 to 5 million cases of severe illness with around 250,000 – 500,000 deaths. Influenza is a global disease which can spread easily through schools, hospitals, nursing homes, towns and businesses.

In order to reduce the impact of influenza and prevent severe disease in those most at risk, such as the elderly, young infants and pregnant women, vaccinations are essential. Here Editor Laura Evans speaks to Caroline Brown, Head of the Influenza & Other Respiratory Pathogens Programme, from the World Health Organization (WHO) Regional Office for Europe regarding influenza and the importance of raising awareness for vaccination.

How much of a problem is influenza throughout Europe?

As you probably know, Europe and other continents of the world have seasonal epidemics. Every year between week 40 and week 20 of the following year you can expect to find influenza circulating in the Northern hemisphere, with the epidemic usually peaking after Christmas time and continuing until early March. Depending on the season and which viruses are circulating, up to 20% of people can become infected and of course quite a large proportion of these will go to their GP. While influenza is mild in most cases, some people can end up in hospital, in intensive care units, and some may die from the disease. Certainly at the peak of the epidemic you can expect health services to be busy with influenza patients or patients showing influenza-like symptoms.

In addition you have the issue of absenteeism – school children not going to school and people not

going to work. So there is also an economic cost as well the cost of health care and life lost.

Are there certain groups that are more at risk?

Yes, certain groups have been identified as high risk. We know that pregnant women are more likely to be severely affected if they get seasonal flu. Elderly persons, residents of institutions for older persons and the disabled, anyone with chronic conditions such as heart or lung diseases or chronic neurological conditions, and also children under 5 years, are all people at high risk. We recommend that any person, above the age of 6 months, belonging to one of these groups get vaccinated. We also recommend that healthcare workers, including those who work in facilities that care for the elderly or persons with disabilities, get vaccinated, to prevent them from being off work as well as from cross-infecting vulnerable persons.

Why are vaccinations the most effective way to tackle and prevent infectious diseases such as influenza?

It's always better to prevent influenza than to try and treat a person with complications due to the infection. Seasonal influenza vaccination is safe and the most effective means of preventing infection and severe outcomes caused by influenza viruses. It's also cheaper than treatment and although the price of vaccines may vary by country, a recent review in Europe showed the price for a single dose of seasonal influenza vaccine for an adult to be between about \$3-15. From both a disease and a cost perspective it's better to vaccinate.

How important is it to raise awareness of the importance of vaccinations for influenza and how is WHO doing this?

This is very important. One of the things the World Health Organization does every year is a policy survey in all the countries of our Region on who they recommend to be vaccinated, as well as how many people at risk actually received the vaccination. A number of countries do not have recommendations

for some of the risk groups and in other countries where there are recommendations, we see a big gap between recommendations and reality, because the country may not have the resources to provide the vaccine or because utilisation of vaccine services is low in the target population. So from a policy point of view, there may be a willingness to increase vaccine access or uptake, but there are not always the resources in place; and secondly, there needs to be the know how to actually encourage people to get the vaccine, even if it's offered. Which is why it's important to raise awareness among policy and decision makers to provide funding for the vaccine. Secondly, it may be the case that the person offered the vaccine simply refuses it, so we also need to raise awareness to the key groups about reasons and benefits of getting vaccinated. In order to tackle this problem, every year at the end of October we have a public awareness campaign ([Flu Awareness Campaign](#)) and invite countries to participate. We provide posters and leaflets with messages targeting specific risk groups which can be used and translated into local languages for national campaigns. We work with the countries to help them boost their own campaigns at the beginning of the flu season. This season, 8 countries participated.

Are there certain countries throughout Europe that are more in need of vaccinations?

You could definitely say that. Our policy survey shows a correlation between countries having a lower GDP and getting less seasonal influenza vaccine. Some lower middle income countries in our Region (which includes countries in Central Asia), with poor access to healthcare services for certain segments of the population, also did not have enough pandemic vaccine. These are the countries that we put a lot of our support into.

Should more of an effort be made to offer vaccinations in certain countries?

We are helping countries to do studies which will help them to prioritize influenza vaccination alongside other health priorities. For example, we help them to



calculate the burden of disease due to influenza. We are also helping countries to look at the cost of influenza in economic terms and the cost from a health service perspective. Once a country has this information their Ministry of Health can decide, if they need to put more funding into vaccinations because it's going to save money and it will improve the health of people. So that's the kind of work we are doing.

Do you think certain countries don't see Flu as such a key policy issue and then don't realise the knock on effect it can have?

Yes, definitely, a lot of people think that seasonal flu is only a mild disease, they are not aware of the economic side nor of the true disease burden side because many people who die from seasonal flu are the elderly and these deaths are not easy to count and pick up because they don't necessarily go to hospital,

they may die at home or they may die in a nursing home. Some may die 6 weeks after they have been infected with influenza as a result of complications, at which time it is no longer possible to detect the virus in the patient. So it's difficult to really determine the true burden of the disease and that's one of the reasons why people think it's mild. ■

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The hidden burden of infectious diseases

Over the course of human evolution, infectious diseases have been one of the biggest causes of death. This reality is now hidden for most of us who had the luxury of being born in high-income countries, but it is still a matter of life and death in poor countries.

The best way to avoid the burden of infectious diseases is to be born in a more developed country...

The World Health Organization (WHO) estimates that if you are born in a rich country, 70% of you will live to your 70s. If you were unlucky to be born in a low-income country, only 20% of you will make it that far. Instead, 40% of people in a poor country die before 15. In a rich country, you are most likely to die due to a chronic disease. In a poor country, the top ten causes of death is dominated by infectious diseases, including: lower respiratory infections, HIV, diarrheal diseases, tuberculosis, and malaria. The impact of infectious diseases can be markedly avoided in rich countries with better access to antibiotics, vaccines, and clean drinking water.

Vaccines are one of the most cost-effective medical interventions

The basic premise of vaccines is to prevent infections and diseases before they happen. Vaccines are also relatively blind to wealth and are a cost-effective means for not only wealthy countries, but also people in economically-disadvantaged locations. While there are some potent vaccines,



it has been said that all of the easy vaccines have been made and we are now faced with engineering to protect against some of the most intractable infectious diseases.

Which vaccines are needed?

There is great debate about the value and risks of vaccines in developed countries. Any medical intervention will have finite risks associated with its benefits. Vaccines are no different. This debate is a luxury. It is hard to debate this if you have been affected by a vaccine-preventable disease. Absent that luxury, vaccines are one cost-effective approach to improve health to the mass of people dying early due to infectious diseases.

2016 dawned with an excellent Feature on vaccines on page 16 of Science by Jon Cohen titled "Unfilled Vials" (Vol. 351, Issue 6268, pp. 16-19 DOI: 10.1126/science.351.6268.16). The feature outlines in part the top 10

list of vaccine priority ranked by 50 experts. These included: 1) Ebola Sudan, 2) Chikungunya, 3) MERS, 4) Lassa Fever, 5) Marburg, 6) Paratyphoid fever, 7) Schistosomiasis, 8) Rift Valley fever, 9) SARS, and 10) Hookworm. This ranking is based on the ability to generate and test the vaccines and having animal models that can explore efficacy.

Vaccines against "Big Rock" pathogens

While these are laudable vaccines that need to be produced, arguably, some of these infectious agents kill a relatively small fraction of people each year. In terms of the Seven Habits of Highly Effective Vaccines, these are relatively "small rocks" and ignore the "big rock" pathogens. More than 90 million people died world-wide due to infectious diseases in 2012. (<http://www.who.int/mediacentre/factsheets/fs310/en/index1.html>). Respiratory infectious killed more than 40

million. HIV/AIDS and diarrheal diseases each killed more than 21 million people, tuberculosis killed 13 million and malaria killed another 8 million. These are frank estimates of death and this ignores years of morbidity and costs to families and to the health care infrastructure.

“The World Health Organization (WHO) estimates that if you are born in a rich country, 70% of you will live to your 70s. If you were unlucky to be born in a low-income country, only 20% of you will make it that far.”

Despite killing so many people, we still need vaccines for most of these “big rock” infectious diseases. Therefore, we should probably amend Science’s Top Ten list to be a Top 14 list starting with: 1) diarrheal diseases, 2) HIV, 3) malaria, 4) tuberculosis.

Vaccines against emerging and epidemic pathogens

Many of science’s list of needed vaccines are potential or actual epidemic or emerging pathogens. The problem of developing vaccines against potential epidemics or pandemics is that you either need to produce them and store them “hoping” that they will be used or hope to respond rapidly to make a vaccine against a looming epidemic or pandemic.

Current industrial-government collaborations to generate vaccines do not really work for either approach. Stockpiling vaccines is expensive and you

would hope to waste most of the money spent by never needing the vaccines. In contrast, rapid response to emerging pathogens is a great idea. However, there really is no “rapid” in current system. The 2014 Ebola epidemic is an excellent example of how risky current strategies are to respond to epidemics.

Seasonal influenza vaccines are a bellwether for what works and doesn’t work for an omni-present and potential pandemic pathogen. Compared to HIV, the number of deaths due to influenza year to year is relatively low, estimated to be about 0.25 to 0.5 million per year. Yet, we invest in seasonal influenza vaccines every year because this is an excellent health care investment. Making these vaccines also may head off the conversion of seasonal flu into a lethal pandemic that could decimate the human population.

Predicting seasonal influenza with vaccines provides proof of principle for predicting emerging pathogens. Year to year, scientists aim to predict which influenza viruses may circulate in the following year. These predictions can be quite poor, for example between 1997 and 2005, the predicted selected vaccine actually mismatched the influenza wave 4 out of 8 (50%) times in the USA.

If we can’t get it right for influenza consistently, this does not bode well for stockpiling vaccines for potential emerging pathogens. Nor does this speak well for our ability to generate

robust vaccines rapidly in a fight or flight response to pathogens like Ebola or other emerging pathogens like MERS, Chikungunya virus, and the new worrisome Zika virus.

Paths forward

Rich countries need to invest in vaccines for poorer countries, or those infectious diseases may spill over into the rich countries. The industrial-government system to generate vaccines is currently expensive, over-burdened by regulatory oversight, and is lethally slow. Decision makers need to apply the 7 habits to deciding which vaccines are needed and invest in rapid technologies to make vaccines. A proactive plan needs to be in place to rapidly respond to emerging pathogens with a timeline less than 6 months or the next Ebola or Zika may overwhelm to planet. Invest in smart and fast rather than in luck.



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Highlighting healthcare-associated infections

Sascha Marschang, Policy Manager at the European Public Health Alliance (EPHA), discusses healthcare-associated infections and antimicrobial resistance (AMR)...

Healthcare associated infections (HCAI) are infections acquired as a result of healthcare interventions or which affect a healthcare worker as a result of their job. They are not confined to hospitals and can occur in a variety of care settings including patients' own homes. HCAI are the most frequent adverse event in healthcare, experienced by over 4 million Europeans each year. They are directly responsible for 37,000 deaths and contribute to a further 110,000 fatalities¹.

Many infections require antibiotics as treatment, however, some result in extended hospitalisation, surgical interventions and more complex treatments. Severe problems arise when the infection is resistant to standard antibiotics, colloquially referred to as a 'superbug'.

Antibiotic or antimicrobial resistance (AMR) is increasing with concerns that we are approaching a critical situation which extends beyond healthcare settings. Fears over a return to a 'pre-antibiotic era' are stimulating efforts across the European Union (EU) to improve quality and safety standards in healthcare in addition to education and training, and the use of surveillance data on the prevalence of HCAI and AMR. Tackling AMR will require a strategic effort to change antibiotic consumption and prescribing habits and implement a One Health perspective that covers people, animals, and the environment.² This will necessitate policies curbing unnecessary uses, e.g. as remedies for viral infections and non-therapeutic deployment in livestock.

How to prevent the spread of infections

Roughly a quarter of (HCAI's) are preventable through intensive hygiene and control programmes. Although alignment of national approaches is still far off,



cross-border collaborations show that positive results can be achieved.³

At institutional level, it is important to promote core fundamental practical interventions. Rigorous hand hygiene can greatly minimise the risks, e.g. washing or sanitising before, during and after examinations or medical procedures.⁴ Staff must also be aware of preventive behaviours (e.g. respiratory protocols) and personal equipment, e.g. disposable masks, gloves, gowns and protective eyewear.

Hygiene extends to rooms and the physical patient environment including equipment, including disposal of all relevant healthcare wastes⁵. Common surfaces (handles, switches, tables, etc.) must be kept germ-free, equipment handled properly (e.g. urinary catheters, medical devices) and staff must be informed about isolation procedures, sterilisation, and management of blood/body fluid spills and needlestick injuries.

Infections drive the need for antibiotics, so just as vital in efforts to reduce AMR is antimicrobial stewardship. This includes, inter alia, surveillance screening of all

patients for infection, controlling antibiotic use, e.g. by restricting broad-spectrum antibiotics, and the education of patients and the public.

Added value of Europe

Although EU legislation and initiatives^{6,7} increasingly recognise the added value of supranational collaboration for tackling health threats, the organisation of health systems remains a national competence. This means that infection control practices vary greatly, not least since they are shaped by unequal economic resources and system capacities – in many countries stretched by the callous demands of austerity.

The link between patient safety, HCAI and AMR has become more explicit as a result of increasingly holistic thinking. A 2009 Council Recommendation⁸ triggered the development of national strategies and programmes, reporting and learning systems on HCAI including surveillance. Preparedness planning and risk assessment, management and communication have been improved⁹ The EU provides support for developing common indicators on patient safety, guidelines on providing information on quality standards, targets and benchmarking.¹⁰

EPHA is calling for a comprehensive review of the Commission’s Action Plan on AMR¹² to ensure that all aspects of the One Health approach are properly addressed, and that European initiatives are coherent with international and national efforts. In addition, the failure of the pharmaceutical industry to produce new types of antibiotics since the 1980s must be urgently addressed, policy-makers need to consider how to design an innovation model for antibiotics that ensures effective delivery to protect public health, before current antibiotics are rendered ineffective. It is also important that policies complement each other, e.g. the revised Action Plan, the strategy on pharmaceuticals in the environment and policies pertaining to animal health and agriculture¹². The prevention of infection is everybody’s business. ■

¹ http://ecdc.europa.eu/en/healthtopics/Healthcare-associated_infections/Pages/index.aspx

- ² Council conclusions on the impact of antimicrobial resistance in the human health sector and in the veterinary sector – a “One Health” perspective, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/lsa/131126.pdf
- ³ Friedrich AW et al., ‘EUREGIO MRSA-net Twente/Münsterland – a Dutch-German cross-border network for the prevention and control of infections caused by methicillin-resistant Staphylococcus aureus’, Eurosurveillance, Volume 13, Issue 35, 28 August 2008, <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=18965>
- ⁴ See WHO Guidelines on hand hygiene in health care (2009), <http://www.who.int/gpsc/5may/tools/9789241597906/en/>
- ⁵ Charlier Y. et al (2014), ‘Safe management of wastes from health-care activities’, 2nd edition, WHO
- ⁶ Directive 2011/24/EU of the European Parliament and of the Council of 9 March 2011 on the application of patients’ rights in cross-border healthcare, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:088:0045:0065:EN:PDF>
- ⁷ Joint Procurement Mechanism, http://europa.eu/rapid/press-release_IP-14-418_en.htm
- ⁸ Council Recommendation of 9 June 2009 on patient safety, including the prevention and control of healthcare associated infections (2009/C 151/01), http://ec.europa.eu/health/patient_safety/docs/council_2009_en.pdf
- ⁹ Decision 1082/2013/EU on serious cross-border threats to health, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:293:0001:0015:EN:PDF>
- ¹⁰ European Commission, Report of the public consultation on patient safety and quality of care, June 2014, http://ec.europa.eu/health/patient_safety/policy/index_en.htm
- ¹¹ European Commission, COM (2011)748, Action plan against the rising threats from Antimicrobial Resistance, http://ec.europa.eu/dgs/health_food-safety/docs/communication_amr_2011_748_en.pdf
- ¹² EPHA Report (2015), The Environmental Dimension of Antimicrobial Resistance, <http://www.eph.org/6469>

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Funding the future of HIV in the UK



Debbie Laycock, Head of Policy at the Terrence Higgins Trust sheds light on the future of HIV among budget cuts and already stretched key services...

Many readers will remember HIV and AIDS in the 1980s – the gravestone adverts and the public health campaign that we recently heard Margaret Thatcher was so fearful of. At Terrence Higgins Trust we speak to people day in, day out about HIV. There are many people who still have a 1980s view of HIV but many others who shrug their shoulders and are adamant that HIV just isn't an issue anymore. To clarify – HIV is still a huge issue in the UK. Thankfully, since the onset of effective HIV treatment in the 1990s in the UK we see very few people die of AIDS related illness. However, in 2014 the UK saw more people than ever living with HIV – nearly 104,000 people, and the highest number of new HIV diagnoses ever recorded in men who have sex with men.

Since the Health and Social Care Act 2012, local authorities have been given a significant role in the

country's response to HIV with responsibility for HIV prevention, sexual health promotion, most HIV testing and HIV social care in their remit.

Funding for local authority HIV services comes from both public health and social care budgets. The services needed by people living with HIV are complex and far-ranging. From specialist clinical care to peer support services, HIV remains a highly stigmatised health condition with a lack of understanding amongst many health professionals, let alone the general public.

Rates of HIV are increasing, stigma is as apparent as ever, yet 2015 saw the start of a worrying trend of local authorities across the country scrapping HIV services. In Oxfordshire, David Cameron's back yard, the local council is set to scrap all HIV support services with as yet no alternative service made available for

the over 200 people living with HIV who use the service. Similar scenes are being played out across England with the scrapping of HIV support services in Leeds, Portsmouth, Bexley...the list goes on.

Many of the services being cut also provide HIV prevention for individuals at highest risk of HIV – vital interventions that will ultimately prevent new HIV infections and save the NHS much needed cash in HIV treatment costs.

The future of public health and social care services hangs in the balance. The Treasury last year announced it was cutting public health budgets in-year by £200m with reductions in the funding for public health set to continue this year. The feasibility of the Chancellor’s plan to allow local authorities to income generate to fund social care services will be tested in poorer areas of the country – those areas that also see the highest rates of HIV. I have to say that I do feel for local authorities – they are being asked to do an enormous amount with an ever-reducing budget.

It is apparent that health has now been split into the haves and have-nots. The protected NHS budget and the raided public health and social care budget. The fake delineations between NHS, public health and social care has been strengthened.

We know that the impact of cutting public health and social care services will lead to an increase in costs to the already cash-strapped NHS. The Faculty of Public Health had already predicted that the impact of the 2015/16 public health cut will lead to an NHS ‘knock-on’ cost of at least £1bn. The Family Planning Association has suggested that a 10% cut in sexual and reproductive health services would result in an additional 72,299 sexually transmitted infections (STIs) by 2020, at a cost of £363m. The Labour Party just this week highlighted their concerns that cutting sexual health services will lead to an “STI explosion”.

HIV prevention and support services are essential. At an individual level they are essential for people at



risk of, or living with HIV. At a societal level they are essential if we are to save money in HIV treatment costs for our much valued NHS.

With HIV support services across England already being scrapped and local authority budgets being squeezed into oblivion, this year we will start to see the impact of decisions made to cut public health and social care funding. Unacceptably, this will also include seeing the impact of the cuts on individuals including the many people living with HIV. At Terrence Higgins Trust, as ever, we will continue to challenge these short sighted cuts to HIV services. ■

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Tackling childhood cancer

Hollie Chandler, Senior Policy Advisor at Cancer Research UK highlights the work being done to improve treatment for childhood cancers...

In the UK around 3,800 children, teenagers and young adults are diagnosed with cancer each year, that's 73 every week. Thanks to new treatments, survival rates are improving. More than 80% of children and young people with cancer now survive for 5 years or more, compared with just 30% in the late 1960s.

Despite these improvements, cancer remains the leading cause of death in children and the most common cause of death by disease in teenagers and young adults. Some types of children's cancer remain very hard to treat. Many patients suffer long-term physical and psychological consequences of their treatment into adulthood.

At Cancer Research UK, we think more needs to be done. Which is why we launched Cancer Research UK Kids & Teens ¹, our campaign to raise money for research into cancers affecting children, teens and young adults. Over the next 5-10 years we aim to double the amount we spend in this area, to accelerate progress finding new cures and kinder treatments. Our ambition is that all young people diagnosed with cancer will survive and go on to live long, fulfilling lives.

Importantly, our commitment is part of a wider UK effort to improve treatment of childhood cancers. The Cancer Strategy for England ², published by the Independent Cancer Taskforce last year, made several recommendations to improve the delivery of treatment to children, teens and young adults as well as improving their access to clinical trials. Cancer Research UK is working with NHS England and other organisations to make sure the Taskforce's recommendations are taken forward.

Trials are essential for establishing the best possible treatments for all cancer patients. Children and young

people are no exception. By running trials in the UK, patients also get innovative treatments that wouldn't otherwise be available to them.

World class research centres such as Cancer Research UK's Children's Cancer Trials Team at the University of Birmingham coordinate groundbreaking trials across the UK and internationally. This team has had some fantastic successes, including a large international trial that has helped lead to liver cancer death rates in children falling by 26% in the last decade.

For teams like this to operate effectively, they need to be supported by the wider NHS research environment. Government's continued support for NHS research infrastructure is key, which is why we've been really pleased to see plans to improve research and innovation in the NHS as part of its Five Year Forward View ³.

But England is only one part of the puzzle. All cancers occurring in children are rare so recruiting enough patients to a trial can be difficult. For this reason, it is often necessary to run large trials that are run over multiple sites across the UK, or even internationally, in order to reach a larger pool of patients.

Unfortunately, such trials are still taking far too long to set up. Streamlining trial approvals would help get these trials off the ground and deliver the outcomes we need for younger patients sooner.

In the UK, work by the Health Research Authority looks set to make real headway on this and we expect to see much better coordination of trials across Europe when the European Clinical Trials Regulation comes into force. Unfortunately, the timelines for this keep getting pushed back, with the latest estimate suggesting late 2018. The UK Government needs to continue its efforts



to support the implementation of this Regulation and ensure there are no further delays.

Creating a supportive environment for research and ensuring trials can be set up in a timely way will attract further investment from industry to conduct trials in the UK. Industry investment in trials for children is limited, although it has increased since the European Paediatric Medicine Regulation was introduced in 2007. This Regulation requires all companies developing new medicines for adults, to develop a plan for how they would investigate the potential of the same drug in children. In some circumstances companies aren't required to complete this plan. And although this can be appropriate, there have been instances where exemptions have been granted to medicines that we believe could be used to treat childhood cancers. This Regulation will be reviewed in 2017 and we'll be working to make sure improvements are made so that it can better support the development of new drugs for children.

Outside of trials, population-based data on how younger patients are being treated and their outcomes can be used to increase our understanding of how best to treat their disease. But to do this

effectively, we need to improve the collection of high quality data for research purposes, and we need to ensure that researchers can gain access to these data in a timely way.

Research through clinical trials and using population-based data is essential if we are to develop new cures and kinder treatments for younger cancer patients. Right now, Cancer Research UK is working so that in the future, all young people diagnosed with cancer survive and go on to live long, fulfilling lives. ■

1 <http://www.cancerresearchuk.org/support-us/donate/kids-and-teens>

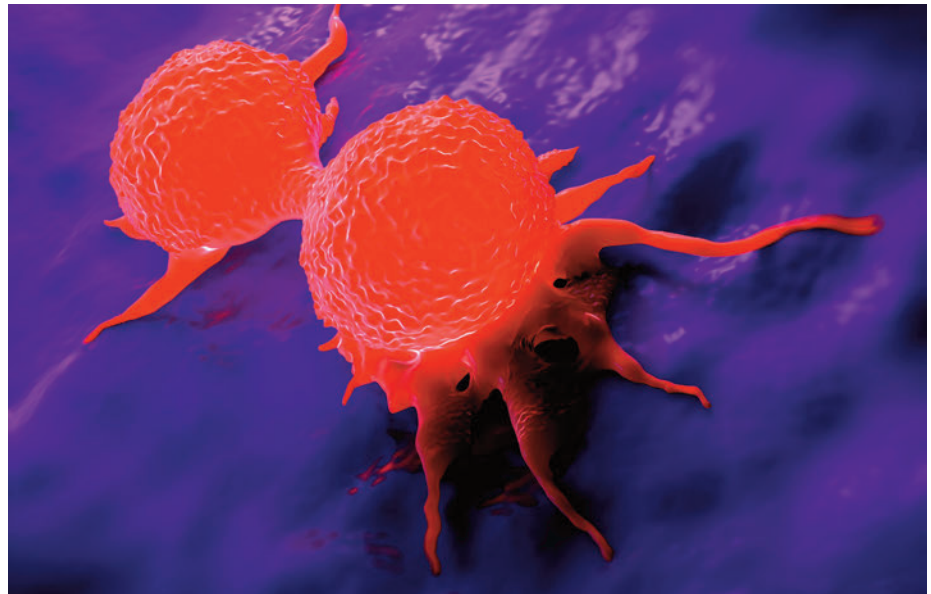
2 <http://scienceblog.cancerresearchuk.org/2015/07/19/taskforce-report-achieving-world-class-cancer-outcomes/>

3 <https://www.england.nhs.uk/wp-content/uploads/2014/10/5yfv-web.pdf>

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Mathematical pathology in determining surgical volume for breast cancer treatment

Ductal carcinoma *in situ* (DCIS) is an early form of breast cancer that can be treated with surgery. Surgery can involve removal of the entire breast or partial removal of the tumor and the breast tissue surrounding it. In the case of partial removal, the challenge is knowing how much to remove. This is important because leaving any tumor behind is a major risk factor for tumor recurrence. It has been reported that, in 38-72% of all cases, the surgery fails to remove all of the affected tissue, highlighting a major health problem for women. Our approach to this problem has been to develop a predictive mathematical model that enables surgeons to anticipate the size of DCIS tumors and plan the surgery in advance to avoid leaving any tumor behind.



We call this approach mathematical pathology because all data being supplied to the mathematical model can be derived from a patient’s biopsy, which is used to make the diagnosis. In our recent modeling work on DCIS

(Edgerton *et al.*, *Anal Cell Pathol* 2011, PMC3613121), we sought to determine if an accurate prediction of tumor size is achievable through measurements that are taken from a single biopsy. The key parameters of

Mathematical pathology model to predict DCIS size

From a previously developed model (Cristini *et al.*, *J Math Biol* 2003, 46(3):191-224), we obtain the following analytic solution:

$$A = 3 \cdot \frac{L}{R} \cdot \left(\frac{1}{\tanh(R/L)} - \frac{L}{R} \right) \tag{1}$$

where A is the patient-specific ratio of cell apoptosis to proliferation rates averaged over the multitude of ducts within the surgical volume, L is the diffusion penetration distance of nutrients, and R is the geometric-mean tumor surgical radius. This equation can be calibrated from the results of immunohistochemistry (IHC), which determines cell proliferation and death. IHC involves staining the cells in the proliferative and apoptotic state, and provides the measurements that drive the proliferative and apoptotic index values. Specifically, in Eq. 1, A and L can be derived from pathology measurements taken on specific patients’ tissue (see the original article). When L and A are known, determining the value of R is simply a matter of mathematics. In this way, this equation uses the cell-scale values for calibrating the tissue-scale continuum model predicting surgical volume.

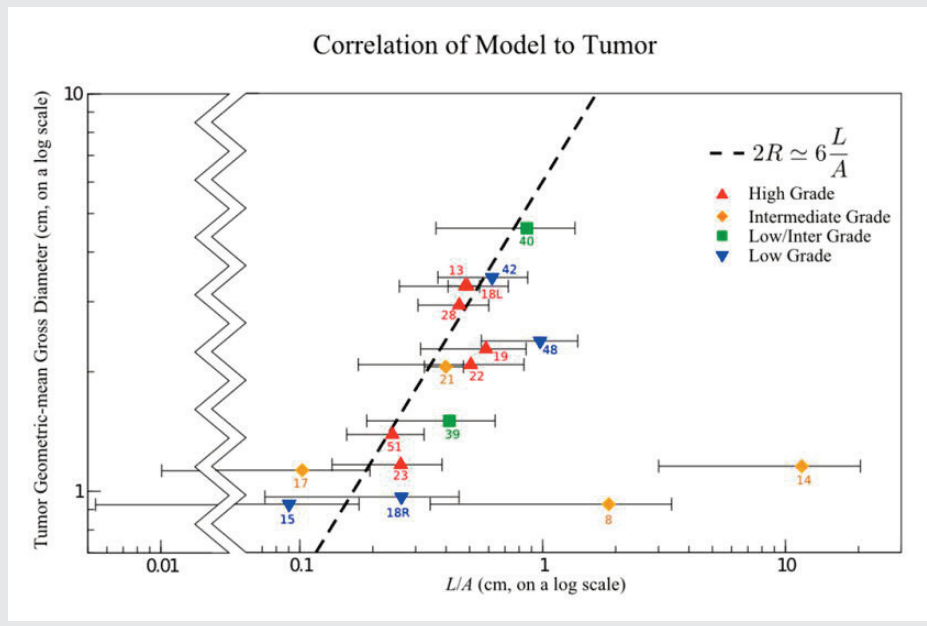


Figure 1: Correlation of tumor size with the death-to-proliferation ratio parameter. Tumor geometric-mean diameters $2R$ (dashed) vs. L/A predicted by the model compared to the corresponding pathology measurements. In contrast, grades based on histopathology are clearly poor predictors of tumor size. Data were obtained from the 17 excised tumors (symbols, with de-identified case numbers). Reproduced with permission from Edgerton *et al.*, *Anal Cell Pathol* 34(5):247-63

the model are the distance for nutrients to diffuse into the tumor, the ratio of apoptosis to proliferation rates in the tumor, and the tumor size. The apoptosis to proliferation rate and diffusion distance can both be measured easily from a biopsy specimen, allowing one to solve for the tumor size. This is described in more detail in the Box.

“It has been reported that, in 38-72% of all cases, the surgery fails to remove all of the affected tissue, highlighting a major health problem for women.”

Our data show that surgical volumes determined by radiology and tumor grade are largely inaccurate when compared to surgical results. We examined 17 excised DCIS tumors, and found that mammography overestimated the tumor size in ten cases and underestimated the tumor size in seven cases. This indicates that the correlation between mammography, nuclear grade, and the final observed tumor size is poor. However, *the correlation between the sizes observed after surgery and those predicted by*

the model were close (see Fig. 1 for an example).

The clinical implication of our model predictions is that with standard mammogram and pathologic specimens, physicians should be able to accurately predict the surgical volume of DCIS tumors mathematically. This study represents a proof of principle that it is possible to incorporate a mathematical modeling step within current clinical practice to aid in and improve surgical planning by estimating the surgical volume and the outcome of surgery before treatment. The practice will lead to less subjective analysis of tumors and an individualized approach to surgical removal of DCIS.

Additional resources:

- www.internationalinnovation.com/taking-cancer-out-of-the-equation/
- www.pnas.org/content/110/35/14266.long
- www.hindawi.com/journals/acp/2011/803816/abs/
- www.sciencedirect.com/science/article/pii/S0022519312000665

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Making Cancer History[®]

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Understanding palliative care

Julie Ling, CEO of the European Association for Palliative Care sheds light on palliative care and how it puts the patient first in terms of treatment...

According to the World Health Organization (WHO), the main aim of palliative care is to enhance quality of life for people with life-limiting conditions where cure is not possible, helping them to live well until they die. Palliative care is an active approach that affirms life and views death as a normal process. Priding itself on treating people with dignity, compassion and respect, palliative care neither hastens nor postpones death.

There is a common misperception that people can only receive palliative care at end of life when other treatments are no longer possible, but in reality palliative care can be provided for people of any age and at any stage of their illness; when introduced

early, palliative care aims to positively influence the course of an illness. Sometimes by providing palliative care at an early stage in a person's illness, for example, while using treatments such as radiotherapy or chemotherapy, symptoms and complications can be managed more effectively.

WHO stress the importance of the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems which some people with life-limiting conditions experience. Usually based on research evidence, the majority of symptoms can be treated effectively which can result in improved quality of life.



Importantly, palliative care considers all aspects of caring for a person including physical, social, psychological and spiritual care. This holistic view to palliative care is most effective when provided by a team approach; this includes access to a range of healthcare professionals with varying and complimentary skills.

Palliative care sees the patient as an integral part of their family and community; therefore, care is also extended to support families. This care aims to help them with their family member's illness and following death, provides bereavement support to help cope with their loss and grief. Palliative care can and should be provided in any location including hospital, hospice and home and can also be provided in any other location where the person is receiving treatment or care. Palliative care is not the exclusive domain of those working in the specialty, and is the responsibility of the whole healthcare team. The planning and provision of care should be tailored specifically to meet the individual needs of the person and their family.

As an indication of the growth and development of palliative care, throughout Europe, the European Association for Palliative Care has 55 member associations from 31 countries. Palliative care services are at varying stages of development across Europe and the rest of the world. Recent developments including

the reorientation of palliative care as a public health imperative by WHO, will help to ensure that some of the barriers to providing palliative care (e.g. limited access to appropriate pain medication) are removed. Such initiatives also aim to ensure that the specialty is developed and strengthened thus enabling all those who require palliative care to access appropriate services, regardless of their geographical location or disease diagnosis.

Evidence suggests that access to palliative care improves quality of life, to make decisions regarding their dying and enables people with life-limiting conditions to live as well as possible until they die. ■



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Research at Oslo University Hospital in the field of Gynecologic cancer

Oslo University Hospital (OUS) is a big hospital formed by the merger of 4 hospitals. The State Hospital, the Norwegian Radium Hospital, Ullevaal Hospital and Aker Hospital. It serves as a local hospital for about 600,000 inhabitants and as a referral center for about 2.8 million people. As a big University center OUS is heavily dependent on research and development.

In the field of gynecologic oncology we are engaged in international clinical trials and in more basic research, but also in refinements of diagnostic and therapeutic procedures.

In the field of international clinical trials, our department has participated in some important studies on ovarian cancer. Standard treatment for ovarian cancer is surgery, if the patient is fit, followed by chemotherapy. The goal for surgery is to remove all visible tumor elements. The ICON7 trial showed a benefit of adding bevacizumab to chemotherapy for patients with a high risk of relapse. This group consisted of patients with residual tumor of 1 cm or more after surgery for ovarian cancer or stage 4. The patients received bevacizumab together with standard chemotherapy, followed by maintenance treatment with bevacizumab for a total treatment period of 12 months. For the high risk group, survival was prolonged by 4.8 months from 34.5 to 39.3 months. The length of the maintenance phase in the

ICON7 study was chosen somewhat arbitrarily. It is a question whether the maintenance phase should be extended until progression of the tumor. This is the basis for an ongoing study (OVAR17), for which we do not yet know the results. Another important study is the Calypso study on relapsed ovarian cancer resistant to standard carboplatin based chemotherapy. Patients were randomized to either chemotherapy or chemotherapy and bevacizumab. The treating physician could choose between 3 commonly used chemotherapies. This study showed a prolongation of the median time to relapse from 3.4 with chemo alone to 6.7 months with chemo and bevacizumab. Survival was somewhat, although not statistically significant, increased from 13.3 to 16.6 months. The addition of bevacizumab was very effective in treating ascites, which can be very troublesome for this group of patients.

Some 10-15% of patients with ovarian cancer have a defect in the BRCA genes. This defect is heritable. Our department offers free testing of the BRCA genes to all patients with ovarian cancer. In the case of a defect gene, the patient can then pass this information to her children. Knowledge about the status of the BRCA genes also has implications for the treatment of the patient. In a previous study (Lancet Oncol. 2014 Jul;15(8):852-61) it was shown that maintenance treatment with Olaparib (a PARP

inhibitor) prolonged the median time to progression by 6.9 months from 4.3 to 11.2 months in patients having a BRCA defect tumor. The patients received maintenance treatment with Olaparib after having chemotherapy for a relapse of ovarian cancer occurring 6 months or later after previous platinum based chemotherapy. We participated in studies on another PARP inhibitor to further evaluate the effect of these drugs after the initial treatment and after later relapse.

For families with a defect BRCA gene, this implies a considerable burden. The women in the family have to decide whether they want to test the status of their gene. In case of a defect gene they have to decide whether they prefer risk reducing surgery by removing the ovaries and fallopian tubes at the age of 35-40 years. The psychologic stress, effect on quality of life and also somatic side effects have been the topic for a recent PhD study from our department.

In the department for pathology at our hospital, Professor Ben Davidson and his colleagues have done a tremendous job by evaluating the importance of a number of genes for resistance to chemotherapy. Detailed knowledge about the biology of tumors is important for drug development. In some cases the treatment for each individual patient can also be guided by knowledge about the biology of the patient's tumor.



For some tumors, important signal pathways in the tumor are already known. In well differentiated serous ovarian cancer, the MEK pathway is such an example. We participate in a study to evaluate the effect on survival by blocking the MEK pathway.

Immunotherapy has become much in focus in recent years after the success first obtained in malignant melanoma and later on in other tumor forms. Studies in gynecologic cancer on checkpoint inhibitors have just started. Our department participates in a couple of phase II studies and a phase III study is in development.

In cervical cancer, the 5-year survival in Norway is about 78%. There are a number of reasons for this high survival rate such as the effect of screening on stage distribution, living conditions and the quality of health

care. In our department, we have used a lot of resources in research and development on treatment aspects of cervical cancer. The delineation of the tumor and metastases is important for good treatment planning. We use DCE-MRI routinely for this purpose. It has for some time been well known that hypoxia in the tumor decreases the susceptibility to radiation. Detection of hypoxic tumors or hypoxic parts in the tumor might therefore be of clinical relevance by either increasing the dose of radiation to these parts of the tumor or by administering some drug that could increase the sensitivity to radiation of these hypoxic tumor cells. Researchers in our institution have found that, by texture analysis of pictures obtained by DCE-MRI, they could predict the outcome for the patient. Other researchers have worked on the importance of genes and their expres-

sion in cervical cancer. They have developed and validated a gene list identifying hypoxic tumors. This list has been compared to the findings by texture analysis of DCE-MRI and they fit together. This can be used to select patients for studies on the effect of drugs with special effect on hypoxic cells given alongside radiotherapy.



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Palliative care in Canada

Gabriel Miller, Director of Public Issues at the Canadian Cancer Society outlines how palliative care has developed in Canada and its benefits...

There's a common misconception that palliative care means "giving up." In fact, palliative care focuses on the quality of life of patients with progressive, life-altering illnesses. It's a critical component of the cancer continuum of care and includes expert pain and symptom management; skilled psychosocial, emotional, and spiritual support; and comfortable living conditions with the appropriate level of care at home, in a hospital or in any other setting of a patient's choice.

We must be careful not to confuse palliative care with end-of-life care – the two are not synonymous. End of life care is a component of palliative care and focuses on specific care needs for someone who is dying. Palliative care can be administered on a continuing basis, starting at a patient's diagnosis.

Palliative care was developed for, and is still largely delivered to, those with advanced cancer. In fact,

about 8 out of 10 people who receive palliative care in Canada are cancer patients. In Canada, the case for quality palliative care is becoming more urgent as our aging population faces a projected 40% increase in the number of new cancer cases over the next 15 years.

It's already known that palliative care, when delivered early, leads to a better quality of life, improved pain control, and increased satisfaction of care. One pivotal study showed a longer median survival in patients who received early palliative care compared to those who did not.

In January, the Canadian Cancer Society released a report on palliative care in Canada that exposes Canada's costly and inconsistent patchwork of palliative care. While there are excellent models of care in the country, the system overall has flaws that are bad for patients and bad for the sustainability of health care. For example, 40% of cancer patients in Ontario, the



country's largest province, do not receive a palliative assessment in the last year of life. In regions of Atlantic and Western Canada, data shows that less than half of people who die in hospital receive any palliative care. So far, Quebec is the only province in Canada to have passed legislation guaranteeing palliative care for those with a terminal illness. This must be expanded on a nationwide scale.

The report, titled "Right to Care: Palliative Care for all Canadians," calls upon the new Canadian government to fix the health care system that is failing its sickest and most vulnerable citizens and to guarantee all citizens to the right to high-quality palliative care.

"Right to Care" reported that, in Canada, the costs of palliative care during the last month of life can be \$1,100 a day in an acute-care unit as opposed to \$770 a day in a palliative care unit and under \$100 a day in the home.

Approximately one out of every 2 cancer deaths across Canada occur in acute-care hospitals, despite surveys showing that most Canadian patients would prefer to die at home. If palliative care in the home is the desired option, as well as the more cost-efficient

option, why are so many patients still receiving palliative care in acute care units?

Canada needs a new approach to palliative care that works better for all patients and lowers the high costs of hospital care. As well, support for homecare and family caregivers must be expanded so the Canadian health system can deliver palliative care that benefits patients most, while easing the financial burden on patients and their families.

Wherever you are in the world, palliative care must be a top priority and should be available throughout the cancer journey. Quality palliative care is not just a 'nice-to-have,' it should be a right. ■

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Viruses and cancer : integrating large-scale data to identify unique gene signatures

Cancer is a terrible disease that touches the lives of millions of individuals every year. With cancer being the second leading cause of death in adults, most people have lost a parent, a loved one, or a friend to cancer. The most recent statistics from the American Cancer Society estimate that roughly 40% of people will develop cancer in their lifetime. Cancer is a disease that originates in our cells. Our bodies are made up of millions of cells, grouped together to form tissues and organs such as the lungs, the pancreas, the liver. Our genes order our cells to grow, function, reproduce and eventually die. Normally, our cells obey these rules and we remain healthy. But sometimes things go wrong, causing the cells to multiply uncontrollably, forming lumps or tumours, and spreading through the bloodstream to other parts of the body (metastases). With the recent advances in medical research, many of these can now be better diagnosed and treated. Although significant progress has been made in treating many cancers over the past 25 years, a number of cancers such as pancreatic and brain cancers, continue to have high case fatality rates after diagnosis thereby creating havoc in that person's life as well as their loved ones.

Viruses and cancer

It is nearly impossible to identify what causes a cancer in any individual, because most cancers have multiple

possible causes. There are numerous causes and risk factors for cancer such as genetic mutations, hormonal changes, immune dysfunctions, tobacco use, alcohol use, obesity, dietary factors, physical inactivity, environmental pollutants, and radiations. One of the most fascinating cause of cancer that is often overlooked is infection by viruses. Indeed, human viruses play an important role in cancer. Around the world, cancer-inducing viruses are estimated to cause 15 to 20 percent of all cancers in humans. With the advent of new technologies allowing genetic identification, it is very likely that this number will continue to increase. Although only a small proportion of virus-infected individuals develop cancers, the total burden of infection-associated cancer is very large, with an estimated 2 million new cases of virally-induced cancer worldwide each year. To date, Epstein-Barr virus (EBV), Kaposi's sarcoma-associated herpesvirus (KSHV), human papillomaviruses (HPV), Merkel cell polyomavirus (MCPV), hepatitis B virus (HBV), hepatitis C virus (HCV) and Human T-cell Lymphotropic virus type 1 (HTLV-1) have been classified as cancer-inducing infectious agents. Cancer-inducing viruses are implicated in many types of human cancer such as liver cancer (hepatitis B and C viruses), cervical cancer (HPV), Burkitt's lymphoma and nasopharyngeal carcinoma (EBV), leukemia (HTLV-1), stomach cancer (EBV), skin cancer (MCPV), and Kaposi's sarcoma (KSHV).

Over the past fifty years there has also been considerable interest in determining whether a virus may play an important causative role in other types of cancer, such as breast cancer, but no consensus has been definitely reached.

How do viruses cause cancer?

Viruses typically initiate cancer by altering the expression of the genes in the cells that they infect or by integrating their genetic materials in key regions of our DNA. They can also induce inflammation or produce viral proteins which will eventually lead the infected cells to start multiplying uncontrollably. The process by which a virus can cause cancer is complex and requires multiple steps in addition to virus infection. Therefore, the latency period (from viral infection to the appearance of the virus-positive tumor) can be many years. Cancer-causing viruses frequently maintain chronic infections in which there is absence or little production of viral particles. However, in many cases, the exact mechanisms by which these viruses cause cancer remain largely unexplored.

During viral infections, the expression of cellular genes is subjected to alterations that are induced by both viral and antiviral mechanisms. Interestingly, cancer cells also harbor modifications in the expression of their genes. It is therefore not surprising that many laboratories are entering

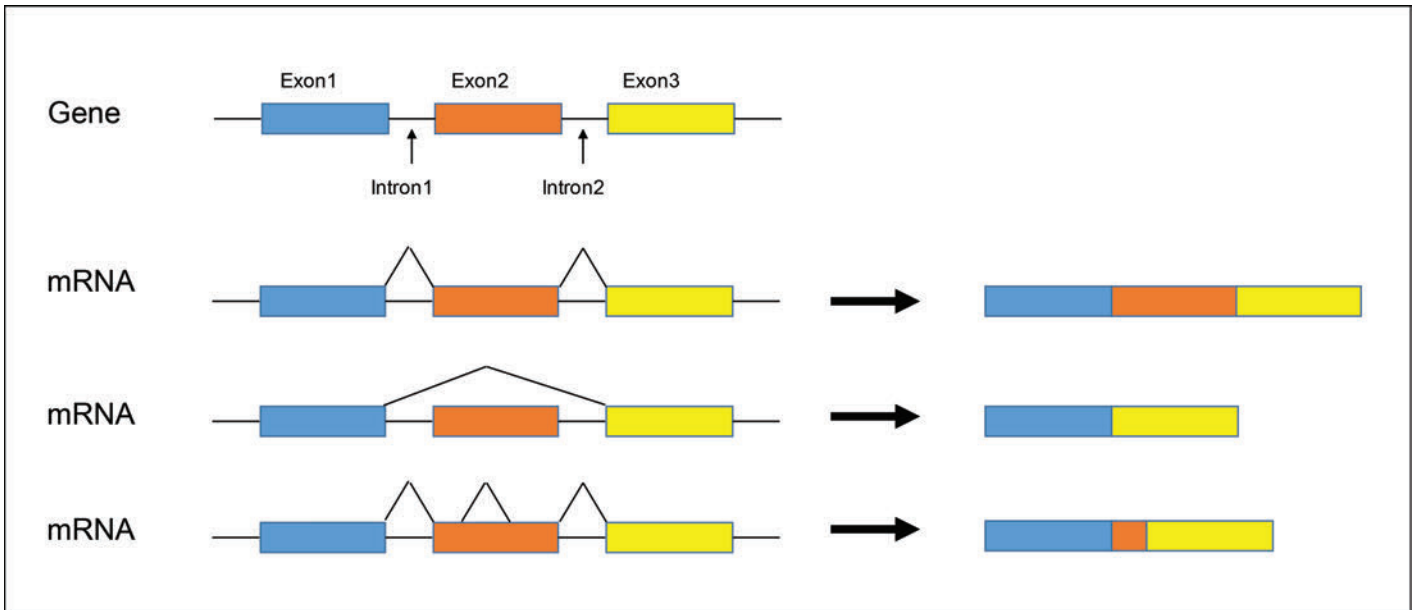


Fig. 1: Alternative RNA splicing. Alternative splicing is a regulated process during gene expression that results in a single gene coding for multiple proteins. In this process, particular exons of a gene may be included within or excluded from the final mRNA produced from that gene. Consequently the proteins translated from alternatively spliced mRNAs will contain differences in their amino acid sequence and, often, in their biological functions. Only a few examples of alternative splicing are presented

the personalised medicine era by focusing their studies on identifying unique genetic signatures which allow scientists to distinguish between very similar cancers. For instance, infection by EBV is associated with at least 10% of all cases of stomach cancer. Nearly 80,000 patients worldwide are estimated to develop EBV-associated gastric carcinoma (EBVaGC) annually. Interestingly, EBVaGC has unique morphological, genetic, and phenotypic features, compared to EBV-negative gastric cancer tissues, and treatment is therefore different for these two similar types of cancer. Correctly and rapidly identifying these types of cancer is therefore crucial for the effective treatment of patients with stomach cancer.

Alternative RNA splicing and cancer

Traditional profiling of global gene expression has resulted in several sets

of biomarkers capable of detecting cancer subtypes. However, most expression profiling techniques have focused on changes in the levels of gene expression and have simply ignore changes in the transcript architecture resulting from a molecular mechanism called alternative splicing. Our genetic information is stored in genes, located in DNA in the nucleus of cells. This information is transcribed from DNA into a messenger RNA (mRNA) template by a process called transcription. These mRNAs are then converted into proteins by a process called translation. However, before the mRNA can be translated into proteins, non-coding portions of the mRNA sequence, called introns, must be removed and protein-coding parts, called exons, joined together by a mechanism called RNA splicing to produce a mature mRNA. Scientists quickly discovered alternative patterns of mRNA splicing that produced differ-

ent mature mRNAs containing various combinations of exons from a single precursor mRNA. Recent studies indicate that almost every human gene can produce different combinations (or isoforms) through alternative splicing. Indeed, the vast majority of gene products (~90%) use alternative splicing (Figure 1). In humans, alternative splicing plays a central role in protein diversity by generating multiple and functionally diverse protein isoforms. In the last few years the contribution of alternative splicing to human diseases, particularly in cancer, has been widely recognised. It is now evident that the unbalanced expression of splicing variants or the failure to properly express the correct isoforms is part of the biology of cancer cells.

Genome-wide approaches are starting to reveal that tumorigenesis, the process by which cells become

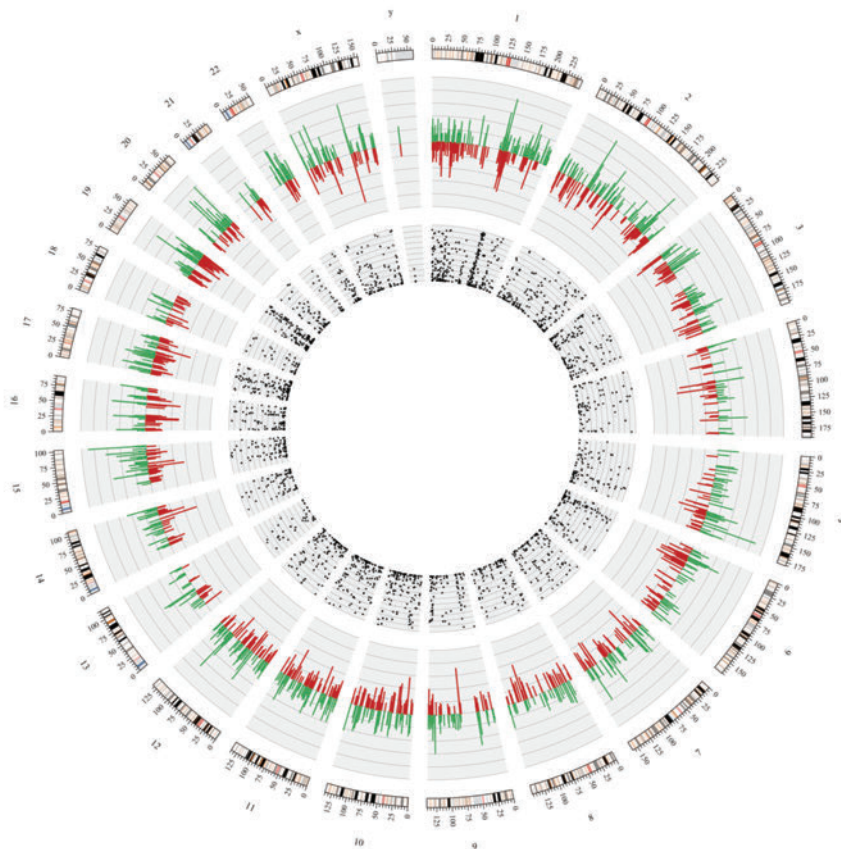


Fig. 2: Global profiling of alternative splicing event modifications in gastric cancer. Alternative splicing event modifications in gastric cancer tissues are presented. The circular representation of the human genome is shown. The localisation of significant alternative splicing events is shown by a histogram where each bars represent an alternative splicing event that is modified between normal and cancer tissues. Positive differences are represented in green whereas negative differences are represented in red. The inner circle represents the statistical significance of each spliced genes where the outer dots show statistical p-value of 0.05 and the inner dots represent a p-value of 0.0001

cancerous, often involves large-scale alterations in alternative splicing. Such approaches have been valuable in providing insight into the regulation of splicing in cancer, and have revealed to be useful in the classification of tumors. In fact, alternative splicing events can now be used as specific biomarkers, as was recently shown in the case of breast cancer tissues. In the case of prostate cancer, it has been shown that alternative splicing signatures derived from microarray-

based profiling are more reliable for diagnostic purposes than are signatures derived from mRNA expression profiling. Frequently the function of the alternative splicing isoform is unknown, but it appears that maintaining a subtle balance between splicing variants is vital to cellular function and dynamics. However, one major challenge still resides in a better molecular understanding of splicing programs which are found in different types of cancer.

Can viruses modify the alternative splicing program of infected cells?

During the past year, my research group has been actively investigating the ability of viruses to modify the alternative splicing program of infected cells. The study of alternative splicing in mRNAs encoded by cellular genes during infection by human viruses remains sparse. Only a few specific examples of cellular mRNAs for which alternative splicing is modified upon viral infection had been previously identified. We relied on a technique called RNA sequencing (or RNA-seq) to provide a comprehensive portrait of global changes in the RNA splicing signatures that occur in cells following infection with a human virus. This technology uses the capabilities of next-generation sequencing to reveal a snapshot of all the mRNAs from a cell at a given moment, thereby providing the ability to look at changes in alternative splicing and gene expression. We designed a simple experiment where we infected cells with a model virus (called reovirus) and looked at all the cellular mRNAs following infection. This initial study allowed us to identify modifications in the alternative splicing patterns of 240 cellular mRNAs. Interestingly, these modifications seemed to occur on mRNAs which encode for proteins with important roles in viral infection/immunity. Among the transcripts for which alternative splicing was significantly affected upon viral infection, many splicing events we documented affect important protein domains. This led us to hypothesise

that viruses might target specific cellular mRNAs in order to escape cellular immunity.

We next investigated alterations to the global RNA splicing landscape of cellular genes in the context of a virus-induced cancer. We chose gastric cancer as a model since two distinct types of gastric cancer can be easily identified: EBV-negative, and EBV-positive associated gastric cancer. Using high-throughput RNA sequencing from 295 primary gastric adenocarcinomas, we identified alterations in the AS patterns of more than 1700 genes (Figure 2). Interestingly, the vast majority of these genes encode for proteins which are known to be important for the development of cancers (such as tumor suppressor genes, transcription factors, and kinases). This study also allowed us to identify unique gene signatures for which alternative splicing is misregulated in EBV-negative, and EBV-positive associated gastric cancer. Analysis of the alternative splicing landscape revealed numerous gastric cancer-specific markers, which significantly increases the number of potential biomarkers that can currently be identified by standard expression profiling alone. We also showed that a specific protein from EBV, called EBNA1, interacts with cellular splicing factors and modifies the alternative splicing profile of cellular genes. The currently available gastric cancer markers available today mainly detect advanced gastric cancer, for which only palliative treatment is available. The current identification of unique signatures for genes

in which alternative splicing is misregulated in the different types of gastric cancer clearly constitutes a step toward the identification of other useful gastric cancer-specific markers.

The future?

Cancer has been around for a very long time being mentioned in papyrus dating to around 1500 BCE. However, the global cancer burden is growing at an alarming pace. It is estimated that in 2030, about 22 million new cancer cases and 13 million cancer deaths will occur, simply due to the growth and aging of the population. The future burden may be further increased by the adoption of behaviors and lifestyles frequently associated with economic development and urbanisation such as smoking, exposure to pollutants, and physical inactivity. Fortunately, there has never been a better time for researchers to work on finding a cure for cancer. With so many new technologies and the advent of personalised medicine, medical decisions and practices will likely transform the way we fight this disease. A number of challenges will surely arise in this new era, including intellectual property rights, patient privacy and confidentiality as well as regulatory oversight. Alternative splicing profiling of tumors, such as we and others are currently performing, is one of the multiple genomic approaches currently being used to better diagnose and treat cancer patients. Interestingly, strategies to modulate alternative splicing by splice-switching oligonucleotides in order to correct aberrant alternative

splicing events are currently being developed. It is therefore tempting to speculate that such a strategy could be applied to many different cancers, including cancers induced by viruses. Our identification of extensive changes in the cellular alternative splicing landscape in gastric cancer likely represents a first step toward the development of such anticancerous agents.

Profile

Pr Martin Bisailon is an expert in Biochemistry and viral enzymes. He obtained a PhD in Microbiology and Immunology at the Université de Montréal in 1999. He then completed his post-doctoral training at the Sloan-Kettering Institute in New York City before directing a research team in the pharmaceutical industry aimed at developing antiviral agents. He is currently Chair of the Biochemistry Department at the Université de Sherbrooke.



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We need a technology revolution in the healthcare sector

John Bowis, OBE, Honorary President of Health First Europe explains how eHealth can bring the technology revolution to healthcare...

“We know that in healthcare we lag at least 10 years behind virtually every other area in the implementation of IT solutions”¹. This was the statement by Estonian President Toomas Hendrik Ilves (Chair of the independent eHealth Task Force) in May 2012. The estimated lag time may be a conservative estimate, but the diagnosis was clear: the time is now to bring the technology revolution to healthcare. Innovation can be the catalyst that drives efficiency gains and personalisation into healthcare services.

Why eHealth?

Unsurprisingly, EU health systems are constantly confronted with important budgetary constraints, while having to respond to challenges such as: an ageing population, rising expectations of citizens, and the mobility of patients and health professionals. Public health expenditure in the EU was on average 5.9% of GDP in 1990, it rose to 7.2% of GDP in 2010, and it may continue to grow to 8.5% of GDP in 2060². Tackling old problems with the same solutions while pushing needed structural reforms further along ‘5 year plans’ has, as evidenced, failed to bring the promised outcomes.

I wholeheartedly believe that enabling a spirit of innovation in eHealth is the way forward to ensure better and safer care, more transparency, greater patient empowerment, and more efficient and sustainable healthcare systems. eHealth also has the potential to promote a culture where patients are put first. Innovation can be a signature of solidarity, building the technological bridge to reach patients³.

There is also an economic argument in favor of eHealth which should help to facilitate support from policymakers. The market potential of eHealth is strong. The global telemedicine market has grown

from \$9.8bn in 2010 to \$11.6bn in 2011, and is expected to continue to expand to \$27.3bn in 2016⁴.

What is Europe doing to promote eHealth?

From a European perspective, the first EU eHealth Action Plan 2004-2011 covered electronic prescriptions and health cards to new information systems to facilitate a more harmonious and complementary European approach to eHealth.⁵ However, we must expand that cooperation and venture into eHealth solutions which support pro-active patients and more importantly, into the continuity of care past the traditional ‘care centers’. Rather than patients receiving ad-hoc care, eHealth can ensure that the pharmacist, the primary care physician and the hospital doctors, all are continuously aware of how the patient is progressing.

As Honorary President of Health First Europe, we continuously emphasise patient-centred healthcare and we welcome all initiatives that foster this goal. The recommendations below provide a non-exhaustive insight into what could be done by policymakers at European level to give eHealth the best environment to flourish and provide citizens with a more adapted healthcare service.

Health First Europe recommendations for an eHealth powered healthcare sector

Patients’ needs should remain at the centre of eHealth policies. These needs are primarily access and quality of care⁶.

Involve healthcare providers such as nurses, doctors and other carers. Greater emphasis should be made on community care services, healthcare workforce mobility and eHealth literacy (for both providers and patients).

Market issues such as interoperability, standardisation and ICT definitions are critical. EU institutions must therefore explore every possible competence to investigate the barriers to eHealth posed by inadequate reimbursement and funding systems in Member States and local health systems.

“From a European perspective, the first EU eHealth Action Plan 2004-2011 covered electronic prescriptions and health cards to new information systems to facilitate a more harmonious and complementary European approach to eHealth.”¹

Re-orient funding – a large chunk of public funding at EU and national level is allocated to eHealth centrally, in large-scale, often indiscriminate and inefficient, top-down solutions. Furthermore, EU funding mechanisms and their multi-annual frameworks are arguably too slow and bureaucratic. To better integrate the user experience, the next logical step would be to work on the basis of specific, agile, responsive budget lines. These would also need to foster the development of new ideas and in turn translate into prototypes/policy experiments⁷.

The EU should play a role

Europe can play a fundamental role in supporting national governments to implement the technologies that can revolutionise healthcare. Though Europe cannot tell countries what to do, it can create a group of pioneering countries who are the forefront of implementing technology in healthcare and help them to share their experiences with countries lagging behind.

Member State countries have significantly different cultures and health systems so no unique eHealth model can be advertised as being the ‘right one’. However, the experiences can be shared among likeminded countries, which means transferring knowledge rather than solutions - and that knowledge can be the catalyst that drives the technology revolution in health. ■

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7 European Commission; Digital Agenda for Europe, EU Task Force on eHealth: Redesigning health in Europe for 2020, p.17. <https://ec.europa.eu/digital-agenda/en/news/eu-task-force-ehealth-redesigning-health-europe-2020>

John is also a former Member of the European Parliament

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Welcome to the House for Children and Adolescents

In November 2013 it was ready to be launched – The House for Children and Adolescents. Over 100 professionals moved into the House, under the same roof, to give integrated help, guidance and treatment to families with children under 18 years. Previously there had been 17 different addresses for children's services, one profession here and another there.



The House for Children and Adolescents is located at the former garrison area in the City of Lappeenranta

The House for Children and Adolescents, integrating social and health care, offers its know-how and concrete help to the inhabitants of South Karelia, Finland (population 133 000). Various processes including every day work habits were – and are – developed to a new kind of integrated easy access service that works tightly on the frame of preventive work and problem solving.

The professionals working in the House for Children and Adolescents are from different areas of expertise. There are social workers, child and adolescence psychiatrists, psychiatric nurses, family workers, psychologists, pediatrician, general practitioners (part of student health care) and office

workers. Depending on the matter of the child (and one's family) they form multidisciplinary teams that can support the family in a crisis or on a matter that can be solved with more time and patience.

There are eight main principles that concern both Family services and The House for Children and Adolescents:

1 Easy access. The help-seeker doesn't have to know what kind of help he/she needs. Contacting methods are easy (e.g. mobil, walk-in, e-contact), there is no referral needed.

2 Counselling and early support. First one to five times evaluation for all new patients.

3 Straight guidance to right address. Patients with certain symptoms are guided straight to the special department (such as child welfare).

4 The whole family is taken into consideration, not just the one who looks for help.

5 A contact person will be named for every family.

6 Tailored treatment plans to those who need care from many departments at the same time (such as child welfare and psychiatry).

7 Cooperation inside the house and also outside with schools, daycare and child health centers. The family can give a permission to exchange the needed information in a multitalented team.

8 Treatment and support at homes and schools.

After the first year of activity there are several results to be seen: The customers get now help easier and at the right time. They are also more confident on getting help. The service system is more equal than before and the access is easier. The Institutional child care has decreased, there has been less custody cases and short term placement from home. The knowledge and know-how of professionals has increased.

However, the development work continues. Prevention has even greater meaning than before.

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Transforming healthcare in Scotland

The Scottish Government's eHealth Division outlines why eHealth is a key enabler for citizen involvement and the transformation of health and social care in Scotland...

eHealth is one of the prime enablers for the delivery of The Scottish Government's overarching vision for health and social care, namely that by 2020 everyone is able to live longer healthier lives at home, or in a homely setting. The eHealth Strategy is critical to delivering the 2020 vision. This includes how we use, share and access information both in boards and across health and social care, how we support patients and users to make good health decisions and manage their conditions, and supporting how we deliver care in people's homes. Our vision for 2017 and beyond is ambitious and builds on the significant progress we have made with the implementation of eHealth in Scotland so far. Although the eHealth Strategy supports a wide range of end users, from clinicians to NHS managers, this article focuses on its role in transforming health and social care in Scotland into an increasingly person-centred service with active digital involvement of citizens.

eHealth is the key to how we collect, analyse, access, use and share information, within and across health boards, local authorities and other partner organisations, in order to deliver integrated health and social care; to how we support patients and their carers to make informed decisions to manage their own health and wellbeing; and how we use health data appropriately to increase the effectiveness of services and treatment, safeguard and improve population health, and make significant advances in medical research and innovation.

In the Scottish Government's 2020 Vision, the citizen (and/or their carer) sits at the heart of the health and social care team and, where possible, takes an active role. Digital tools can support self-management and strengthen the interaction with health and care

professionals. Digital technology has become part of our everyday lives and ensuring that the health and social care services across Scotland harness this effectively together with citizens provides a great opportunity to transform the way services are organised. The eHealth Strategy details how Scotland is seizing this opportunity.

The Scottish Government and NHS Scotland have had a national eHealth Strategy in place for many years. The first eHealth Strategy 2008-2011 guided the implementation of some key foundation IT systems including a common Patient Management System (PMS); a national Picture Archiving and Communication System (PACS); a national ePharmacy system; and the universal use of the Community Health Index (CHI) as a single identifier to be used across all eHealth systems in Scotland. The second eHealth Strategy 2011-2017 built on this with an extension to person-centred services and the recognition that self-care and self-management are a key route to reducing the impact of long-term conditions on NHS Scotland resources. It introduced 6 strategic aims which currently direct all significant eHealth developments at local, regional and national levels in Scotland. A 7th aim, specifically in relation to innovation was added in a refresh of the eHealth Strategy last year. It recognises the importance of partnership in developing and implementing innovative digital healthcare solution in Scotland.

Progress so far with patient-facing eHealth developments in Scotland include:

- The NHS Inform website is being significantly redesigned with a focus on health and wellbeing and self-management support for long term conditions;



- Comprehensive patient platforms for chronic conditions such as PatientView and MyDiabetesMyWay. These provide digital tools for patients with conditions which best lend themselves to effective self-management and co-production with clinicians;
- The Scottish Government is promoting the wider adoption of primary care digital services by investing in a Digital Services Development Fund over the next three years.

All of this means, that progressively over the next few years, people in Scotland will be able to order repeat prescriptions and book appointments online, use secure two-way electronic communication with their health and social care providers, use a patient portal to access their medical information and make their own contributions to their record, have structured access to personalised health and wellbeing information, and access a portfolio of realisable technology enabled solutions such as home health monitoring, tailored to match their conditions and circumstances. This will enable them to undertake a much more active role in managing their own care.

As healthcare in Scotland is moving increasingly towards greater multi-disciplinary team working, patient involvement and self-management, professional care

information needs to be increasingly integrated and linked with data recorded (e.g. through wearables or apps) by patients themselves. With clinically-focussed IT systems and patient-held devices now in everyday use, the richness and volume of personal health and wellbeing data is rapidly increasing. The Scottish Government and NHS Scotland are working on a Health and Social Care Information Strategy to ensure we use this valuable electronic information resource as effectively as possible and choose the right priorities for collection, analysis and sharing.

eHealth will enable care and treatment in Scotland to be more personalised, integrated and continuous. Harnessing digital technology will allow people in Scotland to be healthier for longer, take more responsibility for their own care where appropriate and be treated more efficiently and effectively, benefitting not only the individual, but also the overall resilience of the health and care services. ■

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 eHealth Division – Scottish Government
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Transforming ageing into an opportunity for Europe

Ilias Iakovidis and Bruno Alves from DG CONNECT at the European Commission explain how digital transformation can turn demographic change into an opportunity for Europe...

The challenges resulting from demographic change are well documented and have been moved over the years from technical to strategic and recently to political debate at the highest level. According to the 2015 Ageing Report, by 2060, one in 3 Europeans will be over 65 shifting the ratio of “working” to “inactive” population; from 4 to 1 today to 2 to 1. Increased demand for health and care services due to the ageing population will not only increase the public spending but also lead to an acute shortage of labour supply in the caring services (estimated to be in the order of 20 million by 2025). Unless we act now, our social and economic models as well as the quality of life of our population is at risk.

Changing the conversation

Our vision is to turn the demographic change crisis into an opportunity for Europe. We have embarked on a journey to accelerate the benefits of digital innovation to improve the quality of life of individuals, supporting sustainability of health and care services and at the same time achieving economic growth in ‘Silver Economy’ sectors that serve unmet needs of our ageing population.

The increase of smart connected homes which can support active ageing and independent living solutions will reach 29.7 million homes in the EU by 2020. This represents an annual market worth of €15.4bn. Technology-based long-term care and home healthcare are forecasted to grow 18.8 % between 2015 and 2020, representing a global market value of \$10.3bn. The sales of service robots for domestic tasks could reach 15.5 million units in 2016, with an estimated value of \$ 5.6bn. All these areas have significant potential and will enable the type of transformation we seek to achieve in the way we deliver health and care to our ageing population.



The global spending power of the “baby boomer” generation will reach €13 trillion by 2020. Recognising the potential of the ageing consumer, the European Commission issued a report (in March 2015) outlining a Strategy for Europe to seize the Silver Economy opportunity. The strategy identifies different areas of potential growth for the European Silver economy; age-friendly smart homes and living environments, integrated care solutions (health and social or community care) and finally, Silver tourism. Digital technology can play an important role in all 3 areas.

How can we seize the ageing opportunity?

Like for other societal challenges (climate, energy, migration and security) there is no ‘silver bullet’. But many things should happen in tandem and across many different sectors and administrations:

Since the launch of the Silver Economy Strategy we have been aligning our different policy instruments and measures at EU level to stimulate innovative solutions (products and services) supported by robust business models. Europe’s response to demographic change must look across various policies and not in isolation at healthcare reform, employment and pension reform, economic policy, digitisation of industry and research and innovation priority settings.

The need to work across sectors, to stimulate innovation and manage investment risk, explains our continued commitment to the European Innovation Partnership on Active and Healthy Ageing. The Partnership brings together thousands of stakeholders (end users, public authorities, industry); involved in the innovation cycle, from research to adoption.

One of our priorities is to support the implementation of innovative, ICT enabled solutions for integrated health and social / community care that have demonstrated benefits on a smaller scale in keeping people active and healthy and allowing them to live independently in their homes. This involves improving synergies between health and social care systems (organisational innovation), providing digital environment and solutions to health and social / community care workers to work more efficiently (skills-related innovation) as well as to individuals (which will improve their 'response-ability' to manage their health conditions).

Through the EU Horizon 2020 Research & Innovation funding programme we have been financing ground breaking innovation in the field of digital solutions to support ageing well. This year we are launching new calls: one is dedicated to develop Internet of Things based 'connected home platforms' that will enable interoperability of solutions tailored to the needs of an ageing population, and with functionality across diverse areas such as independent living, health, energy efficiency, security, and others. Another instrument is focused on co-financing procurement of innovative digital solutions for integrated health and social care, in a way that reduces the investment risk for public procurers and private organisations investing in these solutions.

Adapting our care systems will also require moving away from "institutionalised care" into a safe "care- at-home" model. In a way that meets what most people want or expect as they grow older. Unfortunately, some 70-80% of our existing building stock across Europe is unsuitable for independent living for the ageing population. We cannot address this challenge without working across sectors (technology, real estate, construction, transport and mobility etc.).

Connecting the dots: A shared vision

A shared vision is essential to mobilise investment

and guarantee the commitment of all actors to transforming the ageing society into an opportunity for Europe. We can no longer settle for the "prize" of having developed some of the most innovative digital solutions in the world for active and healthy ageing. Now we must ensure that all these innovative solutions become mainstream practices, deliver positive outcomes across Europe and not only in one country and region.

Uniting behind a shared vision will require leadership and determination. In December 2015 European Commissioner Günther Oettinger (Digital Economy and Society) invited stakeholders to work together over 12 months with the European Commission in creating a shared vision on how digital innovation can transform Europe's Ageing Society in the 21st Century.

It was an invitation to work across sectors and borders to boost patient and citizen empowerment, move to a results-based delivery of health and care, and develop new business models and economic opportunities in consumer markets which can scale across Europe and beyond.

Work is in progress to develop this shared vision. If we succeed in "connecting the dots" over the course of the next 12 months, 2016 may well be the turning point in the way Europe has transformed ageing into an opportunity for its economy, health and care services and above-all its citizens.

The views expressed in the article are the sole responsibility of the author and in no way represent the view of the European Commission and its services. ■

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Misuse of Pharmacotherapy: Danger on the Horizon

There is growing concern in advanced countries regarding the improper use of drugs, including the epidemic of illicit drug use affecting the youth (>30%), vulnerable groups with special social problems (>70%), and privileged sectors (>10%) with resources for the acquisition of illegal narcotics. Although much attention is paid to conventional drug abuse (opioids: opium, morphine, codeine, heroin, methadone, buprenorphine; stimulants: cocaine, crack cocaine, amphetamines; and cannabis) – due to its prevalence, associated morbidity and mortality, and substantial economic burden in Western societies (approximately €50,000 per case/year) – much less attention has been devoted to the cost and consequences of the inappropriate use of prescribed drugs in ambulatory and hospital settings, as

well as under conditions of self-prescription.

The economic cost of drug abuse in the USA is over \$180 bn, representing both the use of resources to address health and crime consequences, and the loss of potential productivity due to disability, death and withdrawal from the legitimate workforce. The cost of drug abuse increased by an average of 5% per year over the past 2 decades. In parallel, from 2000 to 2013, drug expenditure ranged between 10.4% and 12.0% of U.S. healthcare expenses; and prescription drug prices are rising significantly faster than general inflation. In FY 2016, a total of \$27.6 bn is requested in the USA to support 2015 National Drug Control Strategy efforts to reduce drug use and its consequences. This represents an increase of more than

\$1.2 bn (4.7%) over the enacted FY 2015 level of \$26.3 bn. Treatment and prevention costs represent \$ 10,960.5 mn (36.8%) and \$ 1,381.9 mn (5%), respectively.

Despite these official numbers, few pharmacoeconomic studies, performed by independent scientists, have investigated the rate of appropriateness of the most prescribed drugs in the world. Over 75% of the American population are consumers of some medication. The top 10 (most prescribed drugs) are: analgesics, anti-hyperlipidemic agents, antidepressants, immunostimulants, antidiabetic agents, anxiolytics, sedatives, hypnotics, antiplatelet agents, beta-adrenergic blocking agents, bronchodilators and anticonvulsants. Some pharmacogenetic studies predict that over 50% of current prescribed drugs are erro-

neously given to patients according to their pharmacogenetic profiles. Some claim that: (i) the cost of medicine is excessive; (ii) there is an alarming increase in overmedication (some vulnerable groups consume over 10 different drugs per day), with the ensuing increase in drug interactions and adverse drug reactions; (iii) it is estimated that over 10% of deaths in people older than 50 years of age might be due to the administration of inappropriate medication; (iv) there is a manifest abuse of psychotropic drugs in elderly patients institutionalised in nursing homes; (v) over 60% of drugs on the market are not cost-effective; (vi) the results of clinical trials performed in Europe, the USA or Japan should not be extrapolated to other ethnic groups; (vii) more clinical trials are necessary in children and in elderly patients for a more accurate dosage of drugs in these groups; (viii) drug resistance can be minimised with the appropriate personalisation of treatments in cancer and in chronic patients (mental disorders, degenerative disorders, chronic pain); (ix) a better moral surveillance should be motivated among professionals, editors, patient associations, medical societies and the pharmaceutical industry when dealing with conflicts of interest in the promotion of drugs; and (x) the regulatory agencies should request more exhaustive studies of new drugs or of approved drugs with potentially harmful effects.

Some of these problems might be overcome with the gradual incorporation of pharmacogenomic screening of patients, simplifying procedures, eliminating bureaucratic barriers, and



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reducing costs, for the physicians to know what kind of medications they can prescribe to a particular patient (and at what dose). Also for the patients to know what medications can be taken and what drugs should be avoided for health preservation and optimisation of the therapeutic outcome. The most valuable information comes from the genotypes and phenotypes of enzymes responsible for the metabolism of drugs and from drug transporters. For instance, CYP2D6, CYP2C9, CYP2C19, and CYP3A4/5 are involved in the metabolism of 60-80% of the most currently prescribed drugs and are highly relevant in the pharmacogenetics of psychotropic drugs. Approximately, 18% of neuroleptics are major substrates of CYP1A2 enzymes, 40% of CYP2D6, and 23% of CYP3A4; 24% of antidepressants are major substrates of CYP1A2 enzymes, 5% of CYP2B6,

38% of CYP2C19, 85% of CYP2D6, and 38% of CYP3A4; 7% of benzodiazepines are major substrates of CYP2C19 enzymes, 20% of CYP2D6, and 95% of CYP3A4. Most CYP enzymes exhibit ontogenic-, age, sex, circadian, and ethnic-related differences. In the case of CYP2D6, in the South-European population, extensive metabolisers (EMs) account for 55.71%, whereas intermediate metabolisers (IMs) account for 34.7%, poor metabolisers (PMs) 2.28%, and ultra-rapid metabolizers (UMs) 7.31%. Remarkable interethnic differences exist in the frequency of the PM and UM phenotypes among different societies all over the world. On average, approximately 6.28% of the world population belongs to the PM category. Europeans (7.86%), Polynesians (7.27%), and Africans (6.73%) exhibit the highest rate of PMs, whereas Orientals (0.94%) show the lowest rate. The frequency of PMs among Middle Eastern populations, Asians, and Americans is in the range of 2-3%. CYP2D6 gene duplications are relatively infrequent among Northern Europeans, but in East Africa the frequency of alleles with duplication of CYP2D6 is as high as 29%. In Europe, there is a North-South gradient in the frequency of PMs (6-12% of PMs in Southern European countries, and 2-3% PMs in Northern latitudes). According to the database of the World Guide for Drug Use and Pharmacogenomics (www.pharmacogenomicsguide.com) 982 drugs are CYP2D6-related: 371 drugs are substrates, over 300 drugs are inhibitors, and 18 drugs are CYP2D6 inducers. Over 600 drugs are CYP2C9-related, 311 acting as substrates (177 are major substrates, 134 are minor

substrates), 375 as inhibitors (92 weak, 181 moderate, and 102 strong inhibitors), and 41 as inducers of the CYP2C9 enzyme. There are 481 CYP2C9 SNPs. By phenotypes, in the control population, PMs represent 7.04%, IMs 32.39%, and EMs 60.56%. Nearly 500 drugs are CYP2C19-related, 281 acting as substrates (151 are major substrates, 130 are minor substrates), 263 as inhibitors (72 weak, 127 moderate, and 64 strong inhibitors), and 23 as inducers of the CYP2C19 enzyme. About 541 SNPs have been detected in the CYP2C19 gene. The frequencies of the 3 major CYP2C19 geno-phenotypes in the control population are CYP2C19-**1/*1*-EMs 68.54%, CYP2C19-**1/*2*-IMs 30.05%, and CYP2C19-**2/*2*-PMs 1.41%. CYP3A4/5 enzymes metabolise over 1900 drugs, 1033 acting as substrates (897 are major substrates, 136 are minor substrates), 696 as inhibitors (118 weak, 437 moderate, and 141 strong inhibitors), and 241 as inducers of the CYP3A4 enzyme. About 347 SNPs have been identified in the CYP3A4 gene (CYP3A4*1A: Wild-type), 25 of which are of clinical relevance. Concerning CYP3A4/5 polymorphisms, 82.75% of the cases are EMs (CYP3A5*3/*3), 15.88% are IMs (CYP3A5*1/*3), and 1.37% are UMs (CYP3A5*1/*1).

The construction of a genetic map integrating the most prevalent CYP2D6+CYP2C19+CYP2C9 polymorphic variants in a trigenic cluster yields 82 different haplotype-like profiles. These 82 trigenic genotypes represent 36 different pharmacogenetic phenotypes. According to these trigenic clusters, only 26.51% of the patients

show a pure 3EM phenotype, 15.29% are 2EM1IM, 2.04% are pure 3IM, 0% are pure 3PM, and 0% are 1UM2PM (the worst possible phenotype). This implies that only one-quarter of the population processes normally the drugs which are metabolized via CYP2D6, CYP2C9 and CYP2C19 (approximately 60% of the drugs in current use).

ABC genes, especially ABCB1, ABCC1, ABCG2, and other genes of this family encode proteins which are essential for drug metabolism and transport. The multidrug efflux transporters P-gp, multidrug-resistance associated protein 4 (MRP4) and breast cancer resistance protein (BCRP), located on endothelial cells lining brain vasculature, play important roles in limiting the movement of substances into, and enhancing their efflux from the brain. Transporters also cooperate with Phase I/Phase II metabolism enzymes by eliminating drug metabolites. Their major features are their capacity to recognise drugs belonging to unrelated pharmacological classes, and their redundancy, by which a single molecule can act as a substrate for different transporters. This ensures an efficient protection against xenobiotic invasions. The pharmacological induction of ABC gene expression is a mechanism of drug interaction, which may affect substrates of the up-regulated transporter, and overexpression of MDR transporters confers resistance to anticancer agents and CNS drugs. Over 1270 drugs have been reported to be associated with the Abcb1 transporter protein P-gp, of which 490 are substrates, 618 are inhibitors, 182 are inducers, and 269

additional compounds belonging to different pharmacological categories of products with potential Abcb1 interaction.

These examples illustrate that pharmacogenetics, used properly, can help us to improve the development of new products, to customise the prescription of drugs, to use them properly in appropriate doses, to avoid unnecessary adverse effects, and to optimise the therapeutic performance of each product, as well as educating physicians and customers in the rationalisation of drug use.



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Housing support for an ageing population

Domini Gunn, Director of Health and Wellbeing at CIH Consultancy outlines the potential for the right kind of housing and support to reduce the burden and improve the quality of life of older people...

I've often heard it said that we are facing 'a tsunami of ageing' – and you only need to take a cursory glance at the latest statistics to see that's no exaggeration.

We're not building enough homes to keep up with our growing population in general – in England 135,050 new homes were built in the year to September ¹, compared to the 240,000 experts estimate are needed. But we are particularly underprepared for future changes in demographics ² – between 2015 and 2020 the UK population is expected to increase by 3%, while the number of over 65s, over 85s and centenarians are expected to grow by 12%, 18% and 40% respectively. Where is the housing that will help these people live independently and well, with access to the care and support they need?

Long-term conditions already account for 70% of health and social care spend ³. Housing 'hazards' such as excess cold and damp cost the NHS more than £600m a year according to a recent BRE study ⁴. There is clearly huge potential for the right kind of housing and support to reduce this burden and improve the quality of life of older people.

A scheme piloted by North Tyneside Homes, focusing on preventing ill health and promoting wellbeing, saved the local NHS Trust £11,000 in 3 months, for example. Housing association Gentoo has launched a pilot with the NHS in Sunderland to 'prescribe' new boilers and insulation for tenants suffering from respiratory problems likely to be exacerbated by cold and damp. In the first 6 months alone ⁵ GP appointments had been reduced by 28% among the pilot group and outpatient appointments by 33%. Research commissioned by the ExtraCare Charitable Trust ⁶ found that costs are slashed by more than a

third and health benefits soar in its housing with care and support developments.

What we really need, however, is a significant increase in housing options, including specialised housing, tailored to meet older people's very different needs and aspirations. But it looks like recent policy developments are going to make that very hard to achieve.

The Care Act 2014 is a laudable piece of legislation – its stated aim is to promote independence, control and choice. But this vision is not reflected in recent housing policy announcements.

The new Housing and Planning Bill, for example, does focus on delivering more homes – but mostly for younger people who cannot afford to buy. Most elderly people already own their homes so are potentially seen as 'lower priority', with an assumption that high levels of housing equity are available to all. The bill is largely silent on older people's housing issues. Some of the measures it includes, however – alongside those in the summer budget, spending review and autumn statement – are likely to have a significant impact on older people, on our existing supply of specialised homes and our ability to build new specialised housing.

Pay to stay, for example – which will see social housing tenants with a household income of £30,000 (or £40,000 in London) paying higher rents – is likely to affect some older people, and we are still waiting to hear whether the policy will include supported housing, which generally commands higher rents and service charges because it is more expensive to build and maintain. If older households are suddenly expected to pay closer to market rents, will they be able to afford it?



Domini Gunn, Director of Health and Wellbeing

In the spending review, the chancellor announced that housing benefit for social housing tenants will be capped at the same rate as Local Housing Allowance (LHA) – the amount that claimants living in the private rented sector are entitled to. Again we are waiting to hear whether this will apply to supported, sheltered and extra care housing for vulnerable, homeless, disabled and older people – but Inside Housing has reported ⁷ that government officials have privately said that it will. Our concern is that current models will become unaffordable for new tenants and developers will see specialist housing schemes as unviable as a result.

Mick Sweeney, chief executive of One Housing Group, told Inside Housing ⁸ that a number of schemes under development, including 300 extra care properties, were now under threat due to the change.

Extending right to buy to housing associations could also affect older people. We know that housing associations will be able to protect certain homes by offering tenants who want to take up their right a discount on an alternative home. But it is by no means certain that all specialised homes will be exempt. If they are sold, will the homes that replace them be suitable for older people or adaptable?

Housing that is designed for older people, or that can be adapted at a far lower cost than acute care interventions, can not only support us to live well as we age and cut health and social care costs, it can also help younger generations struggling to get a foot on the housing ladder. By giving older people the opportunity to move to a more suitable home, it can ‘free up’ housing for younger people to move into.

Housing associations, local authorities and private developers are all keen to play their part in improving and adapting existing homes, and building the new homes we need to support our ageing population – of the right quality and in the right places. But I fear that the current policy environment means we could miss a huge opportunity to get things right now and for the future. ■

¹ <https://www.gov.uk/government/statistics/house-building-in-england-july-to-september-2015>

² <http://www.parliament.uk/business/publications/research/key-issues-parliament-2015/social-change/ageing-population/>

³ <http://www.parliament.uk/business/publications/research/key-issues-parliament-2015/social-change/ageing-population/>

⁴ <https://www.bre.co.uk/news/BRE-briefing-paper-shows-simple-changes-to-the-homes-of-older-people-could-save-the-NHS-over-600million-a-year-1125.html>

⁵ <http://www.theguardian.com/housing-network/2015/dec/03/sunderland-gps-prescribing-boilers-pills-warm-homes>

⁶ <http://www.theguardian.com/housing-network/2015/dec/03/sunderland-gps-prescribing-boilers-pills-warm-homes>

⁷ <http://www.insidehousing.co.uk/policy/health-and-care/care-and-support/calls-to-protect-supported-housing-from-lha-cap/7013004.article>

⁸ <http://www.insidehousing.co.uk/policy/health-and-care/care-and-support/calls-to-protect-supported-housing-from-lha-cap/7013004.article>

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Assisting people to live well with dementia

Colin Capper, Head of Research Development and Evaluation at Alzheimer's Society details how assistive technology can help people with dementia lead independent lives...

There are 850,000 people in the UK living with a form of dementia. At Alzheimer's Society, people with dementia tell us that they would prefer to remain in their own homes and independent for as long as possible. Two-thirds of people with dementia live within the community, with over 30% of these people living alone.

People with dementia can face a number of challenges around the home. There are many daily tasks to remember and carry out, as well as various potential health and safety risks. In order to promote their autonomy and to provide reassurance to carers, important technologies have been developed to support people with dementia to manage day-to-day life and remain at home for longer.

Assistive technology refers to a device or system that supports a person with dementia to maintain or improve their independence, safety and wellbeing. Rather than aid with physical difficulties, such as mobility problems, the term more often refers to technologies that assist people to manage the cognitive symptoms of the condition, for example loss of memory, orientation or communication. They help make daily life easier in a variety of ways, from supporting a person in remembering to make breakfast or have a shower, to improving their safety by managing risks around the home, such as remembering to lock the front door or turn the oven off. They can also help to monitor their health.

Safety, particularly if a person with dementia lives alone, is often a concern for the individual and their carer. Devices such as floor sensors can allow a family to check in on the wellbeing of their loved one and to react quickly should the person have had a fall or be at risk. Tracking devices or location-monitoring

services can ensure that a person with dementia does not wander or get lost.

Using assistive technology has many potential benefits, but it can also pose difficulties. While it can allow people with dementia to feel safe at home and reassures carers, it is crucial that technology never replaces human contact. Continued social interaction and stimulation is important for people with dementia and it is vital that family members continue to visit and spend time with the individual. Some devices can be used as a tool to aid conversations or stimulate memories, such as a digital photo frame which allows people to reminisce or a tablet to support Skyping children overseas.

Devices that increase safety can offer greater peace of mind for both the person with dementia and their family or carers; however it is crucial to remember that they will not eliminate all risks. Assistive technology helps to improve wellbeing by reducing risks in the home, but it must never be considered a perfect solution.

There is no one-size-fits-all resolution and a device that may greatly help one person could be distressing or confusing to another. When making choices about whether to use a certain technology, it is crucial the person with dementia is involved in the decision-making process and, where possible, their consent should always be sought and given. The chosen technology should be personalised to suit their individual needs.

As a result of the Prime Minister's Dementia Challenge and Dementia Friendly Communities campaign, Alzheimer's Society set up a task and finish group on dementia-friendly technology in October 2013. The group created a dementia-friendly technology charter,



which aims to improve the lives of people living with dementia by helping them access technology that may be of benefit, and encouraging best practice among organisations that provide services to these individuals.

Although it can greatly benefit the lives of people with dementia, assistive technology is currently an unregulated area and so cannot be prescribed. It is difficult to say with confidence whether technologies are effective and awareness of the range of technologies that are available remains low. Because of this, health professionals may feel reluctant to recommend a particular device or systems to an individual.

Many companies are now moving to create dementia-friendly devices or systems to make their products less confusing or difficult to use. The Medicines and Healthcare Products Regulatory Agency recently announced that it would now be working with the pharmaceutical industry to optimise the presentation of medicines for Alzheimer's disease. Lloyds Pharmacy has also created the Better Life Healthcare range, which offers a range of assistive technology solutions.

It is always advisable to seek professional advice before buying devices. An occupational therapist, adult social services assistive technology or telecare team (contact your local council), or a local assisted living centre will all have expertise in this area. Your GP or social worker should also be able to help you find an expert and get an assessment. ■

More information about assistive technology can be found at www.alzheimers.org.uk/technologycharter

You can find a range of assistive technology devices for sale online at the Alzheimer's Society shop: www.shop.alzheimers.org.uk

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Musculoskeletal disorders in the workplace

Christa Sedlatschek, Director at the European Agency for Safety and Health at Work outlines how musculoskeletal disorders affect workplaces across Europe...

Across Europe, musculoskeletal disorders (MSDs) are one of the most common occupational safety and health (OSH) risks in the workplace. They are found across many sectors, including agriculture, construction, manufacturing, IT, public administration and education, to name but a few. Not only can they have serious impacts on workers' health and lives, but they cost employers billions of euros owing to loss of productivity and have significant societal costs to European countries, such as worker compensation. Addressing MSDs is becoming increasingly important because of the ageing workforce and the need to keep workers healthy to enable them to work longer.

What are MSDs?

MSDs are impairments to bodily structures, such as muscles, joints and ligaments, and result from repeated exposure to high- or low-intensity loads over a long period of time. The health problems range from minor aches and pains and discomfort to more serious medical conditions, which could eventually lead to permanent disability and the need to give up work. They usually affect the back, neck, shoulders and upper limbs, but the lower limbs can also be affected. The 2 main groups of MSDs are back pain/injuries and work-related upper limb disorders (commonly known as 'repetitive strain injuries').

Causes

As most MSDs develop over time, there is usually no single cause; various factors often work in combination. Work and the work environment can both cause and aggravate MSDs. Awkward postures, prolonged sitting or standing in the same position, handling loads and repetitive or forceful movements are just some of the physical causes of MSDs, all of which are largely dictated by the type of work a person does.



Organisational factors, such as fast-paced work, and aspects of the working environment such as vibration, poor lighting or extreme temperature, particularly the cold, can also be risk factors. What's more, there is a growing body of evidence that suggests that MSDs could be linked to psychosocial risk factors such as high demand of work, low autonomy and low job satisfaction.

Prevalence of risk factors

The European Agency for Safety and Health at Work's (EU-OSHA) European Survey of Enterprises on New and Emerging Risks (ESENER) has made a significant contribution to the evidence base on OSH risks in general. By surveying businesses and organisations across Europe, EU-OSHA has been able to look at how OSH risks are managed, assess drivers and barriers to action in OSH management and determine the level of worker participation in OSH. MSDs in particular were one of the topics covered by the second wave of ESENER (ESENER-2; published in 2015¹). In the UK, there is a significant risk of MSDs throughout the working population. Nearly 60% of establishments in the UK reported that lifting or moving people or heavy loads is a risk factor in their workplace, over 50%

reported repetitive hand or arm movements, and just under 45% reported tiring or painful positions (including sitting for long periods).

In addition, by monitoring and reporting on the incidence, causes and prevention of MSDs in Europe, EU-OSHA plays a critical role in collecting and disseminating information about MSDs. Its report 'OSH in figures: Work-related musculoskeletal disorders in the EU – Facts and figures'² presents an overview of the MSD situation in Europe, providing a solid evidence base for use by policy makers, actors at the organisation and sector levels, and researchers. It has also produced a variety of factsheets on MSDs, providing handy summaries of the topic and highlighting key findings (Work-related musculoskeletal disorders: prevention report. A summary³; Introduction to work-related musculoskeletal disorders⁴; preventing work-related musculoskeletal disorders⁵).

So what is the solution?

Owing to the wide variety of causes, there is no single solution to the problem of MSDs. For those workers who already have MSDs, the aim is to retain their employability and, if necessary, reintegrate them into the workplace through rehabilitation. EU-OSHA's report "Work-related musculoskeletal disorders: Back to work"⁶ and factsheet⁷ focuses on the retention, reintegration and rehabilitation of workers with MSDs.

But a preventive approach needs to be adopted to reduce the incidence of MSDs in Europe. The key to preventive approaches is to combine risk assessment with worker participation. Risk assessment should take a holistic approach, taking the full range of potential causes into account. And worker participation is essential, involving staff and their representatives in discussions about problems and possible solutions.

Although more unusual or serious problems may require expert advice, many solutions are easy to implement and inexpensive. Organisational and administrative interventions can include changes to

working hours or the introduction of additional breaks. In some cases, technical interventions might be required, for example ergonomic hand tools to reduce workload on the back and upper limbs. Moreover, training on working methods could be used if behavioural changes are required. Overall, a combination of these types of interventions is usually the most effective method to preventing MSDs, and teaming this with a participatory approach, including workers in the process, is likely to have the most positive effect. ■

See [EU-OSHA's theme section on MSDs](#).

See also the campaign [Healthy Workplace for All Ages](#) which promotes sustainable work and healthy ageing from the start of the working life.

- 1 <https://osha.europa.eu/sites/default/files/publications/documents/ese-ner-ii-summary-en.PDF>
- 2 <https://osha.europa.eu/en/tools-and-publications/publications/reports/TERO09009ENC/view>
- 3 <https://osha.europa.eu/en/tools-and-publications/publications/factsheets/78/view>
- 4 <https://osha.europa.eu/en/tools-and-publications/publications/factsheets/71/view>
- 5 <https://osha.europa.eu/en/tools-and-publications/publications/factsheets/4/view>
- 6 <https://osha.europa.eu/en/tools-and-publications/publications/reports/7807300/view>
- 7 <https://osha.europa.eu/en/tools-and-publications/publications/factsheets/75/view>

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Therapies for weak muscles

It is estimated that ten percent of the costs of health care in Switzerland (or an equivalent of 500 billion Euros per annum in the EU) being associated with lost work is related to injury or dysfunction of the musculoskeletal system (Fig. 1). Surgical and subsequent rehabilitative interventions are important part of the therapy that re-establishes musculoskeletal function.

The Laboratory for Muscle Plasticity at Balgrist University Hospital aims to bring light into the underlying mechanisms in skeletal muscle with the goal of translating the findings into more effective clinical applications.

Skeletal muscle plays a major part in control of movement and posture and affects whole body metabolism through its effects on energy expenditure. Affections ranging from simple overuse injury to rupture of tendon and bones, or disease, lead to deconditioning of skeletal muscle as a result of inactivity and damage signals¹. The consequent loss in muscle strength and fatigue resistance exerts a distinct negative impact on the quality of life and may render the affected individuals dependent. In these situations a surgical intervention and rehabilitation may be indicated, yet may come too late as irreversible changes may have resulted.

Focus on muscle plasticity: The laboratory for muscle plasticity investigates the mechanisms that underlie the conditioning of skeletal muscle structure and function during recovery

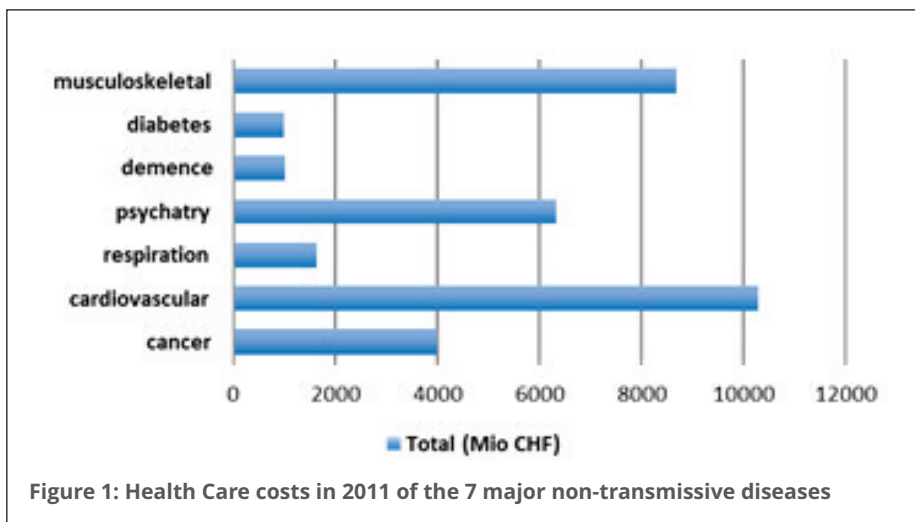


Figure 1: Health Care costs in 2011 of the 7 major non-transmissible diseases

from surgical interventions and rehabilitation. As shown through research on Sport Performance this process is driven by mechanical and metabolic stimuli. It is mediated through a gene response that instructs adjustments in muscle composition with the repeated impact of exercise during training. In consequence, force production and fatigue resistance of muscle may be improved or maintained.

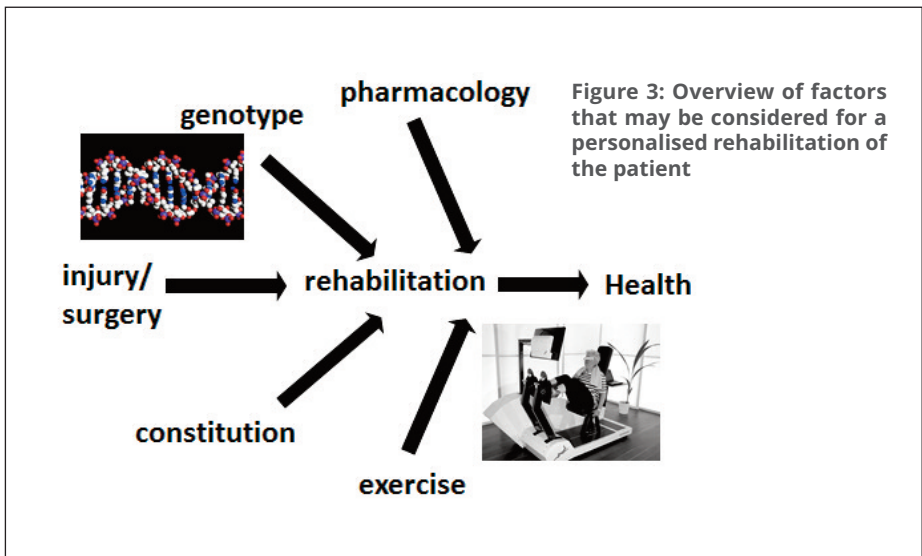
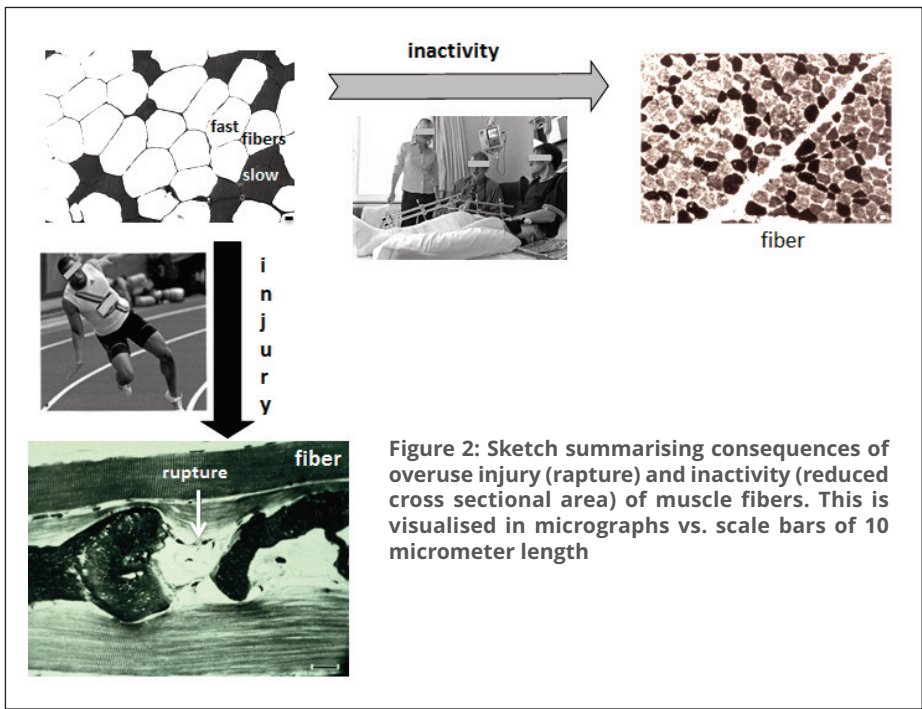
On the opposite muscle's functional capacity is reduced in the absence of a physiological stimulus by a reduction in the size of muscle fibers and their content in mitochondria (Fig. 2).

In fact, while the safety and effectiveness of physical factors for muscle conditioning are well established, the dose-effect relationship between exercise and muscle adaptation is often not fully respected in clinical practice. An example of this biological regulation is the important role of muscle contraction and loading in preserving muscle mass of the bedridden musculoskeletal patient after

surgery which otherwise loose muscle mass at a pronounce rate. Genetic factors (so called gene polymorphisms) importantly affect this adaptation². This indicates that gene polymorphisms contribute to the inter-individual variability of the response to surgical interventions and rehabilitation.

“The Laboratory for Muscle Plasticity at Balgrist University Hospital aims to bring light into the underlying mechanisms in skeletal muscle with the goal of translating the findings into more effective clinical applications.”

Research projects: The emphasis of the research team lead by Prof. Martin Flück at Balgrist is put on major musculoskeletal affections that arise in the context of the Orthopedic Clinics at Balgrist Hospital. A special focus is put on resolving the contribution of gene polymorphisms to inter-individual differences in the healing of muscle with re-attachment of the ruptured rotator



cuff tendon, and the strengthening of skeletal muscle with rehabilitative exercise in patients.

The aim is to develop personalised forms of interventions that maximise muscle adaptation (Fig. 3). The latter approach is based on our previous work that points out the important exercise-intensity and exercise-type related influence of gene polymorphisms on the muscle response to the leisure type Sports activities³. This opens a venue to tailor the therapeutically effective exercise intervention

for patients which otherwise would demonstrate little plasticity to a generic exercise stimulus and for which pharmaceuticals alone do not work due to the importance of activity-induced muscle metabolism for muscle adaptations.

Patient-lead research: By the end of 2015 the laboratory has undertaken a major step towards an expansion with the move into brand new research facilities at the Balgrist Campus (<http://www.balgristcampus.ch/en/>). A key ingredient of this research facility

will an open-space landscape where research and development into musculoskeletal medicine is integrated under one roof between clinicians, biologist, engineers, and industry. The facility situates in the vicinity of the orthopedic hospital at Balgrist; thus providing a pipeline for a reality-driven approach that re-integrates questions from bedside to bench and returns to the patient. The laboratory for muscle plasticity is looking for potential partners that may want to exploit the research options presented in the future Campus in the frame of collaboration.

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Tackling healthcare fraud

Joel Alleyne from the Global Health Care Anti-fraud Network (GHCAN) outlines how the organisation helps with the fight against healthcare fraud...

At a conference in Edinburgh in October 2009, the European (including the UK NHS), American, and Canadian health care anti-fraud associations signed a Memorandum of Understanding to combine their efforts to fight fraud globally. These groups were joined shortly after by the UK private insurers and later by the private health insurers in South Africa. This created the Global Health Care Anti-fraud Network – a network of organisations fighting fraud. GHCAN promotes partnerships and communications between international organisations in order to reduce and eliminate health care fraud around the world.



Signing of the Global Health Care Anti-fraud Network Memorandum of Understanding, October 7, 2009 Edinburgh, UK. (Left to Right) Diane Geddes, CHCAA/Canada; Paul Vincke, EHFCH/Europe; Louis Saccoccio, NHCAA/USA

GHCAN's activities are aimed at:

- Raising awareness internationally about the issue of health care fraud;
- Gathering and sharing information on the trends, issues, facts and figures relating to the problem;
- Working cooperatively to improve international standards of practice around fraud prevention, detection, investigation and prosecution; and,
- Developing joint educational training programs in order to bolster and prepare the world's health care anti-fraud professionals.

Working together, GHCAN members share research and best-practices in counter-fraud measures. One member is often ahead of the others in an area. For example, the US (NHCAA) has led the others in the use of data analytics and technology-enabled tools. The UK (HICFG) has led the way in knowledge sharing and building communities of practices for the individual counter-fraud specialists. The Europeans (EHFCN) have developed risk management frameworks.

Working in the network, these advances are shared and picked up by other members. Often local marketing or social media campaigns are reused in other countries.

Although the fight against health care fraud takes place on a national or regional level, groups of fraud perpetrators act without borders. Health care fraud knows no boundaries. Those who seek to defraud healthcare systems often operate across national borders. Fraud schemes cross borders. In an Internet-connected world, fraud schemes travel from country to country with few barriers. Health care funders / payers who spot new schemes can now share these with their national and regional counterparts, and indeed, through GHCAN across the world. Fraud schemes are similar across jurisdictions so the global healthcare and fraud network allows healthcare organisations, insurance companies and other payers to recognise fraud schemes on a more rapid basis. Fraud schemes (such as faked car accidents, 'billing for services not rendered' or 'providing unnecessary services') are found in all jurisdictions.

Members of GHCAN have quicker access to information on new and developing fraud schemes as they are discovered. A fraud scheme picked up by the National Health Service or an insurance company in the UK might affect an organisation in the US or Canada or the Middle East. GHCAN facilitates the sharing of this information and knowledge on a global basis. Once these fraud patterns are identified, then they are easier to spot or detect.

Medical and healthcare devices are not always licensed for use in all countries. However, these devices can often be purchased and distributed using the internet. If a device is not licensed in your country; perhaps there is a reason. GHCAN links organisations and provides a conduit for information in this area.

Counterfeit drugs are often manufactured in one country and sold to patients in another. Counterfeit medicines often have no active or medicinal ingredients and at the extreme, can lead to patient death. Similarly, grey market products for counterfeit devices make their way across borders and into the hands of patients. 'Snake oil' sales on the Internet are hard to counter because the criminals behind these products often hide in one jurisdiction while shipping their goods from another. Online pharmacies and stores present a problem for law enforcement and organisations with limited reach jurisdictionally. Working together, GHCAN is seeking to inform and work with regulators in various jurisdictions.

Medical tourism is a doubled edged sword. On one hand, it allows patients to go to jurisdictions with special expertise or extra capacity for medical procedures and services. Indeed, in our member countries there are many organisations that treat patients from abroad. However, there are often clinics and practitioners in other countries who prey on our citizens with dubious treatments and modalities. One such clinic was found offering dubious cancer treatment from Mexico, whilst another was found offering suspect stem cell treatments offshore.

Practitioners move from country to country. Sometimes when they lose a license in one country they'll move and set up in another. We have seen

cases where doctors surrender their licenses to a state board and move to another country and re-establish a practice. One surgeon was found in British Columbia, Canada, operating and making the same medical errors that caused him to give up his license in Arizona. In other cases, practitioners flee charges in one jurisdiction and move to another. Such is the case of a Canadian doctor who moved to Newcastle in the UK while are under investigation for significant health care fraud activities.

We often see fraudulent travel plan claims made by individuals traveling to other countries and coming home with medical bills from hospitals, doctors or clinics which may or may not exist.

GHCAN affords its members an opportunity for increased counter fraud awareness. Over the last 5 years, the annual GHCAN Summit has moved around the world, allowing local members a glimpse into the broader reach of their counterparts. Our 2016 Summit will be in the UK.

About GHCAN

GHCAN was jointly founded by the Canadian Health Care Anti-Fraud Association, the European Healthcare Fraud & Corruption Network, the Health Insurance Counter Fraud Group (based in the United Kingdom), the Healthcare Forensics Management Unit (based in South Africa), and the National Health Care Anti-Fraud Association (based in the United States).

Joel Alleyne is a management consultant who has worked with GHCAN since its inception. He was the Executive Director for the Canadian Health Care Anti-fraud Association through 2015 and is currently involved in research in health care fraud and in crime science. ■

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Corruption in healthcare in Europe

From informal payments to industry kickbacks...

In October 2013 the European Commission has published a "Study on corruption in healthcare" (HOME/2011/ISEC/PR/047-A2). The study was developed by ECORYS, a Dutch consultancy and research company, in collaboration with EHFCN, the European Healthcare Fraud and Corruption Network. Aside from being the first ever on the subject of corruption in healthcare in Europe, the study has the merit of offering an astonishing overview of the way corruption has affected healthcare in every 28 of the EU countries. The 86 corruption cases presented read like a sad "best of". Unlike the common assumption that corruption thrives in southern European and former communist countries only, these cases show how stakeholders in "advanced" western and central European healthcare systems incline to corrupt practices as well. Areas affected are healthcare provision, certification and procurement of medical equipment and authorisation and procurement of pharmaceuticals. Corrupt practices vary from "informal" payments requested by doctors from patients, to kickbacks paid by medical devices and pharma companies to physicians. Worldwide 10–25% of public procurement spending in health (medical devices and pharmaceuticals) is lost to corrupt practices. European figures are not available.

The main obstacles in countries in which corruption is widespread include



scarcity of health care services (e.g. organ transplants), relatively low level of healthcare funding (i.e., where healthcare expenditure as a percentage of GDP is below 7%), weak controlling mechanisms, high out-of-pocket payments for healthcare, self-interest and greed from the side of the healthcare providers.

Here are some examples as reported in the study. In Austria a medical doctor working at a regional hospital asked for 60 euro per visitation on top of the official charges. Indications are that this is not an isolated case and that this problem is of a systemic nature. In another case, a hospital doctor offered patients the possibility of moving up waiting lists for cash payments of between 300 and 500 euro.

One of the most prominent scandals in the history of the German health sector was the Globudent Skandal.

The company 'Globudent' imported cheap dentures from Turkey and Hong Kong and sold them overpriced to dentists and dental firms. Dentists would subsequently invoice the cheap dentures to the health insurance companies as if these were high-end dentures 'made in Germany'. The profits enabled Globudent to pay kick-backs. In some cases these reimbursements added up to over 200 000 euro for an individual dentists. About 450 dentists were involved in the scheme. Over 40 of them lost their license.

Royal Philips Electronics was fined 4.5 million US dollar by the US Securities and Exchange Commission (SEC) because of alleged bribery in Poland. The company accepted to pay the fine imposed by the SEC to settle the matter. In at least 30 bids, employees of Philips' subsidiary in Poland made improper payments to public officials of Polish healthcare facilities to

increase the likelihood that public tenders for medical equipment would be awarded to Philips. Philips would submit the technical specifications of its medical equipment to officials drafting the tenders, who would incorporate these specifications into the contracts.

An Executive Director of a district hospital in northern Finland was accused of favoring companies owned by his son. In 11 instances over 8 years the Executive Director bypassed procurement legislation and directed major IT program contracts to these companies (health care IT programs are classified as medical equipment). The deals were constructed in such a way that other players had no chance to participate. Agreements were made in private face-to-face meetings. Purchases were sometimes also delayed so that the family companies had time to prepare for the calls for tender. The Executive received a 9-month suspended sentence for aggravated malfeasance in office.

Impacts of healthcare corruption

The overall impact of corruption in healthcare on society and on individuals can be (much) larger than the monetary value of the sums involved. Directly, corruption in healthcare may lead to low quality in the provision of healthcare services and low quality in the provision of medical devices and pharmaceuticals. Indirectly, corruption in healthcare may cause productivity loss through bad health, distrust in provisions of services by the government, distrust in the health system and distrust in society as a whole.

How corruption in healthcare can be “institutionalised” has been demonstrated by “Doctors against corruption” a Serbian organisation who

successfully detected and disclosed health corruption scandals in Serbia. They played a major role in stopping the trade in radiotherapy waiting lists for cancer patients at the Institute of Oncology Vojvodina and managed to prevent the malfunctioning of the oncology services, costing many patients’ lives due to systematic corruption. They also denounced several cases of EU and World Bank funds being embezzled, resulting in the deterioration of the Serbian health sector. An Action Plan to fight corruption in the healthcare system, although adopted by the Serbian Government, has not been implemented so far.

The degree to which misuse of (high-level) positions is a problem within a country, largely depends on the extent to which corruption is embedded in the economy and society. There is no hard data available on the prevalence of this type of corruption in Europe, but it appears to be a problem particularly in countries where corruption is deeply embedded in politics and society, such as Czech Republic, Latvia, Croatia, Slovakia, Romania, Italy, Bulgaria, Greece. However, it is in many cases difficult to draw a clear line between normal lobbying and unethical forms of trading in influence.

Systematic corruption should be prevented and tackled with good anti-corruption legislation, powerful anti-corruption enforcement, changes in healthcare and healthcare supervision systems and general changes in norms and attitude. Isolated healthcare corruption can be countered with more targeted measures (such as anti-fraud and corruption reporting hotlines). This bottom-up as well as top-down approach requires a sustainable effort and, with time, a change in attitudes helping to prevent

corruption from the outset should be the result.

EHFCN has formally been established in 2005 as a not for profit international association by Belgian law. The Network is membership based. The actual 16 members from 14 European countries represent public and private healthcare insurers, health financiers and payers who all have the countering of fraud, waste and corruption in healthcare as their core business or as part of their mission. The aim of EHFCN is to improve European healthcare systems by reducing losses to fraud, waste and corruption and its objective is to help members to be more efficient and effective in their work of prevention, detection, investigation, sanctioning and redress of healthcare fraud, waste and corruption, with the ultimate goal of preventing from money being lost and returning money to healthcare services for the benefit of every patient. EHFCN provides its members with high quality information, tools, training, global links and access to professional consultancy. It also promotes the share of good practice, joint work, bilateral agreements and the development of common working standards.



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www.ehfcn-powerhouse.org/welcome

Resilience in healthcare

Dominic Smith, Marketing and Client Relationship Manager at Rothwell Douglas Ltd asks what more healthcare organisations can do for their employees...

The NHS Staff Survey, the annual mass staff satisfaction exercise examines, in depth, providers' performance from the perspective of their employees. It includes measures such as:

- Work pressure felt by staff;
- Staff motivation at work;
- percentage of staff suffering work related stress in the last 12 months;
- percentage of staff witnessing potentially harmful errors, near misses or incidents and percentage of staff reporting errors, near misses or incidents witnessed in the last month;
- percentage of staff experiencing harassment, bullying or abuse from staff in the last 12 months;
- percentage of staff feeling pressure in the last 3 months to attend work when feeling unwell;
- percentage of staff feeling discrimination at work.

Providers clearly have markers against which to perform in terms of employee wellbeing, stress management and personal resilience.

Healthcare organisations must be wary of exclusively skilling staff in technical ability to the detriment of skills in areas concerning personal wellbeing. These sorts of skills are not taught in school – they're rarely taught in university – but are crucial to personal development, employee satisfaction and high performance.

What is stress?

Stress is a consequence of pressure. Funnily enough

though pressure is actually a stimulant – it causes the hormones adrenaline and cortisol to pump around, enhancing attention and concentration. If the pressure becomes too much and you feel out of control then you become tense – you feel uncomfortable but you know you need to do something to get rid of that tension – so tension is also a stimulant. When you can't get rid of that tension, then it becomes a strain; strain impairs performance and, if prolonged, becomes stress.

Stress and the workforce

The workforce is at the centre of productivity. In health and social care, the workforce is also responsible for saving lives – for bringing about better outcomes for the service-user, helping to make lives better for people.

As is made known daily by the press and media, the NHS is under significant pressure: complex demographics, geographies and economies, as well as a politically changeable landscape mean that constant change is necessary. To be able to bring about transformational change organisations and systems must develop adaptive cultures that are fronted by adaptive leadership – that is, cultures and leaders who are ready to respond to shifts in economic and political drivers. To be adaptive, employees need to be resilient; ready for change.

What are the behaviours of an engaged and resilient workforce?

There are certain key features of a resilient culture, with a workforce who are engaged and prepared for transformation. Resilient workforces tend to be more committed – they are dedicated to their jobs and are exponents of the values of their organisation. They show trust – it is important in a fast paced and dynamic environment to not read between the lines



and mistrust colleagues – it demonstrates a lack of transparency and is ineffective teamwork. Resilient workforces exhibit high levels of kinship, treating others with kindness and emotional intelligence. Staff feel motivated.

What can organisations do to build the resilience of their workforce?

All improvement starts with an awareness of the area in which to improve. Healthcare organisations should create time for employees to think about how they perform in the key areas of resilience: confidence; adaptability; purposefulness; social support. (Robertson Cooper) Not everyone can tick the boxes in all these areas: for example, sometimes our personality inhibits us from being naturally sociable. However, in identifying these areas of weakness employees can pay attention to how they impact on their day-to-day, and long-term performance. Organisations might consider holding ‘resilience mornings’, workshops or seminars. This would give staff the space and time to dedicate to the personal qualities and skills that can get overlooked in the day job.

To summarise, satisfaction of staff is key to creating motivated, high performing healthcare workforces. The annual staff satisfaction survey will expose those organisations when staff satisfaction and morale is low – and highlight the areas which contribute to this feeling. Healthcare is an incredibly fast-paced industry dependent upon a number of uncontrollable factors. Resilience should be a skill as ingrained in healthcare’s staff as much as clinical competence and technical ability. This way adaptation, improvement and transformation can be tackled with confidence and motivation. ■

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Systems medicine approaches in dermatology

Although a small field in medicine, dermatological diseases are very frequent and span a wide range of illnesses such as allergies, inflammation (e.g. atopic dermatitis, psoriasis), autoimmune diseases or malignancies (e.g. melanoma). Thus, translational dermatological research is an important, innovative field for future basic and clinical research for many diseases in which treatment is still an unmet medical need.

Skin conditions under investigation

The major areas of dermatology under investigation at the Charles Institute are atopic dermatitis, rosacea, itch and other inflammatory skin conditions (Director: Professor Martin Steinhoff, Professor Frank Powell), cell signalling (Professor Cormac Taylor), wound healing and epidermolysis bullosa (Dr Wenxin Wang) and melanoma genetics (Dr Simon Furney). These areas are explored using a wide range of innovative techniques: disease models, 3D skin models, proteomics, genomics, metabolomics, cell signalling, immunology, systems biology, and state-of-the-art imaging.

Itch serves as a self-protective system under normal conditions, but chronic itch can have a debilitating impact on quality of life. Chronic itch can be caused by skin conditions such as atopic dermatitis (eczema) and contact dermatitis, or after zoster (shingles), by systemic disorders or certain medications. Terminally ill cancer patients, for example, often experience such severe itch in response to morphine

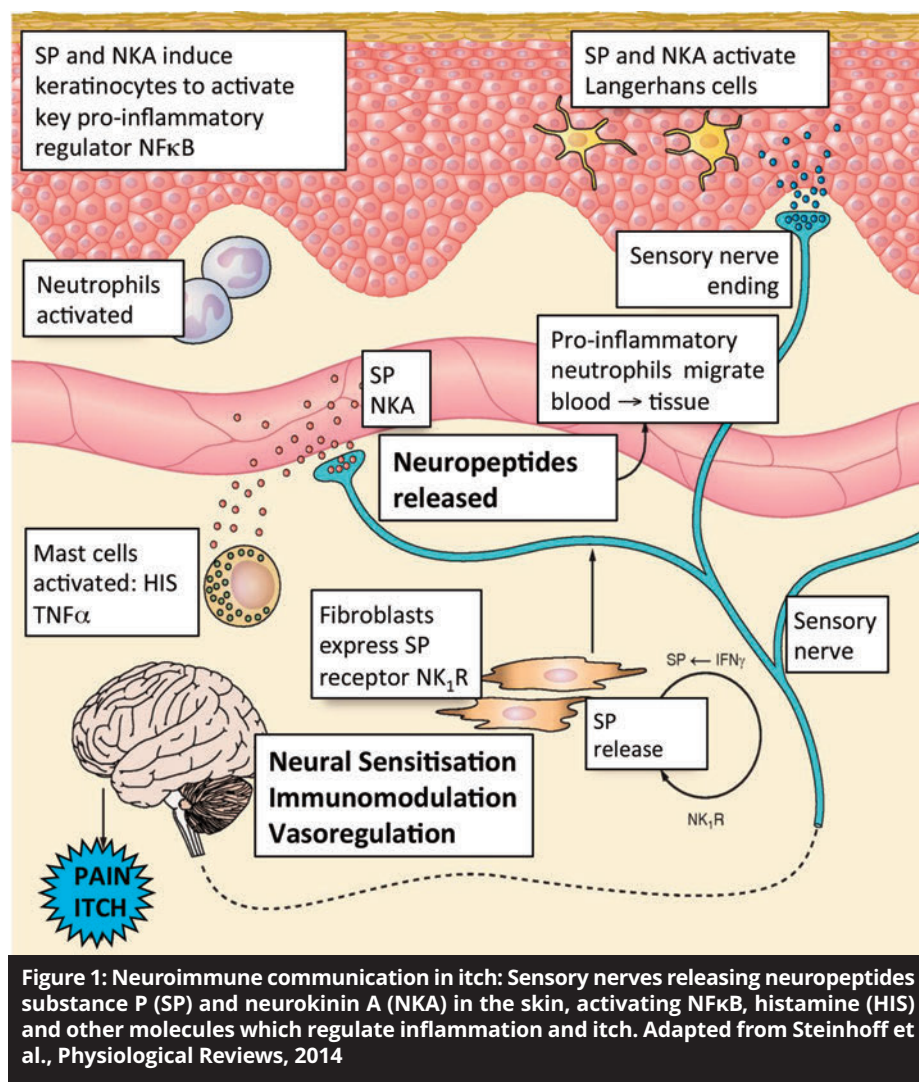


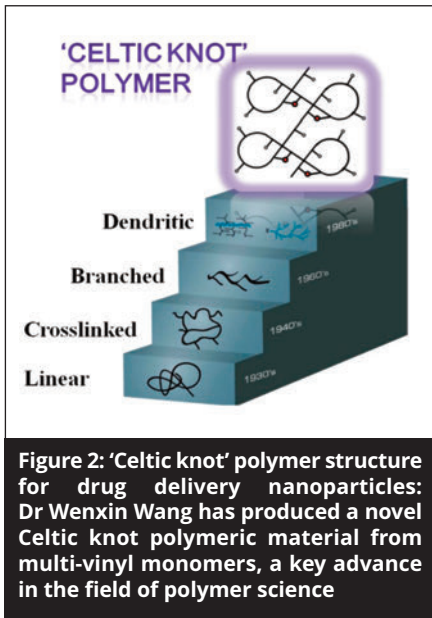
Figure 1: Neuroimmune communication in itch: Sensory nerves releasing neuropeptides substance P (SP) and neurokinin A (NKA) in the skin, activating NFκB, histamine (HIS) and other molecules which regulate inflammation and itch. Adapted from Steinhoff et al., *Physiological Reviews*, 2014

that many choose to live in pain rather than take the medication. Steinhoff’s laboratory is discovering more about the mechanisms of itch (Fig. 1). A large part of their work focuses on endothelin-1, and they have shown that it is possible to turn the dial up or down on the level of itch by targeting this pathway.

Epidermolysis bullosa is a family of genetic skin diseases characterised by skin fragility, resulting in blisters, chronic wounds, scarring and skin

cancer. In an effort to find a cure to this devastating disease, the Wang team has developed a non-viral, polymer-based vector carrying normal collagen type VII expression to cells in which it is missing. Unlike most genetic therapies, this is designed to be applied directly to the skin.

Wang’s laboratory designs and builds polymers with a variety of defined shapes illustrated in Fig. 2 which can be specifically tailored to suit the application. This distinctive combina-



tion of chemical and biological expertise offers promising prospects for application to many areas of bioscience, including drug delivery, immunology and the development of vaccines, biodetection and biosensor, antimicrobials and antiviral agents.

Another target group of patients in Wang's sights is people with diabetes. Over time, diabetes can damage the nerves and circulation of the lower limbs, and if wounds form they can be very hard to heal and in severe cases the person may need an amputation. The Wang group has been looking at the specific needs of diabetic wounds and has developed a tailored biomaterial that could be used in dressings to carry therapeutic agents such as stem cells and growth factors.

Rosacea is a chronic inflammatory skin disorder with symptoms of dry, sensitive facial skin that commonly affects middle-aged people, with a

particularly high incidence among people of Celtic extraction. As an example of modern translational research, Steinhoff's recent findings gave new insights into the pathophysiology of rosacea, which is so far incompletely understood. Using a combination of transcriptomics and immunohistochemistry, his group elucidated for the first time the complex pathways of genes involved in this condition (Journal of Investigative Dermatology 2015). Another approach led by Prof. Frank Powell focuses on deciphering the role of the Demodex mite, a microscopic organism associated with the inflammatory lesions which affect rosacea patients.

Translational research

At the UCD Charles Institute of Dermatology, the vision is to establish a centre of excellence for translational dermatology research in Ireland, working with colleagues in dermatology clinics at UCD's affiliated hospitals. The goal is to understand the pathophysiology of skin diseases in a translational fashion. The outstanding infrastructure with patient care clinics, clinical trial units, and a new €20m research centre for over 70 scientists provides a unique opportunity to comprehensively study the pathophysiology of various skin diseases, develop new treatments and perform innovative clinical trials for patients with treatment-resistant skin diseases.

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Director biography

Professor Martin Steinhoff is a clinical dermatologist as well as a basic scientist with 20 years' experience in translational dermatological research. He is a trained dermatologist, allergist and phlebologist with specific interests in neuroimmunology, inflammatory skin diseases and systems medicine. After his appointment as associate professor in Germany (2005-2008), he worked at the University of California, San Francisco, as full professor (2009-2013) with NIH-funded research. Steinhoff began his position as professorial chair of dermatology and director of the UCD Charles Institute of Dermatology in January 2014.



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Reducing the obesity burden

Dr João Breda and Jo Jewell from WHO Regional Office for Europe highlight the latest projections in regards to obesity throughout Europe and how WHO work with countries to reduce the burden...

Of the 6 WHO regions, the European Region is the most severely affected by non-communicable diseases (NCDs): collectively, cardiovascular disease, diabetes, cancer, and respiratory diseases account for 77% of the burden of disease and almost 86% of premature mortality.

Excess body weight is known to be one of the leading risk factors for many of these diseases, responsible for approximately 35% of ischaemic heart disease, 55% of hypertension and around 80% of type 2 diabetes. It is also associated with increased all-cause mortality. In 2013, overweight and obesity (body mass index >25 kg/m²) was cited as the third most important risk factor for disease worldwide and around 4.4 million deaths and 134 million disability adjusted life years are directly attributable to excess body weight.

Adult overweight and obesity in Europe has almost tripled since 1980, despite the efforts of national governments. Indeed, overweight and obesity prevalence in the European region largely continues to increase among adults, making it one of the most important health challenges facing the region. Furthermore, there are additional worrying trends in childhood obesity. Data from the WHO European Childhood Obesity Surveillance Initiative show that, on average in the participating countries, one in every 3 children aged 6–9 years is overweight or obese.

According to latest projections developed by the World Health Organization Regional Office for Europe and the UK Health Forum, by 2030 the majority of countries in the European region are estimated to have an overweight and obesity prevalence of more than 50%. This means that more than half of all adults will be at an increased risk of disease and disability, placing immense economic strain on health systems

and wider society. Few countries in the region will see stable or decreasing overweight and obesity rates, with no evidence of a plateau in adult obesity in most countries. In fact, a wide cross section of countries appears to likely see a rise in their proportions of overweight and obese adults.

The latest projections look at data from all 53 countries of the WHO European region, and compare the proportions of overweight (body mass index [BMI] over 25kg/m²) and obesity (BMI over 30 kg/m²) for both males and females in 2010 with projected 2030 levels where the quality of the projections depends on the availability and quality of national level data. The data highlights a serious problem for many countries, and are also similar to previous estimates produced by the WHO using different methodologies.

Factors underlying these trends include an energy imbalance resulting from increased consumption of highly processed, energy-dense foods high in saturated fats, free sugars, and sugar-sweetened beverages. These foods have become more widely available and affordable, they also tend to include high amounts of salt and trans fatty acids, as well as a marked increase in average portion sizes. They are also heavily promoted. Simultaneously, Europe has observed a decrease in levels of physical activity across all age groups, with a steep drop off among older children and adolescents (particularly among girls), continuing into adulthood. Poor maternal nutrition (e.g. excess body weight before, during and after pregnancy), inadequate breastfeeding practices and inappropriate complementary feeding are also playing a role.

In the face of such alarming figures, governments from across the world have demonstrated a renewed



commitment to tackle obesity. In 2012, ministers of health from across the world endorsed a global target to halt the rise in obesity levels by 2025. In doing so, they recognised that much greater efforts will be needed to develop and implement effective obesity prevention policies and interventions if they expect to successfully halt the rise in obesity prevalence in 10 years' time.

With the unanimous adoption by European governments of the WHO European Food and Nutrition Action Plan 2015-2020 and the Physical Activity Strategy for the WHO European Region, European Member States have taken a further decisive step towards action. The Action Plan and Strategy call for a wide range of policies to help people from all backgrounds eat more balanced diets, maintain a healthy bodyweight and be more physically active.

Governments can contribute to improving the diets of their population through changes to the wider environments and contexts in which we make our daily food and activity choices; such policies will influence the ways in which foods are promoted, their availability in different settings, and – in some

circumstances – their affordability. Further, in altering the physical environments in which we live, it is possible to encourage physical activity as part of everyday life through active transport (e.g commuting by bicycle, walking) and increased leisure time activity.

Specific policy options highlighted in the European Food and Nutrition Action Plan 2015-2020, include stronger restrictions on the marketing of foods high in saturated fat, free sugars and salt to children, the promotion of clear and easy-to-understand labelling on the front of food packages, improvements to the nutritional composition of food products (through reformulation, calorie and portion size reductions), and strict standards for the nutritional quality of foods available in schools. Increasingly convincing evidence continues to emerge suggesting that a combination of effective food policies is required to address unhealthy diets and obesity, with no silver bullets.

Priority policies in the Physical Activity Strategy for the WHO European Region 2016-2025, include the adoption of national guidelines on physical activity for health in line with WHO guidelines; national and subnational urban planning and transport policies to

ensure supportive infrastructure for active transport (e.g. through cycle paths, safe pavements and pedestrian zones in urban areas); and, the creation and preservation of built and natural environments to support physical activity, including through “green” and “blue” spaces which encourage active recreation (i.e. free outdoor sport infrastructures, clean beaches, woodland areas etc.) Furthermore, in order to encourage healthy physical activity habits early in life, improved provision of quality physical education in educational settings is needed (from infant years to tertiary level) including opportunities for physical activity before, during and after the formal school day.

The WHO regional office for Europe continues to work with countries to support the implementation of the policies and interventions identified in these 2 documents. It is hoped, and expected, that full implementation will go a long way to addressing the challenge of obesity. Close monitoring of the situation will be necessary to identify the trends and progress. However, with time, we should start to see the tide turn on obesity. ■

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Transforming mental health

Helen Gilbert, Policy Fellow at the King's Fund explains why it's time to put quality at the forefront of mental health investment...

Access to the right care at the right time has been at the forefront of recent government policy on providing good quality mental health care. For the vast majority of people this means equal consideration and support for mental and physical health conditions within primary care, but for those who require specialist support, mental health services form a core component.

Mental health accounts for approximately 11% of NHS funding with over [80% of this allocated to NHS providers](#). Increased investment between 2001 and 2011 saw a growth in mental health service provision including the implementation of specialist community psychiatric teams and services to support improved access to psychological therapies. However, from 2011 onwards funding declined placing mental health service providers under increased pressure to deliver good quality care at lower cost.

A [recent report by the King's Fund](#) demonstrates the financial impact of these pressures, with approximately 40% of NHS mental health trusts experiencing reductions in income in 2013/14 and 2014/15. In response trusts have sought to transform services, shifting the emphasis of care from acute settings and placing an increased focus on enabling recovery for individuals with mental health problems by helping them identify and develop their own forms of support. But far from delivering a mental health system for the future, indications are that quality of care has suffered and in many cases, the issues that transformation were set to tackle, such as a reliance on high cost inpatient care, remain as pressing as ever. With the transformation of health services and financial sustainability at the heart of the 5 year plan for the NHS – we should be mindful to the lessons we can take from mental health.

Using the best evidence available

The reconfiguration of evidence based models of care has had a profound effect on the quality of mental health care. Although the initial implementation of specialist community teams such as crisis intervention, assertive outreach and early intervention as part of the National Service Framework for mental health was criticised for being too prescriptive, subsequent changes made by trusts often failed to acknowledge the core components of these models which made them effective and the impact that these changes would have on their capacity to improve outcomes for patients. Conversely many of the new models of care that have been brought in as part of recent transformation plans such as recovery colleges and street triage have received little or no evaluation and there is limited knowledge about their impact or cost-effectiveness.

Radical vs. incremental transformation

The language of mental health transformation programmes has more often been that of 'whole system transformation'. Some of the most radical transformation plans are centred on developing recovery-orientated care. A number of trusts have sought to achieve this by creating care pathways which focus on providing specific evidence-based interventions alongside engaging individuals in activities which support self-management. The expectation was that this intervention would be time-limited with prompt discharge to primary care. However, the scale and pace of implementation allowed little room for learning, evaluation and importantly – failure. For instance, closing inpatient beds in expectation that new community services would prevent hospital admission has left several trusts with insufficient capacity, others are struggling to provide the appropriate staff skill mix for new ways of working and under-developed mental health



capacity in primary care has left many with insufficient care and support. There is little to challenge the ambition of these plans, but arguably more should be done to challenge their underlying assumptions, the processes involved and the resources required to achieve this.

Balancing cost with quality

Perhaps the most important lesson from the current issues in mental health is the role that financial pressures have played. Almost without exception, transformation plans in mental health have sought to reduce costs and ensure financial sustainability for trusts. There is little evidence that trusts have actively sought to make a trade-off between cost and quality, however, what is clear is that the intention to ensure financial sustainability has led to more radical paths of transformation. A do or die attitude is palpable, if not actually stated, in many strategic plans.

Indications that the tide is turning?

Since 2010 mental health policy has focused on a vision for the future but stopped short of defining how it should be achieved. Coupled with increased financial pressures and limited national oversight for mental health outcomes, this has had far reaching

consequences on the quality of care for people with mental health problems. The development of access standards and recent announcements in the spending review on focused service development, signal a change of approach and a national drive to identify and standardise good practice. Increased investment associated with many of these programmes and mandated through funding allocations to Clinical Commissioning Groups further demonstrate a commitment to this agenda. The Prime Minister has pledged a [‘revolution’ in mental health treatment](#) and as we wait to see whether funding promises are realised on the ground, there is cautious optimism that the tide may be turning on quality of care in mental health. ■

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Crises and challenges

Pfalzlinikum – The Palatinate region braces itself/you – civic engagement as the way out of the crisis...

One year ago nobody in Germany and probably in Europe would have imagined what dynamics could develop within a year on the European as well as on the international stage. After the two attacks in Paris and many others in the Near and Middle East a very large number of domestic and foreign-policy coordinates have changed. In addition, there was the European financial crisis in the first six months of 2015.

“With our regional initiative “The Palatinate region braces itself/you – roads to resilience” we substantiate our ambition to be there for the people in the Palatinate region in the field of mental health and to act as a fair cooperation partner in the region.”

You may, of course, ask what this has got to do with us and the health system and you may say that such evaluations can also be read up in the vast media landscape. Well, that's what I believed, too. However, I have realised that these events directly affect our work. The financial crisis for example changes the structures of the occupational pension scheme in the medium term and the financial resources of the social insurances, it changes the structures in the community budgets and the regional budget, and we directly feel the impact on the



integration support or on the financial resources in hospital treatment order.

Refugees also in the Pfalzlinikum

The large number of refugees do not only present a challenge to their home communities and trigger political discussions; they also have an effect on our offers. Beside the initial treatment of people needing our help, we are, with the topics “living” and “work”, directly involved in the discussions in the Southern and Northwestern Palatinate.

PEPP, (semi)in-patient services and reconstruction

Furthermore, the old year has been and the New Year will be marked by the new payment system in in-patient hospital psychiatry (PEPP) here in Germany. This has an influence on

our management decisions in each clinic and on the manner how we will structure our offers. At present, an economic trend towards more treatment forms in the field of (semi) in-patient services is beginning to emerge. So we are happy that the politics approved our request for another 14 in-patient beds in Rockenhausen and the building of a day-care clinic. We are also glad that the reconstruction plans in Kaiserslautern and in Klingenstein for the so-called “combined building” pick up speed quickly.

New laws – new possibilities

The special challenge for me is not to lose sight of our good concepts for further integrating the different types of benefits or of the sector boundaries between the inpatient and the outpatient offers in community based



psychiatry and to always look for new ways together with the health insurance companies. The two latest laws, the GKV healthcare strengthening law (GKV-VSG) and the hospital structure law (KHSG), adopted only in November 2015, give the Pfalzkllinikum many possibilities to participate actively in the discussions about the new reorganisation of our services.

With our regional initiative “The Palatinate region braces itself/you – roads to resilience” we substantiate our ambition to be there for the people in the Palatinate region in the field of mental health and to act as a fair cooperation partner in the region.

2016

As already explained above, the new

financing system regarding our inpatient offers in psychiatry will cause high pressure on “bed and care-intense” services. This may have some advantages but it has also many disadvantages such as the call for even more beds. So, as a result, community-oriented services will be thinned and our efforts to invest in recovery and community will be made even more difficult. We would, however, not be we if we were not able to cope with these challenges and could not prove, by means of our regional commitment and our manifold activities in civic engagement, that we will realise OUR ideas and concepts in the times ahead.

I am looking forward to a networked, international, European, solidary and resilient year 2016.



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Citizens with mental illness are helped by tele-rehabilitation using video technologies

Citizens with mental disorder face a number of challenges returning to everyday life following discharge from psychiatric hospital. The citizens often feel insecure, anxious, and at risk of readmission rate to psychiatric hospital. In Denmark, municipalities are offering support services for citizens with mental illness in their recovery process after discharge from hospital. Municipal social workers visit the citizens in their home from one time a week to several times a day, talk

with them about feelings of insecurity and offer assistance in helping them structure their daily routine.

In 2013, the Danish municipality of Esbjerg began a research project focusing on tele-rehabilitation for citizens with mental illness, where video technology is used to facilitate improved dialogue between the citizens and their social worker. The aims of the research project are twofold: (1), to reduce readmission of the citizens to a psychiatric hospital, and (2), to

prevent worsening of symptoms by giving the citizens the possibility to communicate virtually with a team of social workers on a 24/7 basis.

In the United States, tele-psychiatry has been a part of routine care delivery for citizens with mental illness for years. In Europe, however, tele-psychiatry is still not integrated into routine care delivery, and little research has been performed. The research project in Esbjerg Municipality is one of the first initiatives within this field in Europe.



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“The preliminary findings from the project have shown positive results, and the next step will be to implement the system on a larger scale in Esbjerg Municipality during the coming years.”

The target group for the research trial are citizens diagnosed with depression, schizophrenia, paranoia and manic-depression who have been discharged from hospital. The citizens receive video technology installed in their

homes so that they can communicate with their social worker. Each citizen is assessed after having used the system for a period of 6-18 months. A total of 57 adult citizens have been included in the project: 30 females (mean age 35.3) and 27 males (mean age 39.7).

Preliminary findings from qualitative interviews with the citizens have shown that the video system had given the citizens a feeling of safety and security and helped them to develop new individual coping strategies to avoid admission to hospital. The citizens stated that via the video technology, they could get in contact with a social worker at any hour of the day, whenever they needed to talk about their feelings, heard voices or were having hallucinations.

Some citizens diagnosed with paranoia, however, found it difficult to stand directly in front of the web camera for communication with the social worker. Instead, they chose to stand next to the camera when communicating with their social worker.

The social workers reported that the video technologies have improved their collaboration and communication with the citizens with mental illness. The video technology has been easy to use, and they report having saved time on transportation. The social workers reported that they can now tailor their intervention on a more individual basis and provide higher quality support to those citizens with mental illness.

“The preliminary findings from the project have shown positive results, and the next step will be to implement the system on a larger scale in Esbjerg Municipality during the coming years,” explains Britta Martinsen, CEO of Social Services in the Municipality of Esbjerg.

Esbjerg Municipality have started to plan to scale up the pilot project. They plan to integrate the video technology into the daily work routine for the social workers so that it serves up to 150 citizens with mental illness.



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Climate change and human health: three truths

John Balbus, Senior Advisor for Public Health at the National Institute of Environmental Health Sciences, outlines the connection between climate change and human health in 3 stages...

The complex interactions between climate change and human health may be summed up as 3 truths: one inconvenient, one convenient, and one transformative.

The inconvenient truth: Climate change threatens to reverse decades of progress on global health – and to delay the gains we seek in the future

Climate change is affecting health around the world in multiple ways and is projected to have increasingly serious impacts on health as the planet warms further. Some areas are more susceptible to health impacts from climate change in the near term: for example, urban built environments in historically temperate areas do not have the infrastructure needed for heat waves; coastal infrastructure based on the sea levels of the 20th century will not necessarily suit the needs of the 21st. Health systems are best suited to prevent, detect, and respond to diseases in their current ranges and may be unprepared for shifts related to climate change. The health consequences range from heat stress and related illness to mental stress and related illness, from injuries to infections.^{1,2} The World Health Organization (WHO) has estimated climate change could result in an additional 250,000 deaths per year from just a subset of climate change related causes, even in a scenario in which continuous, sustained economic growth results in overall global health improvement.³

The convenient truth: Measures that achieve vigorous reductions in greenhouse gas emissions are likely to yield substantial and immediate benefits for global health

It is critical that the health sector not only be aware of the health impacts of climate change, but also the health impacts of the underlying causes of climate



change⁴ [cite Lancet series]. Pollution from the combustion of fossil and solid fuels is responsible for over 7 million deaths each year, primarily from contribution of particulate air pollution to respiratory and cardiovascular diseases. The growing global use of cars and motorcycles contributes not only to air pollution, but also to the myriad health consequences of physical inactivity. A recent International Monetary Fund white paper⁵ concluded that the health costs associated with air pollution from fossil fuel use constitute a hidden subsidy on the order of \$2.5trillion n globally – these costs do not disappear, but rather are absorbed by patients and the health systems that treat them. The IMF also found that pricing fossil fuels in a way that accounted for health and environmental costs could reduce the number of premature deaths from air pollution by more than 50%, as well as generate revenue equivalent to over 3% of global GDP. Recognition of the potential benefits to health from climate change mitigation prompted a recent Lancet Commission to conclude that climate change could constitute “the greatest global health opportunity of the century”.⁶

Transformative truth: Preventing disease leads to a healthier planet, populace, and pocketbook

Thomas Lovejoy has stated “The global change challenge will require transformative change in present systems and policies linked to global food supply, urbanisation, building designs, and sustainable development.” The health sector, built around the doctors’ pledge to “first, do no harm,” has an opportunity to lead the way in creating sustainable systems that prevent harm and protect health. What would such transformative change look like for the health sector? At its most basic, it could mean creating a culture of efficiency and waste reduction throughout the sector. Activities associated with health care facilities have been estimated to be responsible for 3% and 8% of national greenhouse gas emissions for the UK and US, respectively.⁷ More complex, but potentially more transformative, would be a redoubling of efforts to prevent non-communicable diseases (NCDs). Such efforts will require strong leadership and coordination among many sectors, including health, transportation, energy, urban planning, agriculture, and education. Internalising the health costs associated with fossil fuel combustion could help provide funds needed for this investment. The IMF estimated that eliminating fossil fuel subsidies could generate revenue roughly double current public health spending in emerging economies and 1.2 times current public health spending in low income countries.⁵ This investment could yield significant dividends for all of global society including a less erratic climate, a more active populace, a cleaner environment, and more sustainable and healthy communities. After all, the cheapest, greenest hospital is the one that never has to be built. And the healthiest person is the one who never has to become a patient. ■

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The gender dimensions of climate change and mental health

Recent participatory research from the Canadian North adds nuance to global literature on gender, climate change, and mental wellbeing...

Global Climate Change & Health Impacts

Climate change has been identified as the greatest threat to human health this century. It is anticipated that the impacts will have wide-ranging consequences globally, including increased risk, frequency, and distribution of foodborne, waterborne, vectorborne, and zoonotic diseases sensitive to climate factors; challenges to food security due to food shortages and agricultural losses; increased heat stress leading to early deaths or aggressive acts; increased morbidity and mortality due to extreme weather events; increased respiratory and cardiovascular disease due to changes in air quality; and wide-ranging impacts to mental and emotional health, including strong emotional reactions and psychological trauma, increased substance abuse, and increased suicide ideation and attempts.

The Gender and Climate Change Narrative

While research examining the gendered dimensions of global climate change is relatively new, the majority of the research is emerging from the global south, and is primarily focused on women working within an agricultural context. From this research, there is a generalized narrative that women are more vulnerable to climate change than men, and are likely to experience the impacts of a changing climate and environment on their health and wellbeing before men, and in a more acute and profound manner.



Portion of mural by Jonathon Cruz in Iqaluit, Nunavut

Image: © Anna Bunce 2013

Yet, recent research from the Canadian North is expanding this narrative.

Learning from the Circumpolar North

Inuit have been at the frontlines of global climate change, experiencing rapid changes in seasonal temperatures, leading to later freeze-up and earlier break-up of the sea ice, and overall declining sea ice coverage. The weather has also become increasingly unpredictable, with more frequent and extreme storms. As a result, travel is more dangerous, and many Indigenous populations are finding it increasingly difficult to travel safely to hunting grounds, feed their families, and maintain subsistence livelihoods and cultural practices, all of which have serious consequences on wellbeing. Many communities are also experiencing noticeable changes in wildlife and vegetation.

Nunatsiavut, Labrador, Canada:

The Labrador Inuit and their ancestors have been living on and surviving from the land along the North Coast of Labrador for thousands of years. Comprised of five coastal, remote, fly-in communities – Nain, Hopedale, Postville, Makkovik, and Rigolet – Nunatsiavut has a population of 2600, approximately 4% of the Canadian Inuit population. Over 120 Inuit participated in this research over a five-year period. Data was collected through interviews, surveys, focus groups, documentary film interviews, and digital stories.

Iqaluit, Nunavut, Canada:

Inuit have been living and travelling through the lands in and around Iqaluit, the capital of the Territory of Nunavut, for thousands of years. Iqaluit is the largest Inuit community in Canada, with a population of approximately 7000

people. 42 Inuit participated in this research through interviews and participatory photography.

What Was Shared: The Gender Dimensions of Climate Change & Mental Health

From this research, all who participated, whether men or women, agreed that being able to travel safely, reliably, and regularly on the land was essential for Inuit identity, culture, livelihoods, and wellbeing. As one Inuk explained, “People like to go out on the land to feel good. If they can’t go out on the land, they don’t feel like people.” Yet, due to gender norms and post-colonial labour division, it was primarily Inuit men who were most often travelling on the land, and who had maintained active connections to hunting, fishing, and trapping to sustain themselves, their families, their communities, and their culture.

With the changing weather patterns, the decreasing ice formation, and the fluctuating travel conditions, many men found themselves unable to get out on the land regularly, and were expressing strong emotions: anger, frustration, sadness, fear, grief, distress, stress, and depression. Many men also felt like they were losing their identities as Inuk men, as providers for their families, and as culture carriers, and were suddenly experiencing “empty time”, where they didn’t feel like productive members of their communities.

Many women also expressed these strong emotional reactions to losing time on the land, sharing that without being able to go off on the land, they didn’t “feel whole” and felt like a “piece of their body had been removed,” especially when traditionally-important activities such as berry-picking were being disrupted. Women, however, also articulated how worried they were

for the males in their family when they were travelling on the land, due to safety concerns with the changing ice and weather conditions. Many women also expressed concern for the mental and emotional wellbeing of males, due to the inability to practice a land-based lifestyle, and who were now “cooped up” in the house without other options. This often led to household stress and increased family arguments and tensions, following a “he’s stressed, she’s stressed” pattern.

Implications for Policy and Practice: Adding a Gender Lens to Climate Change & Mental Health Actions

While Inuit women still expressed many ways in which climate change was impacting their mental health and wellbeing, the overall impacts of climate change on Inuit women were often mitigated based on their contemporary roles, which typically involved earning a living through wage-based employment, rather than land-based employment. In contrast, middle-aged adult males, who were active hunters and trappers, and relied on stable weather and climate conditions to travel, feed their families, and support their cultural identity as Inuk men, often experienced the largest mental and emotional impacts.

These findings are adding nuance and variance to understanding the ways in which the mental impacts of climate change will be enacted and experienced along gender lines within the Circumpolar North. While many global recommendations suggest focusing on women and children when designing protective and preventative policies related to climate change and health, this research indicates that in the Circumpolar North – or indeed, in areas where males primarily rely on the land for identity, wellbeing, and

survival – specific policies and programming should also be targeted towards men. This is not to say that women and other populations, such as children and the elderly, should be excluded; rather, it is to highlight the importance of recognizing and exploring varied gender experiences and of expanding global narratives and recommendations, particularly related to mitigating the mental health impacts of a changing climate and environment.

Research Funding

Health Canada’s Climate Change & Health Adaptation in Northern First Nations & Inuit Communities Program | Nasiwik Centre for Inuit Health & Changing Environments | Canada Research Chairs Program | Canadian Institutes for Health Research (CIHR) | International Development Research Centre | Fonds de la recherche en santé Québec | Northern Scientific Training Program | Climate Change Adaptation Research Group | Nunatsiavut Department of Health & Social Development | Cape Breton University | McGill University



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Health research – the Canadian way

Adjacent Government looks at how health research can play a pivotal role in preventing major diseases throughout the country...

Over the decades we have changed the way we live, which can have a major impact in our health. For example new technologies we use and the environment can all impact our future health outcomes. New technologies such as mobile phones have evolved and research over the years has detailed the health implications of long-term use.

Canadians are considered amongst the healthiest in the world. However, like every country they have their fair share of health burdens. For example, chronic diseases like diabetes, cancer, arthritis and asthma are common health problems across Canada. The Public Health Agency of Canada reported in 2008/09 almost 2.4 million Canadians were living with diabetes. However, 20% of diabetes cases remain undiagnosed. Social, economic and lifestyle factors can have a significant impact on the distribution of type 2 diabetes. ¹

Currently 14.8% of the population in Canada (20+ year) has 2 or more chronic diseases concurrently and life expectancy at birth is said to be 83 years. Approximately 1 in 4 adults have high blood pressure and a massive one half (51.6%) of Canadians have a chronic disease. ²

[The Public Health Agency of Canada](#) is responsible for promoting and protecting the health of Canadians through leadership, partnership, innovation and action in public health. When referring to public health it means the entire population, and through research programs and services, the Agency aims to ensure Canadians live healthy lives with reduced disparities.

In order to help prevent these issues, the Centre for Chronic Disease Prevention: [Strategic Plan 2016-2019](#) Improving Health Outcomes – A Paradigm Shift aims

to highlight actions being taken in order to ensure Canadians live longer and healthier lives.

Reducing the risks is integral, as well as understanding the importance of risk management when looking at health issues such as epidemics and reducing the burden of chronic diseases can help to ensure decision makers have the right policies in place at the right time. However it isn't always easy to know when epidemics might hit, however diseases like influenza are seasonal and plans can be put in place to ensure measures are taken to prevent it from becoming a problem.

The Strategic Plan also aims to understand the risk factors involved with developing these chronic diseases. In adults (18-64) these include:

- Positive mental health;
- Adequate sleep;
- Nutrition;
- Injury;
- Physical activity;
- Sedentary behaviours;
- Alcohol;
- Drugs;
- Tobacco.

Through encouraging healthy living and promoting positive behaviour change the Centre for Chronic



Disease hope to help Canadians maintain or improve their health and prevent injury. Over the next 3 years the Centre will work in collaboration with partners beyond those traditions to public health and develop initiatives that contribute to modernised public health approaches in healthy living and chronic disease and injury prevention.

“Canadians are considered amongst the healthiest in the world. However, like every country they have their fair share of health burdens. For example, chronic diseases like diabetes, cancer, arthritis and asthma are common health problems across Canada.”

Actions such as these can only have a positive impact on the health of citizen across the country. Research by the Canadian Institutes of Health Research (CIHR) is also integral in making a difference. Within the CIHR is the Institute of Population and Health (IPPH), where research is targeted around: health promotion; health determinants; identification of health advantage and health risk factors; methods of practice; environment and health; and, public and community health issues.

The CIHR distributes federal health research dollars through 13 virtual institutes that champions specific aspects of health. The IPPH funds projects that aim to improve population health and reduce health inequalities.

Health research plays a pivotal role in understanding a number of healthcare problems. As well as developing treatments it can also help to understand prevention methods needed. Both the Public Health Agency of Canada and the CIHR lead the way in ensuring the population of the country are moving towards tackling the health burdens. ■

1 <http://www.phac-aspc.gc.ca/cd-mc/publications/diabetes-diabete/facts-figures-faits-chiffres-2011/chap1-eng.php>

2 <http://www.phac-aspc.gc.ca/cd-mc/ccdp-strategic-plan-2016-2019-plan-strategique-cpmc-eng.php#factors>

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Understanding, communicating, and managing risk

The University of Ottawa has created two organizations – the McLaughlin Centre for Population Health Risk Assessment and Risk Sciences International – that together provide a critical combination of core research, professional services and product development to meet today’s risk decision-making needs.

This work builds on a long history of increased understanding of health, environmental, technological and other risks that we face on a daily basis.

Identifying feasible and cost-effective risk management solutions and effectively communicating risk to the public and other stakeholders are critical to effective risk management in the 21st century.

Evolution of Risk Science

Historically, the evolution of risk science can be traced back several decades. The first comprehensive framework for risk assessment and management was put forward by the US National Research Council, in the landmark 1983 publication, *Risk Management in the Federal Government: Managing the Process*. Over this same period, the understanding that the health of populations depended on multiple biological, environmental, social, and other determinants emerged within the field of population health.

Building on these foundations, an integrated framework for risk management and population health was developed within the McLaughlin Centre following its establishment at the University of Ottawa in the year 2000.

Risk Sciences International (RSI) was subsequently incorporated in partnership with the University of Ottawa in 2006 to provide advanced services and solutions in risk science to public and private sector clients.

McLaughlin Centre for Population Health Risk Assessment

Over the last fifteen years, the McLaughlin Centre has provided an academic focus for the advancement of risk science in Canada.

The Centre has contributed to the understanding of animal and human prion diseases through its participation in a federally funded \$35 million Network of Centres of Excellence (NCE; PrionNet Canada) from 2005-2012, including mad cow disease and its human equivalent, variant Creutzfeldt-Jacob disease.

As part of a \$50 million NCE (Carbon Management Canada), the Centre subsequently developed an integrated risk management framework for carbon capture and storage. This work incorporated best practices in risk science to ensure that this technology is deployed in a safe and effective manner.

The Centre is currently leading a team of 21 Canadian investigators in the completion of systematic reviews of the factors affecting the onset and progression of 14 important neurological diseases. This work was done as part of a \$15 million National Population Health Study of Neurological Conditions sponsored by the Public Health Agency of Canada to help address the public health burden of



Figure 1: RSI Areas of Expertise

neurological disease that is on the rise in aging populations.

Risk Sciences International

Since its inception in 2006, RSI has worked with over a hundred of public and private sector clients around the world, providing a broad range of expertise in risk science to meet client needs for risk solutions. RSI’s services facilitate the understanding, communication, and management of risk across diverse risk spheres (Figure 1).

RSI recently played a leading role in the development of a framework for the next generation of risk science as part of the US Environmental Protection Agency’s NexGen initiative (Figure 2). The NexGen framework provides a comprehensive platform for addressing potential human health risks associated with exposure to environmental agents by incorporating new principles and practices in risk science. Key components of the framework include the use of high-throughput in vitro testing and computational toxicology to rapidly

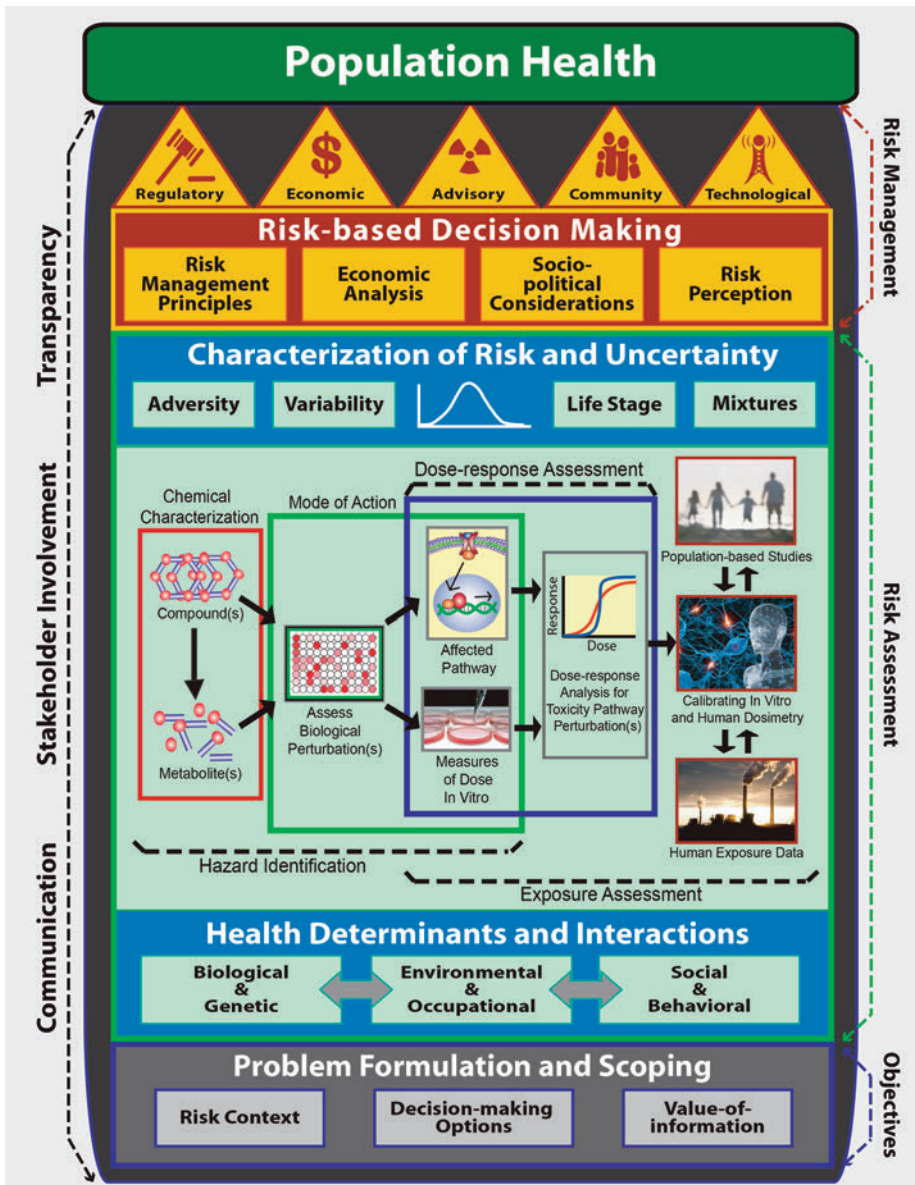


Figure 2: A Framework for the Next Generation of Risk Science

assess the potential risks of the tens of thousands of chemical substances that may be found in our environment.

Over the last decade, RSI has also worked with the US Food & Drug Administration to develop an online risk assessment tool known as FDA-iRISK. This tool is now widely used as a decision-support tool for microbial and other hazards present in the food supply in both the US and Canada.

Future Directions in Risk Science

Working together in a unique partnership, the McLaughlin Centre and RSI are well positioned to play a leading role in the advancement of the theory

and practice of risk science, both within Canada and internationally.

The Centre is currently involved in a 15-country study of potential health risks of mobile phone use among children and adolescents led by the University of Barcelona. This important research will fill an important data gap in the wireless telecommunications sector, with funding from a university-industry partnerships program administered by the Canadian Institutes for Health Research.

RSI is currently deploying a comprehensive suite of risk decision tools for drug safety evaluation in partnership

with the Institute for Safe Medicines Practice and Cerner Corporation in the US. A key component of this initiative is the use of electronic health records from large patient populations to better understand the use, safety and effectiveness of pharmaceutical products.

The overarching goal of these activities is to contribute to the assessment and management of risk on a local, national, and international scale, using the best available techniques in risk science to effectively understand, communicate and manage risk.



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John Laughlin, Aerospace Programme Lead at Innovate UK answers Adjacent Government's questions regarding investment in the aerospace industry and how Innovate UK play an integral role in this...

UK businesses are well placed to take advantage of growing global demand for faster, quieter and greener aircraft. As the biggest aerospace industry in Europe and second largest in the world, the sector makes a major contribution to economic growth and employment in the UK.

In 2013, it employed 239,000 people, many of them highly skilled engineers and technicians. They and thousands of other workers in the supply chain helped to generate nearly £28bn in turnover, 90% of which is in export business. New global opportunities in a total civil aerospace market of \$5 trillion include a need for 27,000 aircraft of 100-plus seats, 24,000 business jets 40,000 helicopters by 2033.

Innovate UK helps the UK aerospace industry in 3 ways; by connecting people and joining up the innovation landscape we help businesses draw upon expertise

and experience in our world class science base and industrial supply chain, in order to come together to exploit opportunities for the global competitive advantage and economic benefit of the UK.

“Focusing on agile, highly innovative companies – often SMEs, that can adapt quickly and create high quality solutions, allows these innovations to be adopted quickly within the supply chain and be fed up to the larger industry players.”

Through our Highly Innovative Technology Enablers in Aerospace ([HITEA](#)) funding programme, we aim to support breakthrough advances in technology that address solutions to key aerospace industry challenges. By investing in the next generation of aerospace technology solutions businesses in the UK will be able to support new aerospace platforms and be able to

enhance the competitiveness of existing products or services.

By being the delivery partner for the £3.9bn [Aerospace Technology Institute](#) (ATI) aerospace programme we work closely with the ATI, government and industry to ensure maximum utilisation of the programme budget, managing the project portfolio and delivering the highest quality projects to maximise the return for the UK economy.

“At Innovate UK we are also in a unique position as we can base our investments not just on what is known in the aerospace sector but on our detailed knowledge of developments in other industry sectors.”

How will Innovate UK’s recent £10m investment in the sector help to ensure the UK maintains its position as a world leaders in aerospace technology?

The recent investment of £10m in aerospace technologies was made through the HITEA programme with the prime purpose of supporting technologies that can help position and grow the UK economy. The investment was split into 2 funding streams. The first was to stimulate completely new ideas and concepts – game changing technologies – that have the potential to fundamentally disrupt existing products and services creating a unique technology propositions that can be embedded in the UK supply chain. The second was looking at technology solutions to key aerospace challenges such as those looking to develop new, novel and flexible manufacturing techniques, enhanced materials for the harsh environment of aerospace, reducing the cost of ownership, integrating component life diagnostics into aircraft, helping manufacturers to continue the move toward intelligent electronic systems replacing part hydraulic systems also looking to stimulate innovation in the maintenance and repair marketplace.

Focusing on agile, highly innovative companies – often

SMEs, that can adapt quickly and create high quality solutions, allows these innovations to be adopted quickly within the supply chain and be fed up to the larger industry players. Supporting supply chain innovation in this way helps to anchor the technologies to the UK, building the supply chain and often establishing a pipeline of innovation.

Our investment was designed for UK businesses to accelerate the exploitation of innovations, many of which originate from knowledge generated by the UK’s world class science base. By supporting these early stage ideas (often from aligned scientific disciplines, such as manufacturing, advanced materials, aerodynamics and fluid dynamics) and stimulating channels for appropriate knowledge flow between the science base and businesses in a manner that balances relevant technology push with market pull and industrial need through to commercialisation.

What role does Innovate UK play in the aerospace innovation landscape?

Innovate UK is a key stakeholder on the innovation landscape. We aim to reduce the lead time for the commercialisation of highly disruptive technologies by joining up the often complex innovation landscape to give companies the right help at the right time. Our unique position in terms of access to small and medium enterprises, the research base and our multi-disciplinary activities across many UK sectors, coupled with the Catapult centres and Knowledge Transfer Network enables a far reaching innovation support structure.

We have developed a programme called HITEA (Highly Innovative Technology Enablers in Aerospace). The programme will accelerate the commercialisation of highly innovative technologies and was developed with key stakeholders to ensure an appropriate focus on the research priorities needed to support future development within the civil aerospace sector. These include the Aerospace Growth Partnership, the ATI and its Technology Advisory Group, the Engineering

and Physical Sciences Research Council and a cross section of key industry stakeholders from large primes through to highly innovative SME's.

The programme has been designed to complement (and sit between) both support provided by the Engineering and Physical Sciences Research Council (EPSRC) and the larger scale support provided by the Aerospace Technology Institute (ATI), by encouraging companies to refine their business plans, to give particular thought to their routes to market and their wider exploitation plans and to collaborate with other companies where partnership would be of benefit.

“Innovate UK is a key stakeholder on the innovation landscape. We aim to reduce the lead time for the commercialisation of highly disruptive technologies by joining up the often complex innovation landscape to give companies the right help at the right time.”

The programme takes on high risk projects that have a very high potential return on investment, de-risking the technology and getting it ready for either early commercial application, or further investment, via the ATI and European investment programmes such as Horizon 2020 and Clean Skies. At Innovate UK we are also in a unique position as we can base our investments not just on what is known in the aerospace sector but on our detailed knowledge of developments in other industry sectors. With a project portfolio of over 5000 funded projects, we can map trends across all industries and connect companies from these sectors to find new ways of solving challenges. For example our investments in manufacturing, advanced materials, resource efficiency, digital, photonics electronics and sensors – along with recent advancements in the automotive sector have all influenced the outcomes of the investment. We also have an emerging technologies programme and the quantum technologies and graphene are starting to find potential applications in the aerospace sector.

This works both ways, of course, with aerospace derived technologies being applied to other areas.

Our other role is as delivery partner to Department for Business Innovation and Skills (BIS) and the Aerospace Technology Institute (ATI) whose programme has a combined investment worth £3.9bn. As delivery partner we manage the portfolio of projects, engaging from the technical assessment stage where we ensure only the highest quality projects are funded, through managing the health of the portfolio and through to commercial exploitation of the technology. We work to manage the performance of the portfolio, ensuring successful delivery of the projects and ensuring that public money is used efficiently and effectively to sponsor economic growth.

How does innovate UK work with organisations such as the Aerospace Technology institute (ATI) to help the UK maintain its position in this sector and develop key new technologies to help it grow further?

In addition to acting as the delivery partner for the ATI programme, we feed the ATI with the latest knowledge and advancements from other sectors, potential projects, and potential technologies and help connect the landscape with regards other companies and organisations. We focus much of our support for technology development through the HITEA programme, but we also utilise our Knowledge Transfer Network (KTN) in order to connect companies to share knowledge and collaborate on projects, our Horizon 2020 EU National Contact Points our Enterprise Europe network and development of skills through our Knowledge Transfer Programme and our dedicated programmes to support SMEs in the sector. ■

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Materials characterisation in support of power generation

Mechanical characterisation of high performance materials has been a long standing area of expertise at Swansea University. A succession of academics has promoted an intimate relationship with the power generation industry, in particular working on alloys aligned to gas turbine technologies. A world renowned research group focussing on high temperature creep, fatigue and associated modes of operation has developed over the years, supported by world class mechanical test facilities.

This provenance has culminated in the Institute of Structural Materials (ISM), recently awarded Major Research Facility status by Swansea University and housed in a purpose designed, bespoke facility on the new Bay Campus to the east of the city. Completed in 2014, the ISM Building houses a mix of academic and commercial activities. In 2009 the University incorporated a wholly owned "spin out" company – Swansea Materials Research & Testing Ltd (SMaRT) sitting under the ISM umbrella, supplying design quality mechanical property data to the wider structural integrity sector. SMaRT now delivers mechanical testing and understanding in support of both commercial and research contracts across campus (for an expanding customer/sponsor base) and formed a key entity at the heart of the University's strategic plans to establish a 'Science and Innovation

Campus' in Swansea. The combination of academic research supported by an ISO 17025 accredited test facility now delivers a unique model to industry.

Rolls-Royce have placed significant onus on SMaRT, to act as an approved supplier for mechanical property understanding, in competition with the wider commercial test house community, at technology readiness levels (TRL) 0 to 4. SMaRT test capabilities deliberately interface with the state of the art Rolls-Royce facility opened in Berlin, Germany in 2010 (Mechanical Test Operations Centre – MTOC) with MTOC retaining the focus on in-service support and materials database generation at higher TRL levels.

The Rolls-Royce University Technology Centre in Materials, also based within the ISM, results from the links forged with this major multi-national enterprise since the early 1970s. Research projects span traditional research contracts, typically based over a two or three year period, to reactive short term consultancies – often formulated at the shortest of notice and aimed at understanding in-service gas turbine operations. Long term research interests have provided a fundamental understanding of microstructure-property relationships in titanium, nickel, advanced steels and metal or ceramic based composites. Stemming from this materials knowledge, lifing methodologies have been developed to predict the performance of compo-



nents under arduous service conditions. The UTC activities currently support a team of six academics, fifteen research officers, eight support staff and thirty plus EngD/PhD students.

The twin requirements of sustainability for existing metal resources and the development of novel metallic systems for future application form the heart of the EPSRC / Rolls-Royce Strategic Partnership in Structural Metallic Systems for Gas Turbine Applications, in collaboration with the Universities of Birmingham and Cambridge. The Strategic Partnership was awarded subsequent to discussions with the UK government, recognising the need for increased support for traditional metals based R&D on the national stage. Uniquely, the scheme combines postdoctoral research programmes

spanning a ten year horizon with a doctoral training partnership (DTP) to develop high calibre materials engineers for the UK metals community. The Partnership encourages inclusivity from other research sponsors. To that end, Swansea University is extending longstanding links with Timet (Europe's largest processor of titanium alloys) and the TWI NDE Validation Centre (Wales).

“It is estimated that the deliverables from this combined portfolio should contribute to a 1% improvement in specific fuel consumption in Rolls-Royce civil engines, yielding a reduction of between 500 and 1000 tonnes of CO₂ per aircraft per year within the next ten years, depending upon aircraft configuration and loading.”

All Partnership projects address topics of immediate or long term industrial relevance for the aero-engine, land and marine power generation sectors. Students are often embedded in the sponsoring company, soaking up the day to day experience of a practising engineer. Research Engineers benefit from bespoke training incorporating case studies from our industry facing research plus professional and management training. This offers significant advantages when faced with gaining long term career employment. Numerous examples are available where students have progressed to senior positions not only within Rolls-Royce, but also Airbus and Timet, taking on International responsibilities after a relatively short timescale.

The entire research programme impacts upon the sustainable use of structural materials. Specifically, our

core interests address the internationally agreed “ACARE 2020” and “Flightpath 2050” targets for more efficient gas turbine operation with accompanying reductions in fuel consumption and greenhouse gas emissions. This will be achieved by engine designs that operate at higher temperatures compared to the existing fleet, thus pushing the capability of existing metallic systems to their structural limits. The characterisation of metallic systems fabricated by advanced processing techniques is central to our interest. In addition, novel ‘Vision 20’ alloys are also under investigation – a new generation of materials for potential entry into service within 20 years (e.g. alloys beyond polycrystalline or single crystal forms of nickel currently used as the basis for high pressure turbine operations).

Our ongoing portfolio in terms of power generation materials includes contributions to large scale initiatives funded through Innovate UK and the Aerospace Technology Institute (ATI), including:

- SAMULET II (Strategic Affordable Manufacturing of UK Leading Environmental Technologies):
 - Advanced Repair Technologies (Cost Efficient High Integrity Blisk Repair).
- SILOET II (Strategic Investment in Low Energy Turbines):
 - CMC and High Temperature Technologies;
 - High Temperature Nickel Alloys;
 - High Temperature Capability – Compressors and Discs;
 - High Temperature Turbine Technology and Demonstration.

All of the above projects are aimed at improving manufacturing processes, increasing the material “fly to buy ratio” and to increase gas turbine efficiency. It is estimated that the deliverables from this combined portfolio should contribute to a 1% improvement in specific fuel consumption in Rolls-Royce civil engines, yielding a reduction of between 500 and 1000 tonnes of CO₂ per aircraft per year within the next ten years, depending upon aircraft configuration and loading.



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Space is anything but empty

Sean Murphy from the Defence Science and Technology Laboratory (Dstl) highlights the role space plays in defence technologies and capabilities...

Hollywood blockbuster films such as “Mission Impossible” and “Enemy of the State” have instilled, within the general populace, awareness of military capabilities such as “spy” satellites and satellite communications. This has generated a commonly held view that space is a technologically exotic and expensive environment with little relevance to our everyday lives. Yet space enabled capabilities make a massive contribution to everyone’s daily life; we watch satellite television; we use Global Navigation Satellite Systems such as GPS to get from A to B; our financial transactions are synchronised using timing signals mostly derived from space based atomic clocks; we use weather forecasts derived from meteorological satellite data, and we monitor land usage, agriculture and disasters with the aid of Earth Observation satellites. Outside of the civil sector, it has been stated by Philip Dunne, Minister of State for Defence Procurement at the Ministry of Defence, that “more than 90% of the platforms and systems within the UK military equipment programme are dependent on space to some degree”, whether it be in the form of Position Navigation & Timing (PNT), Satellite Communications, or Intelligence Surveillance and Reconnaissance (ISR).

The importance of space enabled capabilities to the security of the UK was recognised by the publication during 2014 of the UK National Space Security Policy (NSSP) which identified the following 4 objectives:

- To make the UK more resilient to the risk of disruption to space services and capabilities, including from space weather;
- To enhance the UK’s national security interests through space;

- To promote a safe and more secure space environment;
- To enable industry and academia to exploit science and grasp commercial opportunities in support of national space security interests.

Historically, outside of satellite communications and satellite broadcast television, it has been government investment that has driven the development of space capability, whether for defence and security, or for scientific and civil applications. In recent years we have seen this landscape changing, with new entrants (frequently funded by venture capital) developing new products independent of government investment. For example Skybox Imaging is building a constellation of satellites to provide motion imagery from space, and the largest constellation of Earth Observation satellites has been built and operated by Planet Labs with the intent to have more than 100 satellites on orbit, each with a mass of approximately 4 kg. The launcher market is also evolving with commercial launch providers such as SpaceX developing launch vehicles with re-usable first stages. Taking developments such as these together, we are seeing many of the barriers to access to space coming down.

As barriers to access fall the number of manmade objects on orbit, both satellites and debris, continues to grow leading to an increased risk of collision and the generation of more debris. In addition, the NSSP identifies the potential hazard to capability from “increasingly capable foreign counter-space programmes” leading to the sense that space is increasingly congested and contested.

The Space Science and Technology (S&T) Programme



within the Defence Science and Technology Laboratory (Dstl) is focussed on ensuring that UK defence is best prepared to exploit the opportunities arising from the changing space landscape as well as mitigating risks and hazards as they emerge.

To exploit opportunities, low Technology Readiness Level (TRL) science and technology space research is being carried out via Dstl's Centre for Defence Enterprise through 13 individual contracts with a combination of industry and academia to develop high risk but high potential payoff technologies. Higher TRL development is being progressed through the development of engineering model sub-systems all the way up to joint-funded on-orbit demonstrators. All of this is underpinned by the philosophy that we should leverage, and not attempt to duplicate, the considerable investment already being made by industry and elsewhere in government.

The Space S&T Programme is contributing to the mitigation of risks and hazards through the

development and assessment of Space Situational Awareness technologies and techniques as well as the architectural and system challenges of an endeavour that is global in scope. It is also supporting the enhancement of the Space Operations Coordination Centre at RAF High Wycombe identified in the 2015 Strategic Defence and Security Review.

Defence depends on the capabilities that space enables. Through science and technology, Dstl is helping to ensure that defence continues to be able to depend on these capabilities into the future. ■

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Sean Murphy

Space & Sensing Systems

Defence Science and Technology Laboratory (Dstl)

www.gov.uk/dstl

www.twitter.com/dstlmod

Full steam ahead: STEM, engineering and Brunel save the day!

Clair Prosser, Press Officer at BSRIA highlights how the organisation are hoping to inspire engineers of the future...

Engineers changed the world and turned imagination into reality. There isn't a facet of the modern world that hasn't been touched by engineering. Engineers – and indeed those who take up the STEM subjects – are the wealth creators of the world.

In this respect, BSRIA was very excited that Isambard Kingdom Brunel came out top in BSRIA's chance to 'vote for your favourite and most influential engineer' competition. Brunel is a fine example of how engineering (or STEM) makes working in the 21st century possible. Without his glorious work, there would be no Paddington station, no Thames Valley knowledge economy – the Powerhouse of the UK – trains to the tourist hotspot of Bath or to south Wales would not be possible. Reading station's recent £850m upgrade – where you can take a train to virtually the whole of the UK – wouldn't exist.

To coincide with last year's 60th anniversary, BSRIA launched its INSPIRE commemorative publication which looks at 120 engineers of the past and present to show their achievements and the great impact they've had on the industry and the world. BSRIA narrowed down the engineers to a list of 15.

Brunel was the outstanding winner with 35% of the vote. Leonardo Da Vinci came second with just under 17% and joint third were Tim Berners-Lee, Bill Gates and Alan Turing. Voting closed on New Year's Eve.

Isambard Kingdom Brunel (1806 – 1859) was a British civil and mechanical engineer who is considered by many to be one of the greatest figures of the Industrial Revolution. He undertook many projects, building things such as dockyards, a series of steamships, numerous tunnels and bridges – including the Clifton

Suspension Bridge – and, of course, the Great Western Railway.

Julia Evans, Chief Executive, BSRIA, said: "We are delighted Brunel received the most votes. He is clearly one of the most ingenious and prolific figures in engineering history, one of the 19th century engineering giants and one of the greatest figures of the Industrial Revolution who changed the face of the English landscape with his groundbreaking designs and ingenious constructions. His designs revolutionised public transport and modern engineering.

Though Brunel's projects were not always successful, they often contained innovative solutions to long-standing engineering problems. During his career, Brunel achieved many engineering 'firsts', including assisting in the building of the first tunnel under a navigable river and development of SS Great Britain, the first propeller-driven ocean-going iron ship, which was at the time (1843) also the largest ship ever built.

Brunel set the standard for a well-built railway, using careful surveys to minimise grades and curves. This necessitated expensive construction techniques and new bridges and viaducts, and the 2 mile-long Box Tunnel between Chippenham and Bath. Brunel is a fantastic advocate for engineering and, indeed, the nature of STEM which is about pushing boundaries and making the impossible possible. STEM has changed the way we work, travel, heal and enjoy life. The advancing of the human race has always depended on the bright minds willing to focus their energy on engineering ideas.

Engineering and scientific experimentation is an invaluable skill, alongside the robust nature of an investigative style which tolerates and builds on both

success and failure. Perseverance is failing 19 times and succeeding the 20th. Brunel is a splendid example of this attitude.”

Leonardo da Vinci is best known for his world famous artworks, but he was actually an inventor and engineer. While many of his inventions were far-fetched, many of them were capable of performing their desired function. Some of his more practical designs included: hydraulic pumps, reversible crank systems and finned mortar shells.

Some of his designs, such as giant crossbows and a parachute, have actually been constructed and tested with a degree of success.

INSPIRE raised the question of why are STEM subjects important? What does engineering mean for you? Why does technology matter? There is one answer to those three questions which is quite simply ‘everything’. History has shown that those who pursue science arguably make the biggest impact to the world; incredible minds provide us with incredible ideas we once might have thought of as unbelievable but are now ingrained in our society.

The BSRIA INSPIRE project is working with local schools, national and local politicians and the media to promote STEM and change its perceptions.

The choices were:

- Tim Berners-Lee
- Katherine Blodgett
- Isambard Kingdom Brunel
- Willis Carter
- Marie Curie
- Leonardo da Vinci
- Michael Faraday
- Rosalind Franklin
- Bill Gates

- George Stephenson
- Nikola Tesla
- Alan Turing
- James Watt
- Frank Whittle
- Steve Wozniak

BSRIA's INSPIRE publication, researched and designed by sixth form student Jason Finch, commemorates the achievements of STEM and celebrates the impact it's had on the world. By featuring 120 of notable past and present engineers BSRIA hopes the book inspires the next generation by showing them what they're capable of.

Engineering is an incredibly flexible profession and has an entry route to suit everyone. BSRIA – and many other engineering organisations – take on students for work experience every year. ■

If you want to get involved, visit:

www.gov.uk/topic/further-education-skills/apprenticeships

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Implementing Bioeconomy with Electrobiorefinery

Food, chemical and industrial sectors are challenged with the growing population, increasing longevity and quality of life. In consequence, the demand for fossil energy sources, agricultural land and drinking water what will lead to irreversible changes in climate with unpredictable consequences. A recent declaration of G7 leaders that in 2100 all major economies are intended to operate free of fossil fuels requires new solutions. A possible direction to sustainably address this challenge is increasing the efficiency of current processes and to replace fossil energy sources by renewable biomass resources.

The substitution of fossil-resource-derived chemicals and fuels with biomass for the production of food, platform chemicals and fuels is known as bioeconomy. A basic productive unit in the bioeconomy is *biorefinery*. Bringing biorefineries to practice is expected to contribute to low carbon economies, by production of chemicals, energy and jobs without using fossil fuels. The design and implementation of a biorefinery depends on a large number of factors, including availability of feedstocks, advances in biomass production and processing technologies, environmental impacts and socio-economic conditions.

Energy efficiency is a key factor for bioeconomy and decarbonisation success

Despite the long history of biomass use by humans, biomass processing and converting technologies are mostly

traditional and not efficient in terms of outputs and energy consumption. Therefore, fossil sources are often preferred for synthetic chemicals and energy production. During last centuries, fossil fuels based technologies for electricity generation achieved high efficiency, e.g. ~ 35% for oil and coal power stations and ~ 60% for combined heat-electricity processes. However, biomass based processes are fundamentally less efficient than fossil fuel based sources, as the efficiency of the solar energy conversion to chemical energy by photosynthesis is 5% at most. However, given the advantages of biomass in terms of product versatility and local and global availability, there is a strong motivation to develop new processes and technologies that will boost the energy efficiency of biorefineries.

One type of these new technologies is based on pulsed electric fields (PEF). First developed in the USSR in the 40ies and 50ies and then in Europe in the 60ies of last century for oil, juice and phytochemicals extraction and microorganisms inactivation, tremendous progress in fundamental understanding on PEF impact on cells, development of new processes and technologies suggests that PEF can become an essential tool for energy efficient biorefineries, i.e. *electrobiorefineries* (Figure 1).

How pulsed electric field processes work on biomass?

In 1972, Neumann and Rosenheck reported first observations of transient permeability changes in the vesicle

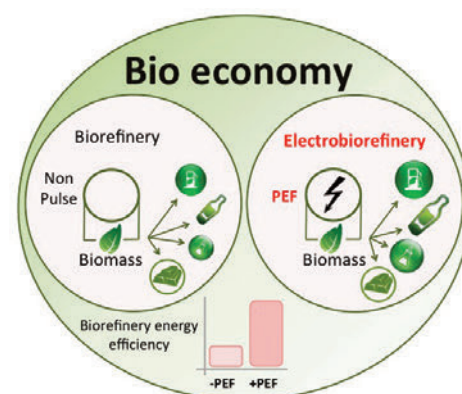


Figure 1: Electrobiorefinery improves the energy efficiency of biomass processing

membranes as a consequence of external electric field impact. In recent decades this observation led to understanding of cell membrane electroporation phenomena. Electroporation is already used in medicine for tumor treatment, in basic molecular biology for gene introduction into cells and in food industries for disinfection and phytochemicals extraction. The unique property of electroporation technology, to affect cell membranes selectively and non-thermally. This selective targeting of cell membrane opens applications of this technology for sustainable biorefinery.

Biorefinery processes that already benefit from electroporation based technologies

Electroporation technologies are already used in biorefinery applications such as feedstock development, biomass dehydration and extraction of high value and energetic products. Genetic modifications of microalgae and plants have been done by transferring the genes inside the cells using electroporation. In dehydration, one of the most energy intensive processes in biomass processing, electroporation



Figure 2: Industrial test of PEF (10t/hour) in sugar beet factory

pretreatment increases diffusion of water and vapor, thus reducing the energy and processing time required for biomass drying. For example, the time required for drying energy crops in an oven could be reduced by a factor of 2-3 compared to material not electroporated, i.e. not treated by PEF.

PEF provides a new and scalable technology for extraction of phytochemicals from biomass for energetic use. Lignocellulosic biomass from terrestrial plants, energy crops, and crop residues and macroalgae exhibit strong potential for biofuel or biogas production. Energy-efficient PEF-assisted recovery of value-added compounds, e.g. proteins, lipids and phenolic compounds will boost the economic efficiency of these biorefineries. Due to its fractionating abilities, PEF enables energy efficient subsequent recovery of minerals, lipids and proteins from microalgae. For instance, after PEF treatment and separation of the water-soluble fraction, the lipid yield from the residual fraction was 3-4 times higher, compared to untreated samples,

recovering more than 80% of stored lipids on average. Moreover, electroporation can accelerate hydrolysis steps and digestion during biogas production from dedicated biomass and waste.

How electroporation technologies can transform the biorefineries?

Electroporation based technologies have been very successful in the medical applications, transforming the fields such as gene therapy, DNA vaccination and cancer treatment. They are a part of every biology lab where they are used for genetic modifications of organisms. On lab scale, electroporation technology shows promising results for multiple biorefineries applications. Next step will be the industrial implementation. Biorefineries today are complex systems that integrate multiple technologies for agriculture, aquaculture and biomass processing. Integrating PEF system into existing facilities is a technological and economic challenge. However, as it has been demonstrated in the sugar industry, where up to 10 tons/hour PEF systems exist (Figure 2),

this integration is possible when justified. Future research on pilot scale biorefinery PEF units will provide detailed answers about the energetic, water and resource benefits of the processes that use electroporation technologies in biorefinery applications.

The concept electrobiorefineries was developed within the European Cooperation in Science and Technology framework – COST Action TD1104. COST Action TD1104 is now in its 4th – final year and has organised in September the 1st World Congress on Electroporation in Portorož, Slovenia attended by 400 participants from 42 countries. The 2nd World Congress is already announced for September 24 to 28, 2017 in Norfolk, Virginia, USA.

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It's all around us – Heterocyclic chemistry

No surprise that the public interest is readily attracted through the media to the latest fashions in science and it's good that there is a continual stimulus of discoveries and inventions to whet the practical and intellectual appetites. Behind all the innovations the basic rules of the chemical and physical sciences still apply governing what will work and what won't. It's the skill and imagination of the scientist and technologist that brings things together to create innovation. Or in the case of biology, it's time and evolution that work together. When I look out of my office window I see objects from both nature and technology: trees, flowers, painted objects, dyed banners, for example. I've picked or implied colours because colour is the visible manifestation of one of the most important branches of chemistry; scientists call it *heterocyclic chemistry*. Basically, it's defined as the chemistry of compounds containing atoms joined in rings, mostly with 5 or 6 atoms, most of which are carbon but others are nitrogen especially, oxygen, sulfur, or phosphorus and sometimes metals and other elements. I've worked in heterocyclic chemistry all of my research career, from PhD onwards and for me, *heterocyclic compounds make things happen*.

A lot of other people think so too. One source of evidence for this assertion is the publication of patents. The international patent offices' databases provide information on published applications. Using the subject code 'C07D' for Heterocyclic Chemistry we can see from the European Patent Office database that

between 50,000 and 60,000 patent applications concerning heterocyclic chemistry have been published each year for the past 10 years. The World Intellectual Property Organisation database lists those applications that have been taken forward to the international stage (PCT as it is known). The numbers are smaller, 2,000 to 3,000, which is not surprising considering the cost at the PCT stage, but in the context of the ubiquity of heterocyclic chemistry it is interesting to note the specific topics for which international applications have been published.

Here are some recent statements of what the patent is intended to provide from the database:

Organic optical materials:

- A novel organic compound and alternatively provide an organic compound that can be used as an electron-transport material of a light-emitting element; from Japan
- A material for organic electroluminescent devices which has a high efficiency and a long life, and an organic electroluminescent device using the material; from Korea

Chemical synthesis and process chemistry (typically to provide compounds for use as drugs):

- A synthesis method for a spiro-oxy indole compound; from Canada
- A process for making modulators of cystic fibrosis transmembrane conductance regulator (CFTR); from the USA.

Drugs and medicines:

- Novel compounds for use in the treatment or prophylaxis of cancers and other proliferative conditions; from Scotland
- A compound as a glucokinase activator useful for treatment of metabolic diseases and disorders, preferably diabetes and more preferably Type II diabetes; from Switzerland
- Compounds and methods for treating tuberculosis; from India.

I've selected arbitrarily examples from different fields covering the whole world. If you've read any of my previous Special Reports, you'll recognise that these applications overlap substantially with research here at the University of Strathclyde. Like the subjects of the patents quoted above, our research is at the cutting edge of making things possible especially in high performance materials and in medicinal chemistry and drug discovery. Heterocyclic chemistry has never been so penetrating through its significance in applications.



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Chemistry and climate change

Santiago V. Luis, Chair of the Chemistry and Environment Network at EuChemS outlines how chemistry can play a vital role in tackling climate change...

Any human activity has a definite impact on the Environment. In this context, climate change is one of the main current concerns and challenges for mankind. Data in our hands reveals the existence of a global warming process and urgent actions are needed before dramatic and irreversible (on a human scale) climate changes could take place. The emission of certain substances to the atmosphere produces a greenhouse effect contributing to the global warming. Their origin is diverse. In some instances, they have a natural origin, as is the case of methane generated by living organisms, in particular in the oceans. In other cases however, they are associated to human activities. The most well known is carbon dioxide (CO_2) and its increasing content in the atmosphere is mainly associated to the combustion of fossil fuels. According to data from the US Department of Energy, global emissions of carbon dioxide resulting from combustion of fossil fuels increased by a

larger than 10 factor since 1900. A variety of other gases contribute to the greenhouse effect, including solvents, chlorofluorocarbons and other volatile organic compounds (VOCs), or nitrogen and sulfur oxides. Some of them can have, intrinsically, an even greater greenhouse effect than CO_2 but, in general, are released to the atmosphere in amounts significantly lower. Besides, some of them, like nitrogen oxides, are generated concomitantly to CO_2 in combustion. In the data presented by Eurostat, for EU-28 in 2012, energy generation (excluding transportation) accounted for almost 58% of the emissions of greenhouse gases, while transport itself was responsible for an additional 22%; industrial activities and agriculture accounted for about 7 and 10% respectively.

A variety of responses are needed to efficiently tackle the challenge of climate change. One trivial answer is the reduction of emissions. Nevertheless, even though

in the future we can envision some changes in our way of life, it cannot be expected that developed societies will accept resigning from their current life standards. Moreover, it cannot be accepted that less developed societies can be denied the access to the technological progress other regions achieved decades ago.

Chemistry has to play a pivotal role in the consecution of the required answers. Making more efficient technological and industrial activities less resources and energy consuming is essential. We know we can perform this. Thus, for instance, the emissions of non-methane volatile organic compounds (NMVOCs) have been decreasing continuously since 1990, to less than half, through the implementation of the chemical processes and formulations involving these substances. New generations of automobiles consume considerably less fuel than those from just 2 decades ago.

New chemical materials with improved performance are being developed providing enhanced isolation and lower energy consumption at home or lighter vehicles with optimised fuel use.

Regarding new energy resources, substitution of fossil fuels by biofuels is a key issue. Although their combustion also generates CO₂, their origin from renewable sources involves that this CO₂ was taken previously from the atmosphere, providing a global CO₂ balance close to neutral. Lessons from the recent past illustrate that this needs to be made with the utmost care to guarantee a rational use of land and water and to avoid using food for energy. Biofuels are currently being developed based on non-edible fats or waste. Chemistry also has a role in other green alternative energy sources like wind, tidal or solar energy. Again new materials being able to efficiently transform the energy from Sun into electricity or to resist under extreme corrosion and mechanical conditions will be a key element for success.

These approaches will decrease the greenhouse gases released to the atmosphere, but reduction of current CO₂ levels requires different strategies. Green plants use carbon dioxide from the atmosphere to create the organic molecules they need. Thus, avoiding deforestation and desertification, improving the health of the forests – in particular rain forests, detecting and controlling pollution or remediating

contaminated sites are simple and effective answers. Developing mechanism for large volume CO₂ sequestration is a hot topic in chemistry. Some alternatives proposed, like the addition of iron to the oceans, are controversial. Others, as the reaction of carbon dioxide with certain mineral compounds or the use of systems for its capture from the atmosphere, facilitating its further injection into porous geological structures still require a careful analysis of the corresponding economic and energy balances. Finally, CO₂ can be considered as a potential raw material for the construction of compounds and materials of application in our everyday life.

Undoubtedly, chemistry has the potential to provide a variety of answers to limit the emission of greenhouse gases and to reduce the levels of CO₂ in the atmosphere. Some of them require the use of large amounts of energy. Like green plants that take the required energy from the Sun, we need to combine these methods with green energy sources (solar or wind power) not involving the emission of CO₂ in their generation. Much work is still needed, but these goals can and need to be achieved by a combined effort of our societies, including those from chemistry scientists and engineers. ■

Footnote: EuCheMS, the European Association for Chemical and Molecular Sciences, aims to nurture a platform for scientific discussion and to provide a single, unbiased European voice on key policy issues in chemistry and related fields.

Through the promotion of chemistry and by providing expert and scientific advice, EuCheMS aims to take part of the solution to today's major societal challenges. Within EuCheMS, several professional networks are being active in specific areas of chemistry (<http://www.euchems.eu/divisions/>).

Prof. Santiago V. Luis, the author of the article, is chairing the one on Chemistry and the Environment.

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Where will our new medicines come from?

A view from one of the drug discovery teams at the University of Strathclyde, Glasgow, Scotland...

Earlier this year I completed a three-year term as a 'Public Partner' on the Scottish Medicines Consortium (SMC), which is the body that advises the National Health Service in Scotland on the cost effectiveness of medicines. My job was to make sure that the patient and the public had a voice in the debates. With that in mind, my blunt answer to the title question is that I don't care, provided that the new medicine is effective and safe. However working also in early stage drug discovery (at the University of Strathclyde, Glasgow, Scotland), I must have a starting point from which to begin the search for a new drug. In the history of therapeutics, many things have been used as medicines: plant and animal products, microbiological products, synthetic compounds including both small organic molecules and large proteins, and even a few elements. Almost all of these possibilities remain viable today but different people take different approaches.

Some pharma companies specialise in proteins, the so-called biologics. This is the most recent source of active compound to reach the market and has had an impact chiefly in the therapy of cancer and inflammatory disease. My experience on the SMC showed that these medicines were high cost, often required out-patient care for administration, and were sometimes challenging with respect to side effects. Other companies



maintain an emphasis on small, organic molecules as the active ingredient. Indeed there are pressures for the size of molecule to become smaller in order to get the best value for a drug. Cost and side effects matter with these compounds too. Outwith western industrial pharma an answer from an Indian physician might be "Very little, actually. We've have plenty of good drugs from Mother Nature in our traditional Ayurvedic medicine".

Now as an academic, one of my principal concerns is to create opportunity from my research, specifically in the field new small molecule chemical entities for new drugs; most of the work in my labs concerns designed small organic compounds. Our central scientific input is the mature field of

heterocyclic chemistry, which, almost uniquely, is able to bridge creatively chemistry and biology and to connect further with medicine. So I make no apology for plugging a science that still makes a difference at the cutting edge. We must continue to teach and train young scientists in chemistry so that they can translate its powerful methodology and creativity into products containing new chemical entities that will make a difference.

No surprise, therefore, that having found something new with potential, I'm very keen for it to be developed towards the market and happy to play an appropriate role in that. Gratifyingly I can speak to several new opportunities from my lab in immunomodulation, cardiovascular

disease, and most significantly in anti-infective compounds. I'll write more about immunomodulatory compounds another time but in the anti-infective field, we have a new antibacterial compound that has now successfully completed phase I clinical trials developed by our partner company, MGB Biopharma in a formulation designed to treat *Clostridium difficile* infections. MGB Biopharma has also developed an intravenous formulation for the treatment of other Gram-positive bacterial infections building upon basic science from the University of Strathclyde (see <http://www.mgb-biopharma.com>).

MGB-BP3 is the first in a line of new anti-infective compounds that ultimately work by controlling gene expression by binding to the minor groove of DNA in the target organism, according to the best evidence we have. It's one of a family of compounds that we call Strathclyde MGBs (S-MGBs). We now have S-MGBs that are effective against a wide range of infectious organisms in particular Gram-positive bacteria and trypanosomes, the disease causing agent of sleeping sickness. Malaria and tuberculosis are further target diseases for which we have leads. We've been able to make such progress and to create such impact for several reasons. Firstly the S-MGB platform uses very flexible heterocyclic chemistry so that we can tune the properties of our compounds to target different pathogens whilst remaining safe for the infected host. Secondly, we have strong team-work between many academic colleagues in chemistry and biology at Strathclyde but also at the University of Glasgow. Thirdly, we've worked in partnership with MGB Biopharma; the company's

ability to raise funds in a difficult economic climate and to drive through the development programme for MGB-BP3 has been extraordinary.

“We must continue to teach and train young scientists in chemistry so that they can translate its powerful methodology and creativity into products containing new chemical entities that will make a difference.”

The outcomes of our research are not just the important practical applications but the advancement of the underlying science. In studying the effect of our drugs on the target bacteria and parasites we are discovering more about the internal workings of the infectious organisms. With such information available we would hope to devise new and more effective drugs for infectious disease.

So what does a heterocyclic chemist do to create opportunities for new drugs? Firstly, there has to be a promising and preferably novel starting point, which could be a new compound discovered by screening, usually plant or microbial products or occasionally a compound from animals, or it could be a molecular hypothesis. This is not new at all. In fact it's what has been done ever since chemists got into drug discovery. The new thing, however, is the stringency with which 'promising' and 'novel' can be defined. 'Promising' may relate to an unmet need in medicines currently available. 'Novel' may also reflect unmet need but will also concern the chemical class of compound being investigated. From there, the chemistry-biology interface is so much better developed

now that a good deal can be discovered about important things like selectivity and toxicity before a synthetic chemistry programme is begun.

Choosing what to make and how to make it with due regard for the probability of a successful development and for chemical novelty is the key contribution of the heterocyclic chemist. This is the essential link that both mediates between chemistry and biology and also creates the therapeutic opportunities through the new compounds that emerge. What makes today's science so exciting is that the tools and techniques that we have the power to explore the most detailed properties of molecules and the intimate workings of biology. This means that the coupling between chemistry and biology that is essential in drug discovery is stronger than ever before and is why we place such an emphasis on scientific teamwork at Strathclyde, as is discussed in my e-book which also gives more details of our projects and our approaches through heterocyclic chemistry ([see “New and Effective Drugs? Yes, please, but where from?”](#)) available from the Adjacent Government website.



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Industrial biotechnology workshops kick-start academia-industry collaborations

by Alison Parkin, University of York and Jon Lloyd, University of Manchester

A key aim of the Metals in Biology network, one of thirteen UK government-funded Networks in Biotechnology and Bioenergy, is to bring together scientists from academia and industry to work together more effectively. With this remit, the network recently funded two workshops.

The first of these was a meeting entitled 'Characterising and utilising *Rhodococcus* enzymes for industrial biotechnology' held in York in November 2015, organised by Alison Parkin (University of York) and Colin Murrell (University of East Anglia).

Rhodococcus bacteria are inspirational chemical factories; they are able to use enzymes contained within their cells to beneficially breakdown a dazzling array of molecules. For example, they can degrade compounds from explosives such as RDX (royal demolition explosive) to volatile organic compounds such as isoprene, the molecule released by trees in such large quantities that it causes the blue haze of the US Blue Ridge mountains.

The enzymes which confer this activity upon *Rhodococcus* contain metals, so harnessing this biochemistry will facilitate new industrial bio-based tools that will allow highly efficient and sustainable chemical processing. Examples include tyre-recycling – exemplified by Recyclatech, a company which uses biological sulphur removal to reprocess waste rubber tyres into

reusable rubber – and environmental clean-up, where research by Neil Bruce (University of York) develops grasses which use *Rhodococcus* enzymes to detoxify weapons manufacturing and testing sites.

At the meeting, scientists discussed opportunities for developing new *Rhodococcal*-derived bio-fuel production systems (Tim Bugg, University of Warwick), anti-microbial and immunisation strategies (Jose Vazquez-Boland, University of Edinburgh), and achieving low-cost chemical manufacturing (Tom Smith, Sheffield Hallam University; Colin Murrell and Neil Bruce). New chemistry-derived tools for accessing previously hidden biochemical information about *Rhodococcal* enzymes were also described by John Slattery, University of York and Alison Parkin. Nagamani Bora (University of Nottingham) and Christopher Corre (University of Warwick) exemplified ways in which cutting edge analysis of genetic sequencing can unsilence *Rhodococcal* biological activity – such as antibiotic-drug synthesis – that is not readily accessible in a laboratory setting.

The meeting highlighted that the UK has a wealth of biotechnological expertise, which ranges from microbial discovery through to industrial processing at international companies such as Piramal Healthcare. Facilities such as the Centre for Process Innovation offer a rapid route for commercialisation of new biochemical

discoveries. A limitation in the field of *Rhodococcus* research is the need for a robust and optimised toolkit to enable enzyme extraction and manipulation.

Now that a community of scientists has been assembled who share world-leading expertise in probing, understanding and manipulating the genetics of *Rhodococcus* microbes to achieve industrial biotechnology, with this activity championed by Jon Marles-Wright and Louise Horsfall of the University of Edinburgh, we will move towards open-source sharing of our methodologies.

The second meeting supported by the Metals in Biology network focused on 'Industrial applications of metal-microbe interactions' and was held on 9-10th November 2015 at Charles Darwin House in London. It was organised by Jon Lloyd (University of Manchester) and the Microbiology Society.

This meeting brought together a broad range of specialists from academia and industry – who study and use the complex interplay between microbes and metals – with the goal of strengthening fundamental and translational research activities. Co-support from the UK Geomicrobiology Network (a special interest group of the Mineralogical Society) and the British Mycological Society helped to promote a genuinely cross-disciplinary meeting.



The meeting, which featured contributions from academic groups augmented by talks focused on industrial needs, was built around four themes: A session on biomining, describing advances in the understanding and application of microbes to leach valuable metals from low-grade ores, kicked off the meeting and featured talks by Chris Bryan (University of Exeter), Barrie Johnson (Bangor University) and Carlos Frias (Las Cruces Mine, Spain). Metal biorecovery and bioprocessing was the focus of the second session. Speakers included Piet Lens (UNESCO-IHE, the Netherlands) and Lynne Macaskie (University of Birmingham) describing how biologically mediated processes can convert even the low concentrations of metals found in wastewater into potentially useful nanomaterials, such as catalysts. Andrew Moore from Northumbrian Water gave a valuable industrial perspective on this area.

Day 2 began with discussions on the bioremediation of metals, with talks from Julian Bosch (University of Duisburg-Essen, Germany), Graeme Paton (University of Aberdeen and Remedios Limited) and others describing how

bioremediation can be used to clean contaminated land. A talk from Joe Small (National Nuclear Laboratory) described the unique challenges faced by the nuclear industry in this area. A final session on biofabrication of higher-value products, including metal-containing enzymes and inorganic nanomaterials completed the second day, including talks on incorporation of the iron-containing compound haem into target proteins (Nick Le Brun, University of East Anglia) and the consequences of incorporation of incorrect metals into enzymes (Kevin Waldron, Newcastle University).

In total there were 74 attendees at the meeting, who presented 28 oral presentations and 20 posters. Feedback from the meeting was very positive: the majority of respondents noted that they had attended in order to network and to update their knowledge on the latest research. All respondents noted that their objectives were met fully, and the conference was rated excellent (73%) or very good (27%).

Importantly, discussions at the meeting identified several new proposed areas proposed for follow-up meetings,

including environmental microbiology, industrial applications of geomicrobiology and the role of microbiology in the energy sectors. It was clear to the organisers that the support of the Metals in Biology network was key in making the meeting a success.

Metals IN BIOLOGY

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Chromatin and epigenetic changes the immune response

Histone modifications and chromatin remodelling are involved in regulating the immune response to different pathogens. A proper immune response is essential in combating viruses, bacteria and parasites that are harmful for us. We have several lines of defence; from the physical barrier of the skin to specific cells in the body. The innate system is an early response and is composed of several cell types; monocytes, macrophages and natural killer cells (NK cells). These cells react unspecifically to infectious viruses, bacteria or parasites and present these agents to the adaptive immune cells. T-cells and B-cells comprise the adaptive immune system and these cells recognise specific antigens of the infectious agents. These cells constitute the memory, developing specific memory cells that can quickly be stimulated upon a further infection. Several studies have now shown that a memory exists in the absence of T-cells and B-cells, trained immunity, but the mechanisms behind are not fully understood¹.

Several recent studies have shown that both the innate and the adaptive immune system change the epigenetic landscape in response to infections. The development of immune cells in the bone marrow involves a large epigenetic reprogramming. Depending on signal, the different cells in the immune cells develops and acquire the specific gene profile for the cell



lineage^{2, 3, 4, 5, 6}. High through-put transcriptome analyses, performed together with ChIP seq of histone modifications^{7, 8} and analyses of the global DNA methylation profile^{9, 10, 11}, has shown that the change in gene expression follows changes in the epigenetic landscape in the different cell lineages. In particular, cell type specific transcription factors and signalling pathway factors are regulated by histone modifications and DNA methylation.

The further response of different immune cells to infections also involves transcriptional and epigenetic responses^{12, 13}. In response to viral infections, not only genes regulating the immune response, such as cytokines and signalling factors, are modulated, but also genes involved in DNA methylation and histone modification changed, maybe to adjust cells to the new epigenetic state. Similar changes also occur upon the induction of inflammation processes in response

to infection, but also to non-infections stimuli, such as nutrients, stress and exercise. Inflammation is the host early response induced by innate immune cells, creating fever, swelling and pain. When the response goes wrong, inflammation can be harmful. Genes involved in the inflammatory response is particularly regulated and is marked by epigenetic mechanisms¹⁴.

The immune system protects us upon infections, but can also be the cause of diseases. Allergy is caused by the immune system overreacting and autoimmune diseases, such as rheumatism and MS, is caused by the immune cells starting to attack our own tissues. Autoimmunity together with chronic inflammatory response have now been linked to many diseases and disorders, and may be the underlying cause for yet many more.

The immune response differs slightly depending on the pathogen involved. Many pathogens have evolved ways to elude or inhibit the full response of the host. The immune system has particular difficulty when combating pathogens with a life cycle in several stages. One such pathogen is the Plasmodium parasite, which is the cause for malaria. Studies towards specific antigens produced by the parasite has been investigating specific responses. The biology of the mosquito^{15, 16} has also been studied and the immune response elicited to understand to many ways the plasmodium parasite affects its hosts. Malaria affects mainly children, those that survive are less susceptible as adults, but no real immunity is obtained. There are, however, differences in response between individuals as well as populations,

most likely caused by genetic factors. One ethnic group in Africa, the Fulani, which has been extensively studied because of the resistance to malaria. The immune response upon infection in the Fulani have been studied and compared with the response in various other neighbouring ethnic groups. These studies have mainly been SNP analyses, investigating variations in genes coding for factors in the immune response. One such example is the SNP study performed between them and the Dogon people in Mali that found genetic differences¹⁷. However, these studies have so far not been able to fully explain the differences in response between ethnic groups in the sub Saharan region. The relative resistance found in the Fulani group could therefore be explained by other factors. Interestingly, it was shown that miRNA also involved in the response to malaria and most likely other parasites¹⁸. Hence, we are interested in studying the underlying cause for the difference in immune response on another level; in epigenetic factors, such as differences in DNA methylation and histone modification profiles as well as in non-coding RNA levels. A further phenomenon of certain complex pathogens that needs to be explained is the lack of real immunity. Immune tolerance could be part of it, but not fully explain the lack of immunity. The memory of the innate immune system, trained immunity¹, could be involved in the finding that adult people living in exposed areas are less susceptible to malaria, a protection that is lost when leaving these areas.

To understand the human immune response to complex pathogens, and

how host and the pathogen interacts, can then shed light to other responses causing a variety of diseases, such as stress-induced immune responses, autoimmunity and chronic inflammation.

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Gender equality in Switzerland today

Brigitte Liebig, President of the Steering Committee NRP 60 at the Swiss National Science Foundation outlines the results of the NRP 60 program and how it hopes to create knowledge regarding gender equality in Switzerland...

Since the 1980s, a variety of political programs, strategies and measures have pursued the aim of achieving equal opportunities for men and women in Switzerland. A recent national research program offered the opportunity to review the various gender equality activities in Switzerland of the last few decades and highlighted not only progress but also persisting inequalities. The 21 research projects of the NRP 60 'gender equality' covered a wide range of issues and have been completed recently.

Education, labour market, family, and social security

In education, the gap in qualifications achieved by young women and men at secondary-school and university level has narrowed, which constitutes an important step towards gender equality in Switzerland. Despite this success, there has been little change in

educational aspirations: young women are over-represented in general knowledge subjects while young men dominate in technical and scientific subjects. Young men, in particular, may encounter derision from their peers if they want to pursue a "typically female" education or career. What's more, young women who wish to have children continue to train for professions which allow for part-time work and career interruptions, whereas men's choice of career is still largely informed by the notion of "bread winner" and life-long working. Parents, heads of schools, teachers and career advisors still fail to question sufficiently the gender connotations of education and career choices.

The situation is similarly complex in the job market: during the last 2 decades, the labour force participation of women in Switzerland, particularly of mothers, has

risen significantly, and is one of the highest in Europe today. However, NRP 60 shows that labour market opportunities of men and women remain far from equal despite this great achievement. It is rare to find men or women in “gender-atypical” jobs and positions or with atypical work-time percentages. In addition, the large pay gap and different wage developments of men and women persist. Even for first jobs there is an inexplicable 7% gender wage gap that is often accentuated as careers progress. It was also noted that women with few qualifications and women in the second half of their working life are often overlooked in gender equality politics. In working environments, women over 50 are often not considered for courses and measures related to age management.

The compatibility of family, education and work has also enjoyed political priority in recent years. Child care services have been expanded throughout Switzerland and families with children now pay less tax. But also in this case challenges persist: paid and unpaid work continues to be distributed unequally. Mostly women provide unpaid care work for the young and the old that is of crucial importance to society. In addition, there are large discrepancies between cantons with regard to child care services, and the overall costs of child care in Switzerland are very high. Further, researchers note low wages in care jobs: The increasing numbers of women from third countries who provide care work in private households are barely protected against precarious and under-regulated working conditions. In addition, analyses conducted by NRP 60 showed that there is a continued lack of family-friendliness in companies. In practice, measures for improving the compatibility of family and career are too often directed at women and rarely include men.

With respect to social security, numerous political reforms have aimed to improve gender equality in old age. However, a number of shortcomings have been identified in this area too: NRP 60 shows that the

inequalities of traditionally “female” education and careers are accentuated over the course of a lifetime. To this day, women’s biographies typically include limited education, few professional qualifications, unpaid work in care or family businesses (e.g. in farming), interrupted careers and low wages; this reduces their capability of providing for their old age and ensuring social security: Provisions for loss of earnings due to unemployment, illness or age are closely associated with an uninterrupted, full-time working life. For this reason, women in Switzerland are often in a worse financial position as they reach retirement age or if they experience a crisis, and they have to depend on supplementary benefits or on support from social services to make ends meet.

Much remains to be done

The NRP 60 highlights complex mechanisms – including social measures and norms – that prevent gender equality policies from being more successful than is presently the case. The results also suggest that the chances of equality are determined at crucial moments in life, influenced by the expectations and functional logic of different fields of life. To address the complexity of causes and effects, gender equality measures need to be comprehensive in their design by taking account of the biographical moment and the functioning and requirements of different parts of society. Gender equality policy needs to address stereotypical concepts of masculinity and femininity, the self-evident structures of professional and private lives, if it is to achieve greater freedom for “atypical” choices and life courses of women and men. ■

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Prof. PD Dr. Brigitte Liebig

President of the steering committee NRP 60

Swiss National Science Foundation

<http://www.nfp60.ch/en>

Women's careers in STEM – What does it take?

Elena Makarova, Professor at the Centre for Teacher Education and at the Department of Education at the University of Vienna, outlines the obstacles young women have to overcome if they aspire to a career in the STEM fields, and how teachers can support their gender-atypical career choice.

Makarova and her colleagues in Switzerland have conducted extensive research on the gender-atypical career choices of young women in secondary schools. The study "Gender-atypical career choice of young women" was funded by the Swiss National Research Foundation and was a part of the Swiss National Research Program (NRP60) on Gender Equality.

Makarova says: "Young women who aspire to a STEM career have to overcome a variety of hurdles and conquer gender stereotypes on their way to becoming a professional in a male-dominated career field". She further explains, what makes it difficult for young women to pursue a gender-atypical career in Switzerland.

Perception of science as a male domain

Secondary school students not only have a stereotypical perception of both genders and personality traits associated with women and men, but also a gender stereotypical image of science. In the perception of female

students women are labelled as being soft, dreamy, lenient or frail, whereas mathematics and physics are seen as being hard, sober, strict or robust. Thus, young women are strongly challenged in relating the masculine image of science to the self. This image of science not only endangers young women's identification with this academic domain but in the long term also negatively affects young women's interest in science, their academic self-concept in the science subjects and lastly their decision to choose a career in science-related fields.

Gender stereotypes in the science textbooks

In our study we analysed the textbooks for mathematics, physics and chemistry in secondary schools with respect to the numerical representation of female and male characters in the text and illustrations as well as the context in which both gender appear. It was obvious that male protagonists and the everyday experience of male students vastly dominated the representation of gender in the science textbooks. Moreover, persons of female and male gender were presented in highly stereotyped roles and activities. It can be assumed that the textbooks are less likely to appeal to young women and to encourage them to pursue science. Thus, issues of gender mainstreaming should be given more consideration by textbook editors and authorities who approve these teaching materials.



Prejudice towards women in STEM careers

Young women apprentices learning a STEM profession are at risk of experiencing discrimination during their vocational education and training. In order to adjust to a male dominated career field and to combat prejudice in the work place, young women need to outperform their male co-workers and need to be resilient towards gender stereotypical beliefs and attributes in the work place, or to assimilate within the gender atypical career field. Thus, training companies which provide apprenticeship programs in STEM fields should be strongly challenged to combat sexism and gender discrimination in order to create an inclusive working environment for young women in gender-atypical careers.

Makarova highlights further, that teachers can support young women's interests in science and their career choice in STEM.



Fostering students' motivation in science classes

As shown in our study, students' learning motivation in science classes can be increased through the connection of science to different everyday experiences of female and male students, through providing individual instructional support for students, by using gender-neutral language, by giving information about STEM professions and by encouraging and supporting female students' interests in STEM careers. Thus, science teachers can increase female and male students' willingness to choose a career in science related occupational fields through conducting gender inclusive science classes.

A need for professional role models

Role models and mentors are highly important in the process of profes-

sional orientation and especially for the gender-atypical career choices of young women. A young woman who has chosen a career in the STEM fields highlighted the impact of male or female professional role models on their gender-atypical career choice. Consequently, parents, siblings, teachers and peers – regardless of gender – can function as a role model or a mentor by inspiring, supporting, encouraging and accompanying young women who opt for a career in the STEM fields.

A way to go

Gender segregation in career fields typically chosen by women or men constitutes a serious obstacle to gender equality. In this endeavour instructional design of science classes which increase students' learning motivation emerges as a promising means to gaining more women and men for STEM occupations. In this

endeavour teachers play a crucial role in helping students to overcome gender stereotypical beliefs and make their life choices independently of their gender.



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Transforming higher education in the UK

Adjacent Government outlines the government's plans to ensure higher education in the UK is value for money for students...

It's not a difficult assumption to make that universities in the UK deliver exceptional education, enabling students to secure some of the top jobs around the world.

In fact, in the [QS World University Rankings](#), UK universities take 4 of the top 10 places. The University of Cambridge comes in 3rd place, followed by Oxford University in 6th and UCL in 7th.

In August last year the BBC reported that, despite a drop in A-level grades, record numbers of students had been accepted onto university courses. The Ucas university admissions service reported that 409,000 places had been confirmed, up 3% on last year. Universities Minister Jo Johnson hailed the rising numbers as "great news".

In September last year (2015) however, Johnson announced that more needed to be done to put students at the heart of higher education. Launching a green paper, the government outlined their ambitious proposals, which are designed to boost teaching standards, to ensure better value for money, and improve employment prospects for students.

The Minister warned vice-chancellors that bad teaching was damaging the reputation of British higher education.

"We must do more to ensure that the time and money students invest in higher education is well spent," said Johnson.

"Our ambition is to drive up the quality of teaching in our universities to ensure students and taxpayers get value for money and employers get graduates with the skills they need."



In a speech at the University of Surrey last year, Johnson outlined plans to set out a broader vision for higher education. This included the publication of a green paper, 'Fulfilling our potential: Teaching Excellence, Social Mobility and Student Choice'. A consultation on the proposals in the green paper closed last week.

In a speech ¹ given in September 2015, Johnson said:

"We have no target for the "right" size of the higher education system, but believe it should evolve in response to demand from students and employers, reflecting the needs of the economy.

"At the centre of this vision are the young people contemplating their future in a world where no one owes them a living, where they must depend on their wits and drive to survive.

"We have all been reminded of the scale of the challenge by a recent CIPD survey suggesting that almost 60% of graduates are in non-graduate jobs."

A critical element of the consultation last year were the government's plans to introduce new incentives

for universities to focus on teaching via the Teaching Excellence Framework (TEF).

“Speaking to parents and students since taking on this job has confirmed for me the extent to which teaching is highly variable across higher education,” Johnson said.

“There are inspiring academics who go the extra mile, supporting struggling students, emailing feedback at weekends and giving much more of their time than duty demands.

“There are many people who will change our children’s lives and I want every student to learn from and have access to the kind of teacher who suffered me when I was an undergraduate.

“This patchiness in the student experience within and between institutions cannot continue. There is extraordinary teaching that deserves greater recognition. And there is lamentable teaching that must be driven out of our systems.

“It damages the reputation of UK higher education and I am determined to address it.”

However the Minister’s comments have not been met entirely with open arms by the UK’s most senior university leader. Sir David Eastwood, the vice-chancellor of Birmingham University, rejected the claims from the Minister that universities failed to offer students value for money.

Eastwood suggested the Minister’s claims did not match reality, citing the international renown of UK universities, including the high demand for places among overseas students.

“If you look internationally, the reputation of UK universities stands high,” said Eastwood in an interview with the Guardian. “Why do students from China, Hong Kong or other far eastern countries want to come to the UK? Because they see these universities offer high quality teaching.”²

Sally Hunt, the general secretary of the University and College Union, said the quality and status of university teaching would be best improved by tackling the low pay and insecurity of academic staff.

“The reality is that over two-fifths of university teaching staff are on temporary or zero- hours contracts. Academic pay has fallen by more than 15% since 2009 and promotions, particularly at a senior level, focus on research,” she said.³

Johnson’s ambitions extend beyond raising the quality of teaching in order to drive forward social mobility. He explained the green paper will also consult on how to accelerate progress in widening participation to help more people benefit from higher education. He highlighted research from BIS, which revealed concerns regarding white children eligible for free school meals.

“The problem is particularly acute for disadvantaged white boys,” he said. “Barely 10% of white British boys from the most disadvantaged background go to university, making them 5 times less likely to study at this level than the most advantaged white boys.

“Poor attainment in school is a major factor driving differences in participation, but attitudes towards university, which can be shaped by good careers advice and employer engagement, also play a part.”

The Minister concluded his speech by saying despite record numbers attending universities in the UK there is still much more to be done in order to reshape the higher education landscape.

“With these changes higher education fulfils its full potential: not just as an engine of economic growth and productivity, but also, now that student number controls have been lifted, as the most powerful driver of social mobility we have,” he concluded. ■

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3 <http://www.theguardian.com/education/2015/sep/09/lamentable-teaching-damaging-higher-education-jo-johnson-minister-warns>

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Stoical leadership in a 'bear market' in higher and further education

In 2016, in a difficult global environment, stoical, trustworthy leadership of higher and further education is needed more than ever before. In harsh times, the deeper values and purposes of authentic educational leaders stand out clearly. Research on trust and leadership demonstrates that when education is led and delivered well by trustworthy leaders, it develops resilience, self-reliance and positivity through knowledge and skills. It fosters social harmony through communities of learning. It enables new growth and adaptive change in difficult times. It also helps students to progress in their achievements to gain confidence and employment. Such education brings comfort, economic stability, new meaning and relief to communities that are insecure and anxious in such troubled times.

Stoical leadership in a 'bear market' in higher and further education

Across the world, in early 2016, we face difficult, uncertain times. Mass migration and security crises, global macro-economic challenges, climate change and terrorism issues are now so complex and bleak that a convergence of hazards seems to be gathering. As Dickens might have said, globally we seem to be approaching 'the worst of times'. As oil prices drop to 12 year lows, a new recession looms, and politicians on all sides alert us to Brexit and Bremain arguments of the UK leaving or staying in Europe, either

way, a maelstrom of unknown perils threatens to destabilise certainties we once knew.

As people shiver in the freezing winter of a 'bear market', conditions are harsh. In higher and further education in the UK and elsewhere, leaders are challenged as never before by the uncertainties of funding cuts, global competition, staff overload, student demand, health and security issues and ever rising quality and productivity targets in key performance indicators.

When times are so difficult, scepticism and distrust tend to be on the rise. People are generally less willing to take risks and to trust others. Fear and uncertainty increase. That's what a pessimistic 'bear market' heralds in the economy and wider environment: a negative terrain in which caution and loss of confidence prevail.

During harsh times, the values and well-tested practices of the ancient philosophy of Stoicism can help us. Stoicism fosters the strength and happiness that can be found in inner virtue during times of great uncertainty and change. It encourages a focus on integrity, endurance and composure in all of our endeavours. It is a useful philosophy for leaders who need to foster trust and to develop inner resilience.

Research interviews and surveys on trust and leadership in higher and

further education (Jameson, 2006, 2012) have reaffirmed the importance of principled leadership in which senior managers act with benevolence, openness, competence, high standards of moral conduct and emotional intelligence. Such leadership is essential to foster trust.

When communities are threatened by uncertainties, strong leaders are needed to act as beacons of hope, speaking out and acting with clarity, wisdom, temperance and courage. Those leaders do not have to be perfect. In fact, it is better if they are not. We need leaders who act calmly with humour and humility, showing they are not – indeed are not trying to be – immaculate. It is easier for people to trust leaders who demonstrate human authenticity in ordinary ways, admitting frailty, than to have confidence in those who act as Teflon puppets.

To demonstrate the importance of leadership authenticity, I recall a story told to me some years ago in interviews on trust and leadership in post-compulsory education (Jameson, 2006)¹ by a distinguished leader of further education, a person much honoured for her work. We can call this person 'Lillian', for convenience sake, though that is not her real name.

Lillian said that, many years previously, she had been appointed as a young senior educational manager of a faculty full of academics much older,



more qualified and experienced than she was. She had a very difficult time for the first few months. The staff regarded her as a naïve newcomer. She aroused resentment when trying to introduce many changes in the faculty that did not go down at all well.

Lillian said that although she worked diligently, developing expertise in the faculty subject areas, attempting 'gravitas', trying everything she could think of to support these academic experts, the planned changes she tried to introduce continued to fail. She was at a loss to know why the staff did not seem to value or trust her, why some of them in fact seemed to hate her and blocked all the changes she had proposed.

Hence there was a palpable sense of dislike as Lillian rose to speak to faculty staff one afternoon at an important meeting. She was shaking with nervousness, but, summoning

up her courage, she determined to speak her mind to these academics, even if it was really difficult.

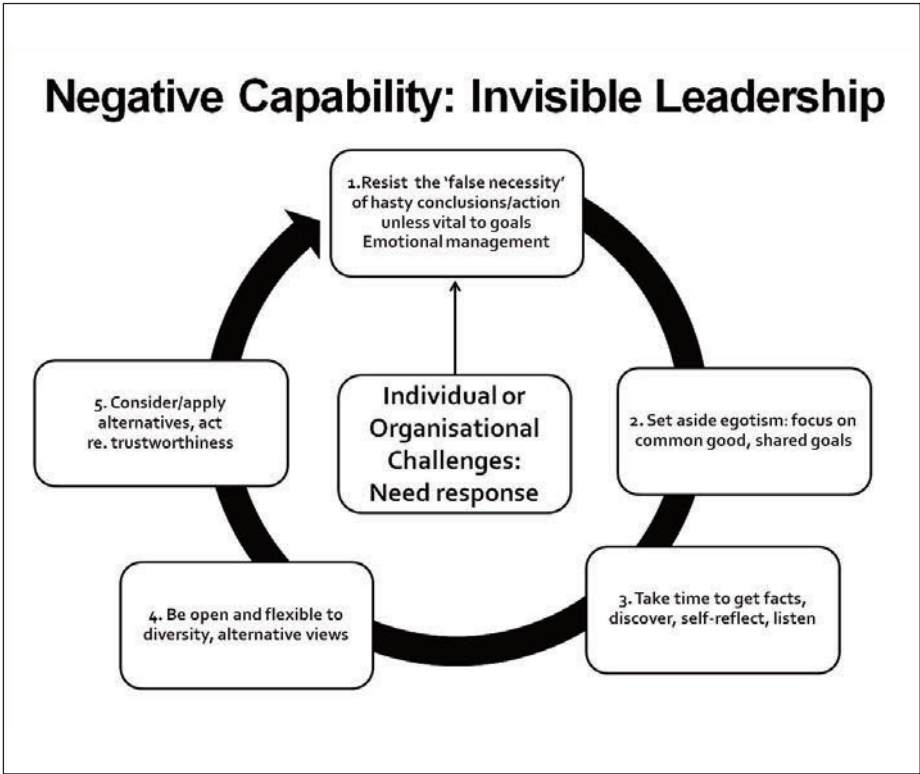
Lillian decided to confront them with the truth. Bravely, putting herself on the line, she apologised for her mistakes when introducing changes in the faculty. She told the staff she was working as hard as she could, but she wasn't as experienced and knowledgeable as they were and therefore had got things wrong. She said she was learning, developing expertise, but hadn't got there yet. She asked for their help and patience in supporting her to grow in knowledge of the faculty, to understand what they needed and how the curriculum could grow in beneficial ways. She asked them to guide and help her in trying to change things for the better.

Interestingly, instead of ridiculing this vulnerable young manager or rejecting her apology, the academic staff,

including those who had previously resented and hated her, suddenly seemed to turn around slightly. They suddenly began to warm to Lillian on that afternoon. By speaking the truth, she had broken through to them. By humbly acknowledging her own weaknesses and their strengths, by recognising and valuing their expertise and asking for their support, Lillian had begun to win them over. With tears in her eyes, Lillian realised that suddenly the staff were clapping her speech, accepting her apology, unexpectedly agreeing to support her.

In leadership, sometimes things turn suddenly, from one moment to the next. From that day onwards, Lillian consciously understood for the first time how essential it was for leaders to be authentic. She began to recognise that leaders needed to hold onto their inner values and to speak out, even if it looks like weakness. She realised that leaders needed to demonstrate they are truthful, courageous human beings, unafraid to admit their faults and ignorance, albeit selectively and in a self-controlled way. She understood there was no point in unrealistic acting, in trying to pretend to people she was an expert if she was not.

Lillian realised that it was better to be honest, to speak her mind and heart, however flawed, than to try to take on an air of false prestige she did not really possess. She also realised that sometimes an honest apology wins the hearts and minds of people in ways that nothing else will. She told me it was a lesson she has never forgotten: to this day, Lillian, much celebrated



gies about this. What is harder is to make this happen on the ground, every day. This does not necessarily mean that leaders always need to be highly visible all the time. In fact, the 'visibility/invisibility' paradox that I have written about (Jameson, 2015)² suggests that sometimes 'less is more'. Sometimes, particularly in times of crisis, it is essential for leaders overtly to speak out, to be demonstrably present, but at other times it is sometimes better for leadership to be quieter, to step back and allow others to take the centre stage. This kind of temporary and deliberate 'invisibility' of top managers is useful in enabling the development of leadership at all levels. Essentially, as Lao Tse indicates '...when the best leaders' work is done, the people say, "We did it ourselves!" ...'

for her work and contributions to executive management in further and higher education, continues to promote the concepts of values-based and authentic leadership.

In addition to authenticity, we need leaders who demonstrably understand the many benefits that education and training can bring. Ideally, such leaders need to be keen learners and adaptive 'change agents' themselves. In harsh times like these, such leaders clearly show the way in which the deep values and purposes of education stand out.

Our institutions of higher and further education can be the engines of social growth and adaptive change in difficult times. It is important that both policymakers and institutional leaders in the public sector develop the resilience and self-confident stoical

leadership that inspires staff to feel that they are valued and trusted.

Another of the outstanding educational leaders in further and higher education I interviewed many years ago (Jameson, 2006) said that managers needed to recognise 'how long a shadow they cast'. By 'shadow', he meant the impression that senior leaders and managers made on others in their area of control: what are the real effects of the work that is carried out by senior management?

Leadership that welcomes constructive critique and encourages openness in discussion and transparency in decision making is important. Procedural fairness that is very evidently practised and valued throughout educational institutions encourages trust. It is easy to write policies and strate-

Hence in the effective management of educational sectors, areas of work and institutions, there is no one rule that always holds fast for every situation. Contextual appropriacy in response, flexibility and spontaneity are vital to ensure that operations are well managed and services succeed. The complexity of modern institutional settings means that an awareness of systemic operations can be critical in recognising the need for deeper analysis of longer-term problems than just knee-jerk reactions to crises.

The model of 'negative capability' in relation to leadership that I have developed (Jameson, 2015) proposes that leaders resist the 'false necessity'³ of hasty conclusions in uncertain situations. The model suggests that leaders set aside time to manage unwise emotional reactions to events.

It proposes that leaders should reflect, listen to possible alternative solutions, to gather evidence, and, through a process of agreeing common goals and values, develop improved solutions to problems. This is, essentially, a stoical leadership model of resilience for difficult times.

If stoical virtues are practised, the effective development of trustworthy leadership throughout higher and further education enables students to progress in their achievements, to learn, gain valuable qualifications and employment. Such education brings comfort, economic stability, self-confidence and relief to those who are struggling in difficult times.

Objectives

- To build trust and shared knowledge of values-based leadership in communities of practice;
- To use emerging technologies for sharing authentic learning opportunities;
- To find improved leadership and e-leadership solutions in higher, further and vocational education.

Key collaborators

Professor Dick N'gambi, University of Cape Town. Professor Vivienne Bozalek, University of the Western Cape. Professor Ann-Marie Bathmaker, University of Birmingham. Professor Kevin Orr, University of Huddersfield. Professor Paul Gibbs, Middlesex University. Hugh Joslin, University of Greenwich, UK. Sharon Smith, Canterbury Christ Church University, UK.

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Social media

- ResearchGate profile:
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- Google Scholar profile:
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Bio

Jill Jameson has two MAs from the University of Cambridge and Goldsmith's College, both in the UK, as well as a further MA and PhD in Computers in Education from King's College London, UK. She is Principal Investigator for the 2013–16 Economic and Social Research Council Research Seminars

Project on Higher Vocational Education and Pedagogy (HIVE-PED) in England. She leads a group of professors and expert academics/practitioners and policy makers from around the world.

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Quantum theory of matter and light

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The metamaterial concept has in recent years inspired scientists to conceive perfect lenses, new lasers, ‘invisibility’ and acoustic cloaks and opened the door to slow and stopped broadband light with applications in quantum science and technology, sensing and nano-chemistry. At the same time, quantum nano-photonics promotes an extreme control of light and matter interaction and empowers novel femto- and attosecond and nano-photonics phenomena, forming the basis for quantum photonics and innovative nano-photonics lasers. The Quantum Theory of Matter and Light (QTML) group (Professor Ortwin Hess) in the Blackett Laboratory (Department of Physics) at Imperial College London explores these research frontiers, studying the physics of nanophotonics, optical and electronic metamaterials, and investigating the (ultrafast) nonlinear and quantum dynamics of nano-plasmonic particles, nano-photonics nano-devices and complex systems with gain. Concurrently the group is striving to embed metamaterials in new realms

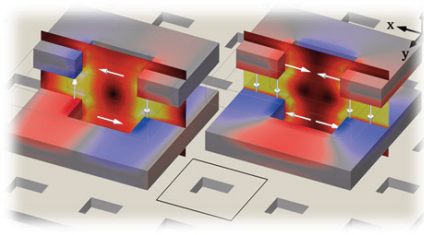


Figure 1: Bright (left) and dark (right) modes in gain-enhanced nano metamaterials

of applications in information and laser technology, nano-photovoltaics and the bio-medical sciences.

Nonlinear Nanophotonic Active Metamaterials

Ever since their conception, metamaterials have fascinated both researchers and the wider public alike, due to the prospect of a unique realisation of photonic properties such as a negative refractive index or functionalities such as optical cloaking that are not accessible otherwise. While initially many proof of concept realisations have been made at microwave frequencies, the quest for miniaturisation has opened up both new challenges (such as the compensation of losses) as well as opportunities for new functionalities such as ultrafast nonlinearities. Incorporating gain molecules into the fabric of the metamaterials, the QTML group has shown that it is realistically possible to overcome dissipative losses, even in the exotic negative-index regime. Moreover, the strong coupling of the excited (bright) modes of optical metamaterials to the radiative continuum has been shown to open up a broad window within which we can achieve full loss compensation and amplification in the steady-state regime. When the gain supplied by the active medium embedded, e.g. within the fabric of an active nano-fishnet metamaterial structure is beyond a level that is sufficient to overcome dissipative and radiative losses, the nano-fishnet structure can

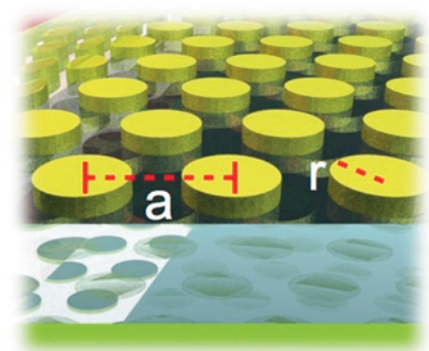


Figure 2: Nanoplasmonic array thermal emitter for CO₂ gas sensing

function as a coherent emitter of surface plasmons and light over the whole ultrathin 2D area, well below the diffraction limit for visible light.

“Since their first conception nearly 50 years ago, lasers have evolved from a scientific curiosity in the laboratory to take a place at centre stage in today’s society.”

Nanoplasmonic Metamaterial Thermal-Emitter Improves CO₂ Gas-Sending Devices

Over the last two decades surface plasmon polaritons have been intensely studied from a theoretical and applied physics perspective and many promising applications in sensing have been proposed. Examples are Surface-enhanced Raman spectroscopy (SERS) or single molecule sensing. They both take advantage of huge field enhancements, while nano-lasers or stopped light lasing use field confinement and localisation

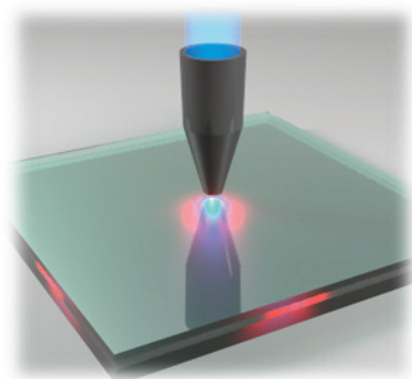


Figure 3: Subwavelength localised vortex-lasing in a gain-enhanced nano-plasmonic metal-dielectric-metal (MIM) heterostructure. Localised optical pumping excites in-plane sub-wavelength cavity-modes that self-localise at singularities of the density of states forming an optical near-field energy vortex

to replace cavities. While some applications are hindered by the resistive losses that occur in the metal, an application of plasmonics to thermal emitters, in contrast, even calls for absorption (i.e. losses in the metal), because Kirchhoff's law dictates that only good absorbers make good thermal emitters. The QTML group recently demonstrated that a plasmonic thermal emitter, fabricated in collaboration with using an industrial CMOS process that enables a 400% increase in emission intensity at the CO_2 absorption wavelength used for non-dispersive infrared gas-sensing device, compared to a standard non-plasmonic device.

Stopped-Light Nanolasing

Since their first conception nearly 50 years ago, lasers have evolved from a scientific curiosity in the laboratory to take a place at centre stage in today's

society. Lasers do come in all kinds of sizes and for an incredible variety of wavelengths but all have two vital components: a (laser) gain material and coherent feedback of the emitted light. In normal lasers feedback is provided by placing the gain material between mirrors – i.e. inside a cavity. Now, could we accomplish such feedback by keeping photons that have just been emitted from an active laser medium, simply from propagating away? Light is normally the fastest 'object' in the universe, but researchers have, indeed, recently conceived ways of slowing it down considerably, even long enough to consider it as having been stopped altogether.

The QTML group has recently demonstrated that lasing does not require modes pre-defined by a resonator with a particular geometry but only a feedback mechanism: providing feedback by stopped-light singularities in the density of states stopped-light lasing can be realised on subwavelength (nano-) scales. Extensive full-time domain Maxwell–Bloch Langevin simulations in combination with (semi-) analytic theory have uncovered that in the absence of cavity-induced feedback a phase-locked superposition of quasi dispersion-free waveguide mode promotes the dynamic formation of a subwavelength lasing mode with a remarkably high in-coupling of (amplified) spontaneous emission into the lasing mode. The realisation of trapped/condensed nonequilibrium surface-plasmon polaritons at stopped-light singularities. The recently proposed nanoplas-

monic stopped-light lasing principle conceivably thus not only opens the door to ultrafast cavity-free nanolasing, ultra-thin lasing surfaces and cavity-free quantum-electrodynamics but, applied to surface-plasmon polaritons, also provides an entry point to SPP-condensation, quantum gain in quantum plasmonics and quantum fluids of light.

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- 3 J. M. Hamm and O. Hess, *Science* 340, 1298 (2013).
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- 5 T. Pickering, J. M. Hamm, A. F. Page, S. Wuestner and O. Hess, [Nature Communications 5, 4971 \(2014\)](#).
- 6 A. Pusch et al., *Scientific Reports* 5, 1751 (2015).

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Apprenticeships: where should we direct the money?

Nida Broughton from the think tank the Social Market Foundation shares her thoughts on whether apprenticeships are good value for money...

Apprenticeships were described as the cornerstone of UK's skills system in George Osborne's last Autumn Statement. The Statement also gave additional detail on how apprenticeships are to be funded, with a levy on employers set to raise £3bn a year. But is this good value for money?

There are a number of advantages to apprenticeships. They can provide opportunities for gaining useful training whilst working, thereby improving apprentices' future career prospects. In turn, a higher skilled workforce can increase the performance of firms and raise overall productivity. However, despite the potential benefits to both firms and employees, under-investment in training is a common problem. Taking on apprentices can be a risky investment if the employer thinks that they may well leave once they have completed their training.

So the Government has, for a number of years now, provided rewards and incentives for taking on apprentices. With a target for 3 million new apprenticeship starts this Parliament, more funding was sorely needed. Yet, simply more funding for any type of apprenticeship is unlikely to result in good value for money.

Worries about the quality of apprenticeships are long-standing. Last year, an Ofsted report found that of those inspected, a third of apprenticeships "did not provide sufficient, high quality training that stretched the apprentices and improved their capabilities". Completing tasks such as making coffee and cleaning floors were being accredited as skills, and some learners were unaware they were on apprenticeship programmes.

Evidence such as this suggests that some apprenticeships have not yet got the balance right between provision of valuable training and on-the-job experience. Admittedly, the new levy system has the potential to bring in the magnitude of funding needed to improve quality. And a new employer-led institute – the Institute for Apprenticeships – is to be set up to oversee quality levels.

However, to really understand which schemes are valuable and which are not, we need to understand what types of apprenticeships make a significant difference to career opportunities and firm performance. Inevitably, this will be tied to the demand for skills. Indeed, the government recognises that it is the "critical need for high numbers of new technical and professional skilled workers" that presents a strong case for a high quality apprenticeship system in the UK.

It is clear that the value of apprenticeships varies widely. Research by the Social Market Foundation (SMF), and others, finds that Level 3 apprenticeships tend to be more valuable than Level 2, in terms of the wage boost they provide to apprentices undertaking them. The SMF study finds that Level 3 apprenticeships boost hourly earnings by around 16%, consistent with other studies. It finds little earnings boost attached to Level 2. This is in contrast to other studies which look at different time periods and use different data sources. However, there is a common thread running through all studies, which is that the value attached to undertaking a Level 3 apprenticeship is consistently higher than the value attached to Level 2. Directing funding towards encouraging more Level 2 apprentices to progress onto Level 3 apprenticeships is therefore likely to



make a positive difference to job prospects.

There is also wide variation by occupation and sector. Apprenticeships in areas such as engineering and manufacturing tend to provide higher returns than retail, for example. To really create value for money, it is important that funding is targeted towards areas that generate real returns, for employees, firms, and the wider economy.

Of course, over time as sectors grow and contract, the pattern of skills demand will change. The best sector to do an apprenticeship in a few years' time will not necessarily be the same as it was a few years ago, or even the same sector as it is today. However, a vital role for the new Institute for Apprenticeships will be to track these changes and ensure that funding for apprenticeships meets the evolving needs of firms and the wider economy. That means capturing information on how well former apprentices from different programmes go on to do, and publishing

that data to help both prospective apprentices and the Institute to decide how funding can best be used.

Apprenticeship investment has the potential to improve the UK's productivity performance. And the money needed for high quality programmes is coming through. It would be a great shame now, if having found a way to make the funds available, we do not invest them wisely in training that will make a genuine contribution to improving skills, pay and productivity. ■

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Reflective practice: Power, paradox and professionalism

In Newton's terms the symbolism of 'reflection' seems obvious. Given our first apperceptive views of ourselves as objects in a mirror as neonates. To the empirically minded spirit, at least, reflective practice constituting grounds for professional activity in a wide range of professions, following the works of Schön and Argyris in America along with Boud and his colleagues in Australia in the 1980s, seems to remain almost beyond any space for questioning.

One measure of the powers involved comes from the fact that over the last thirty years, no one has been prepared to take a step into such space. Bucking the trend in a recent study for the 'helping professions' Flint and his colleagues have sought to do just that.

Let us for the moment remain with the metaphors. Such signs each purport to point towards something else. In physics, for example, three contrasting languages have emerged; Newtonian, Maxwellian and quantum theories of light mean that reflection may now be understood in terms of the actions of light particles [quanta] and waves. Each of these discourses constitutes its own quite different understandings of the same phenomenon, reflection.

But, in Foucault's 'apparatus of education' only one possible understanding of reflection derived from the seventeenth century prevails. Herein with the aid of Foucault's [1977] perhaps over zealous narrative, *Discipline and Punish*, is manifest the production of

the 'docile body'; the iteration and re-iteration each day of this compliant and submissive social body within disciplinary apparatuses found in all so-called developed economies and most developing economies around the globe. Despite his later obvious revisions of this genealogy in a series of lectures entitled *Security, Territory, Population*, a mark of the sovereign powers constituted by reflective practice is that its effects continue to be experienced daily across almost every professional practice in most leading economies around the globe. No professional activity worthy of this name is excluded: architecture, medicine, engineering, the helping professions, management, the media etc.

Reflective practice based on Newton's discourse remains the only show currently available on this small island in the solar system we call earth.

One is not suggesting by analogy with Maxwell and quantum physics that somehow reflective practice should adopt parallel languages. Rather the question is raised concerning the very constitution of possible *languages of reflective practice and the understandings* cultivated by such languages within all professional activity.

Currently within all professional apparatuses and their aligned research activity only one form of discourse constituting reflective practice prevails. And its ontotheological structuring privileges the principle of assessment: nothing is of educational value in professional practice without assessment.



Though conveniently consonant with the simulacra of dominant forms of performativity at work in most professional practice, this principle serves to reduce human beings to a 'standing reserve' of energy that is both available for use and driving such systems. Rather than being autonomous professional agents, professionals are always in danger of being reduced to becoming the machinery of professional apparatuses.

Moreover, a mark of the sovereign powers constituted in the language of reflective practice is that it has the capacity to produce exceptions. Flint and his colleagues' on-going studies of reflective practice have so far revealed that while there is some questioning concerned variously with the efficacy of reflective practices in particular professional settings. Until now no one has yet asked the question about the delimiting effects upon our understandings iterated and re-iterated daily in such discursive practices.

The reason for this impasse is clear. In moving to this reason, despite Foucault's [1977] obvious later reservations concerning the capillary actions of the 'micro-physics' [ibid: 27] of modern power, gathering together, conditioning and shaping societies through in this case the disciplinary apparatuses of the professions, one needs to examine what is the basis for such powers. It is, of course, the very naming force and gathering powers constituted by that tiniest of words in our lexicon, the *is*, being as presence. As the present participle of the verb, to be, the economies of what are given by being as presence purport to inscribe as objective facts matters concerned no less with every nominalisation and verb in the lexicon of the English language.

In all professional apparatuses two powerful 'meaning makers' are used, ensuring that in any projected understandings of entities arising from reflective practices the integrity of each and every projection is maintained. Moreover as principles, with two of our most powerful meaning makers, 'reason' and 'assessment', each constituting their own axes around

which understandings are formed. As principles 'reason' privileges the connection of subject with object, and 'assessment' privileges what is valued in the pedagogic apparatuses of the professions.

It is here that we come to the paradox of professionalism and its aligned 'emotivist' and managerialist cultures where ends available to human beings in their various practices have become the very means of evaluating the performativity of any reflective practice. 'Performatives', of course, following Austin's [1975] deliberations, are those statements that carry with them the promise of simultaneous action. Herein lies the paradox. The principle of assessment concerns itself only with the 'object' formed in reflection in the mirror. In so doing, in purporting to create the basis for caring for other human beings, reflective practice creates a double division. There is a division between real human beings and their objects formed in the mirror. It also creates a divide between winners and losers in the 'language game' of performativity.

The real paradox arises from two inter-related matters. Despite the endless barrage of the measures of professionalism in different practices, such divisions at the heart of reflective practice always falls short of being a whole practice. The very possibilities open to human beings in their practices simply constitutes a reservoir of energy that is available for use in such systems. Secondly that very 'object' is never a unity. It has other identities at play within it. Consequently, as Derrida [2000] suggested, what is given in any economy of the 'object' constituted by reflective practice 'can

only be possible as impossible, 'that is, unconditionally', 'as the impossible' [ibid: 300].

The danger, ironically, is that the prerogatives of professional practice remain locked within this seventeenth century model. Consequently failing to reflect on how to work not only with homogeneous economies of the conditional, calculable and possible aspects of practice, but also with their heterogeneous counterparts. The danger lies in not only not taking further action in researching this matter. But, not in the current fog of polysemic space constituted from objects of reflective practice, rather within the disseminative drift – that 'empire of signs' that grows everyday.

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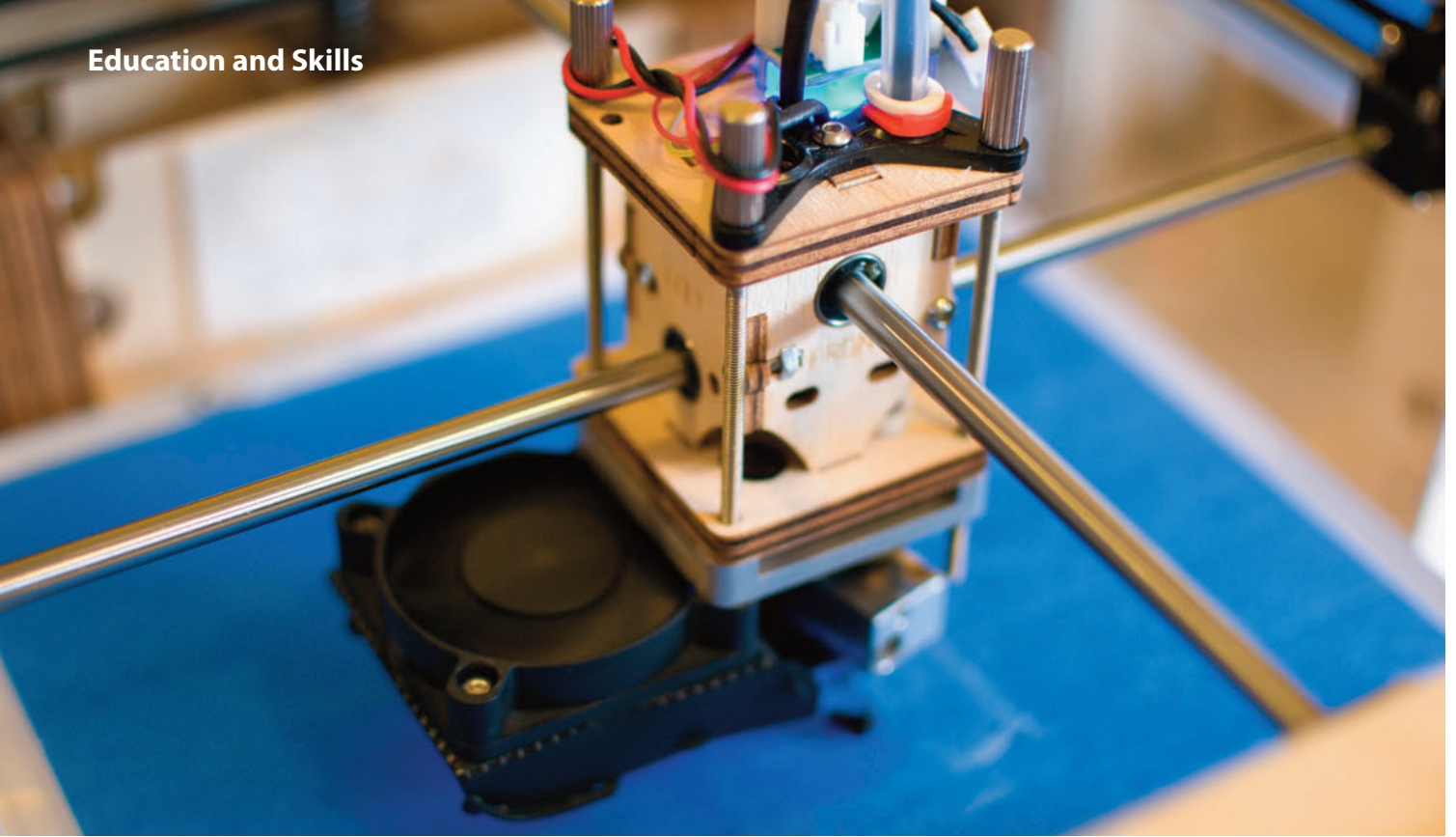
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The benefits of bringing 3D printing into the classroom

Wyn Griffiths, Senior Lecturer at Middlesex University outlines how 3D printing can bring excellent benefits for both students and teachers into the classroom...

3D printers are one of the hottest new innovations in the manufacturing and design world, and this new tech is fast moving past its infancy. To many, it's a technology that seems futuristic for the time in which we live, never mind the classroom – but nevertheless is one that holds enormous potential not just in the STEM industries, but in schools as well.

For the uninitiated, 3D printers allow users to “print” three-dimensional models from computer-created designs. Using plastics, resins, metals – even chocolate – users of the devices can craft designs that would otherwise be tricky, expensive, or impossible to make using traditional manufacturing processes. In short, it's a game-changer of massive proportions that can give excellent benefits to both teaching and learning.

Boosted attainment

3D printers are being used across a number of different subject areas, and both the skills taught and the sheer

ability to create products means that the technology can be applied to a number of different subjects, improving student attainment in the process.

The most obvious subject, design technology, benefits hugely from having 3D printers to hand. Instead of spending long periods of time measuring, crafting, and finishing their products by hand, students can spend more time mulling over the actual design and purpose of their project, creating things that are more considered and complex. Many designs that can be created with a 3D printer are also either difficult or impossible to make using traditional DT equipment, similarly broadening students' capabilities.

The design software associated with 3D printers can also give IT students an improved degree of support. Following a design from conception all the way to production is rewarding and, compared to merely designing the product, far more engaging.

Art students also have the ability to fully engage with a 3D printer. Creating models that are only restricted by the imagination, a massive range of possibilities emerge, moving past typical artistic processes and forms.

Improved attention

One of the biggest blessings that 3D printers can give to both learners and teachers is a boost to pupils' attention spans. [Government research](#) into the use of the technology has found that students whose attention spans were usually poor were more likely to stay interested throughout the duration of projects that utilised 3D printers.

One of the best things about bringing such cutting-edge technology into the classroom is that it plays on both children's and teenagers' intense interest in technology. When students see a piece of equipment that they have seen or heard about in the flesh, excitement levels are peaked as the intriguing utility and utterly amazing capabilities of the printers come together to make the learning process unmistakably interesting.

Simply being able to see real, material, results in a short space of time also gives students motivation to hone their ideas and develop more complex designs, keeping them interested in the process.

A long-lasting resource

If teachers across a variety of subjects are given training in the use of both 3D design software and the use of the printers, a raft of possibilities for teaching are opened up. Biology, chemistry, and physics teachers could use 3D printers to create study aids that show microscopic, molecular, or even atomic structures, turning difficult-to-conceive ideas and processes into a form that can be studied in far more detail than would otherwise be possible if a simple 2D image in a textbook was used.

History departments have the potential to print items of historical significance, creating learning experiences that would before have only occurred during school trips to museums; art departments can design and print out specialised tools; even maths teachers could benefit, using the inexpensive plastic models as teaching aids for algebra, calculus and trigonometry.

If each and every one of a school's various departments were given access to a 3D printer, over time a vast and permanent bank of teaching aids could be amassed, giving teachers and pupils a quick and easy means to showcase and understand all sorts of information.

It's the future

Although less than a decade old, 3D printers are poised to completely change the way in which we manufacture goods. Creative and design occupations will easily make use of the tech, while new and innovative technologies will be spawned in the STEM sectors. In the future we'll also likely see the technology being used in the medical and pharmaceutical fields too.

Allowing learners to get to grips with a tool that they will probably use in their adult lives matters enormously – imagine what digital literacy levels would be like if ICT lessons hadn't become a school staple decades ago! ■

Want to know more about the 3D printing process? Take a look at Middlesex University's [3D printing guide](#).



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SECRETS OF LEADERSHIP SUCCESS

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Leaders tend not to complain – they just cruise silently to Burnout! Pressure of the job, family sickness, deadlines to meet, parent-teacher evenings, contracts to negotiate, elderly parents with health issues...! Even where they can successfully switch between the two, over time it can take a toll and leave them out of Flow [i.e. stressed]. And that's not a good place for a leader to be!

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You can download the worksheets for Creating your Vision Statement **HERE**.

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The EU Urban Agenda for our cities of tomorrow

European Parliament MEP, Lambert van Nistelrooij outlines why cities are the engine for economic growth and are integral for the EU Urban Agenda...

Cities have the future. While the regions in Europe always had the 'first' attention from Brussels, the spotlights nowadays have to be on the cities as well. For Europe, cities are engines for economic growth and employment, the breeding grounds for art, culture and creativity and the perfect platform for innovation and start-ups. Therefore, urban areas also play an important role in achieving the EU 2020 goals due to their concentration of people and economic activity. To fulfil this potential of urban areas, coordinated action at all levels of government is needed. This year, during the Dutch Presidency of the Council of the European Union, we will intensively integrate the cities in Brussels policy. We have to come to an EU Urban Agenda in which cities take the lead.

For years, European policy for the cities has been fragmented. Instead of fully including cities in the

mainstream policies, the European Commission, for example, has come up with initiatives to realise the so called "Smart Cities", at the same time "Smart Specialisation" has been adopted for regional policies. Those region policies apply to the cities in Europe as well. For this reason, better coordination of EU policies is important. Smart Cities as well as Smart Specialisation have been quickly adopted by policy makers and now translated into specific EU policies or initiatives. Both are of relevant importance for the cities in Europe and have to take into account together.

Smart Specialisation is all about making the right choice: a region chooses its priority, uses the benefits and shares the acquired knowledge with other regions in the EU. A Smart City is logically doing something similar. A city that uses its possibilities, that is driven by the strengths of its inhabitants and is reaching an enjoyable and user-friendly place, is doing a smart

business. We simply cannot create Smart Cities without Smart Specialisation and vice versa. To really fulfil the potential of cities in Europe and to meet the EU 2020 goals, like sustainable growth and more jobs, the 2 smart concepts have to become a combined and excellent one.

The priorities of Smart Cities

That's the gap in Europe we have to close. The EU Urban Agenda can deliver new possibilities to make this happen. There are eleven priorities set up so far by the European Commission to develop Smart Cities. I will highlight some of them. Above all, citizens have to come first. They are at the heart of the challenges cities daily face and have therefore a say in the creation of a city as an enjoyable and user-friendly place. With a better understanding of their behaviour, cities could make effective policy and adopt citizens in their smart strategies. Cities could also be more attractive and competitive when inhabitants as well as business people can travel in an easy and sustainable way. An improved and well-connected public transport system is needed. This will help to meet the EU 2020 goals. With 'greener' public transport systems they improve air quality and tackle congestion.

In line with this, cities need to create new and innovative infrastructure networks in their own area, but also across different urban areas. This will include road systems, energy-infrastructures (new ways of lightning) and communication and information networks. A city therefore needs technological improvement to be that innovative frontrunner in Europe. This encompasses the use of ICT and the use of collected data. These new techniques are part of new solutions. They could for example help to create a more interactive and responsive city administration, but also to create safer public spaces through security cameras on demand. By collecting data, we need to find a way to use this information effectively and wisely. Switching to smart cities requires thus investments and coherent policy.

For creating this coherent policy, a link to the regional strategy for Smart Specialisation is needed. We often do speak about cities self-contained, but in fact we have to

speak about urban areas. Cities are not operating alone. Cooperation with their neighbour surroundings will help cities to be successful. By sharing their acquired knowledge, they will create smart, or even excellent, areas together. Therefore, we do not need more policy regarding urban development. It is about time to start this kind of fruitful cooperation. The focus of the EU Urban Agenda has to be on finally creating one policy for this cooperation.

Empower the cities

The EU Urban Agenda will be even more effective when it is not just a declaration, but when it will also lead to an agreement in which cities are empowered. During the Dutch Presidency this agreement will be set in the 'Pact of Amsterdam'. The intention of the Pact of Amsterdam is to create a bottom-up approach. A direct commitment between the cities and the European Commission will exist. Cities will have the possibility to express their ideas, their knowledge and their fears. They have also the possibility to bring up their events and initiatives in the EU 2020 framework. Cities in the end will be affected by the legislation and do understand best the impact that this legislation will have.

Together we will build a strong European framework for sustainable and intelligent cities. This will be the EU Urban Agenda for the cities of tomorrow with the possibility to agree on "City Deals": for the moment there is €371m available from the European Regional Development Fund. ■

Last autumn I have published a booklet about the importance of the EU Urban Agenda. Please find an online version of the publication here: http://issuu.com/eppgroup/docs/schijnwerpers_op_de_stad

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Building renovations – The Nordic way

The Nordic Built “Active Roofs and Facades” project has received support from Nordic Innovation, EUDP(DK), Energimyndigheten(SE) and Rannis(IS) allowing strong development of leading Nordic competences in the area of building renovation. This is achieved by creating transnational Public Private Partnership models to support the development of nearly zero energy building solutions and associated performance documentation – which is required in the EU building directive.

The proposed cooperation with the building industry on developing models and the demonstration of “Active House” based sustainable renovation is creating a strong Nordic alliance.

The project runs from 2014 to 2017 and involves companies which are represented in the Nordic countries and companies, from the international Active House Alliance. The development will use the best transnational competences and networks, creating greater possibilities to export technology.

The background of building renovation in both Nordic and European projects, where energy use is often 30-40% higher in practice, compared to what was expected from calculations and where innovative solutions are seldom used, is very much connected to the way the building industry is organised. Here consultants will normally only want to operate in a

conservative way. This is because, they are not only selling their expertise, but also the insurance that goes with it, and due to consultants fees being considerably reduced, it is common to work with well-known large suppliers, who can contribute to large parts of the design process. This means there is a tendency to not choose the most energy efficient solutions, but to allow more mediocre and old fashioned solutions, that the suppliers prefer. It is also common knowledge that detailed performance of equipment in practice is never controlled, there is no incentive to perform better, and higher energy use will often be explained by the user behaviour.

A main issue of the proposed Nordic Built project will be to realise the renovation projects in a much better way and secure positive involvement of consultants, so they can be more proactive, e.g. by full scale testing of innovative solutions before large scale implementation. And, by monitoring key performance indicators as a basis for negotiating guarantees of performance results as part of the overall procurement process, something which also might be used to avoid normal tendering in connection to development of renovation projects.

An important challenge is to introduce holistic oriented demands in the so-called Nordic Built Charter in practice, in involved demonstration projects.

Further background of the Nordic Built Active Roofs and Facades in Sustain-



Work on innovative ventilation solutions with heat recovery. Demonstration of improved decentralised heat recovery ventilation with low electricity use. Window integrated heat recovery ventilation in Sydhavnen in Copenhagen has been made in 2013 with great satisfaction for the involved tenant also because there was absolutely no noise and the combined injection of paper granulate insulation in the floors along the facades ensured a much lower air leakage than before. Each of two units only uses 5-6 W of electricity when providing approx. 50-60 m³/h of 95 % preheated fresh air

able Renovation project Coordinated by the Danish energy specialist company Cenergia, the project will utilise the results from the recently finalised EU-Concerto project Green Solar Cities (www.greensolarcities.com).

These results has been presented in a book by Routledge/Earthscan in 2015, while main results from Copenhagen

are illustrated in the two small videos below:

<http://vimeo.com/98926904>

<http://vimeo.com/98926905>

Important features of the workplan is e.g.:

To work along side Active House Alliance (www.activehouse.info) aiming at involving Nordic best practice producers and using the Active House Specifications in practice. Here the Finnish company ZED Consult will give a special input, whilst at the same time comparing it to existing certification schemes like LEED, Bream and DGNB as well as the Nordic Built Charter in general.

Both innovative and best practice solutions will be full scale tested in cooperation with the housing association, KAB (DK). This will realise the overall winning project of the Nordic Built Challenge architectural competition, Ellebo Garden Room in Ballerup near Copenhagen and the WSP Group working with the housing company

Trianon in Malmø, as basis of later implementation of sustainable renovation in Denmark and Sweden. There will be a special focus on innovative building integrated PV modules from the Danish company Gaia Solar together with Steni façade and roof plates with a long service life.

Besides new decentralised heat recovery ventilation (HRV) solution developed for housing renovation by the Danish companies, Øland and Ecovent will be full scale tested and documented. Innovative features that will be introduced here are window integrated inlet of air, use of a new type of "automatic filter shift box", which only need to be exchanged every 10 years. And, the use of a new intelligent control device which allows for continuous registration of airflow and electricity use through the internet. At the same time this secures a reading of the mean seasonal factor of performance (SFP) and general survey of operation.

As an alternative there will also be a focus on compact window integrated HRV solutions, both for housing



School facade in Copenhagen with window integrated heat recovery ventilation

and schools. The benefit here will be much lower total costs due to the avoidance of large amounts of duct work, but the challenges include an optimised operation in correspondence with a minimum air exhaust possibility from wet rooms based on humidity sensors. Besides this, handling of condensate from the used air in a way that does not create problems.

In Norway the building renovation specialist company, Høyer Finseth, will work with full scale testing of best practice solutions and will at the same time work with the Norwegian solar thermal panel producer AVENTA.



Here is shown an optimised decentralised HRV system from Ecovent / Øland mounted under the loft in connection to urban renewal at Gl. Kongevej in Copenhagen



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On the way to sustainable concrete structures?

Prof. Dr. Bernhard Elsener of ETH Zurich - Institute for Building Materials details the importance of achieving sustainability within the cement industry...

In many countries around the world, Portland cement has for decades been the most used type of cement to build reinforced concrete infrastructure. For new structures that will be built in industrialised and emerging countries to expand the civil engineering infrastructure, the challenge is to achieve long service life, practical, cost-effective solutions with materials having a reduced environmental footprint. To achieve this, the cement industry made great efforts in substituting clinker (responsible for great part of the CO₂ emissions) with supplementary cementitious materials (SCM) such as limestone, fly-ash, geopolymers etc. This substitution is ongoing and reflected in the decreasing amount of Portland cement and the increase of blended cements. However, achieving sustainability clearly not only requires decreasing the environmental footprint of the materials at the time of their production (reducing the clinker content), but to combine this with long and maintenance free service lives of the structures in their actual exposure environments.

Durability of reinforced concrete

Achieving strength similar to Portland cement is not a problem with new binders, thus blended cements can be used to build concrete structures. From the point of view of the end user (engineer, owner of the structure, society) the long-term durability of reinforced concrete structures has to be guaranteed. Experience and research on corrosion of reinforcement in concrete made of Portland cement have shown that the very high alkalinity of the pore solution ideally protects the steel. The introduction of non-Portlandite binders has strongly increased the diversity of the pore solution chemistry in concrete. One important factor is that the hydroxide (OH⁻) concentration in the pore solution of systems with SCMs is typically about a factor of 10 lower than in Portland cement systems;

this results in a proportionally lower tolerable chloride concentration for corrosion initiation. Additionally, also the pH buffer capacity is generally depressed as a result of the reduction (or elimination) of the calcium hydroxide reserve considered one of the main reasons for the corrosion inhibiting nature of Portland cement systems. On the other side the new binders might show a higher chloride binding capacity, eliminating part of the aggressive chloride ions from the pore solution. Whereas it is clear that the different pore solution chemistry of concrete made with blended cements will affect the corrosion protection of the reinforcing steel, precise information on how much are not (yet) available. Despite the ongoing massive use of the new blended cements convincing answers regarding the long-term durability of these new structures, both regarding the resistance against carbonation and against chloride-induced corrosion, are lacking.

Service life prediction

Due to the lack of long-term experience on the field performance of modern binders, engineers are forced to make predictions, essentially to extrapolate the short-term behaviour from laboratory tests to long-term and field conditions. These predictions are based on well-established data for chloride ingress into Portland cement concrete: the chloride concentration is determined in different depths from the concrete surface both in laboratory tests and in cores taken from structures under different exposure conditions. Experience has shown that these chloride profiles can be approximated with the solution of Fick's second law of diffusion, as a result the apparent diffusion coefficient D_{app} can be determined. D_{app} is related to concrete quality: a small diffusion coefficient relates to high concrete quality viz. low porosity. The same equation is also used for the prediction of long-



term performance of structures exposed to chloride environments during the design stage or the evaluation of the residual service life of existing structures. Although this approach is simple and used very often, it should be observed that its reliability strongly depends on the parameters utilised, especially the “critical chloride content” C_{crit} , threshold for corrosion initiation. As this value is statistically distributed and varies in a wide range, predictions are difficult or, assuming a low C_{crit} of 0.4% by weight of cement, very conservative. Note that most of the information on the critical chloride content stems from Portland cement concrete – for concrete made with new binders service life prediction is thus highly difficult and has poor predictive power.

Challenges for research

The substitution of Portland cement with supplementary cementitious materials (SCM) will continue. To make this a sustainable solution, cement industry, research

networks such as NANOCEM and individual research groups dealing with durability of reinforced concrete structures urge to study the pore solution chemistry of concrete made with new blended cements, its variation with time and to link these findings to the conditions for corrosion onset when chloride ions or CO_2 penetrate into concrete. Without convincing results blended cements reduce the CO_2 emission in short term but might fail to be a sustainable solution in long term. ■

Prof. Dr. Bernhard Elsener

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Corrosion rate of steel in carbonated concrete made with modern binders

Concrete and reinforced/prestressed concrete is and will be the main construction material for civil engineering infrastructure. Much more than in the past this construction technology faces challenges that have been discussed at the International RILEM workshop held at ETH Zurich in Switzerland on 17-18 April 2012¹.

For new structures that will be built in industrialised and emerging countries to expand the civil engineering infrastructure, the challenge is to achieve long service life, practical, cost-effective solutions with materials having a reduced environmental footprint. To achieve this, cement industry made great efforts in substituting clinker (responsible for great part of the CO₂ emissions) with supplementary cementitious materials (SCM). These modern binder systems containing limestone, fly-ash, burnt oil shale etc. in a complex blend (see e.g. European Cement Standards EN 197-1) are

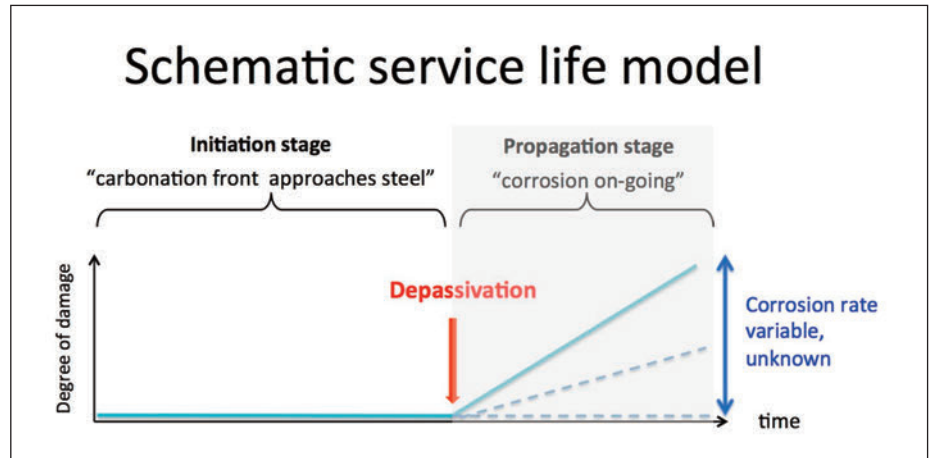


Fig. 1: Service life model of a reinforced concrete structure exposed to carbonation. At the end of the initiation period the steel is depassivated and corrosion can start

increasingly used worldwide. This ongoing substitution is reflected in the decreasing amount of Portland cement (CEM I) and the increase of blended cements (CEM II, CEM III etc.). Whereas these new blends are suitable for achieving strength similar to Portland cement, thus can be used to build concrete structures, their long-term durability when used to make the final product concrete is far less established. The key durability chal-

lenge for engineers in the design process of new concrete structures lies in predicting long-term performance of these new materials with an ever-increasing diversity of cement blends.

To address durability of reinforced concrete structures, the European concrete standard EN 206-1 defines exposure classes (a kind of standardised environmental conditions) and the (national) requirements for concrete such as water/cement ratio, minimum cover depth and minimum cement content. Concrete for a bridge in the Swiss mountains exposed to a severe climate and de-icing salts (exposure condition XD3) must be of much higher quality (lower w/c ratio, higher cover depth) compared to concrete inside a building (XC1). This prescriptive approach is based on long-term experience of the past.

Long experience with concrete structures made with Portland cement (CEM I) has shown that carbonation,



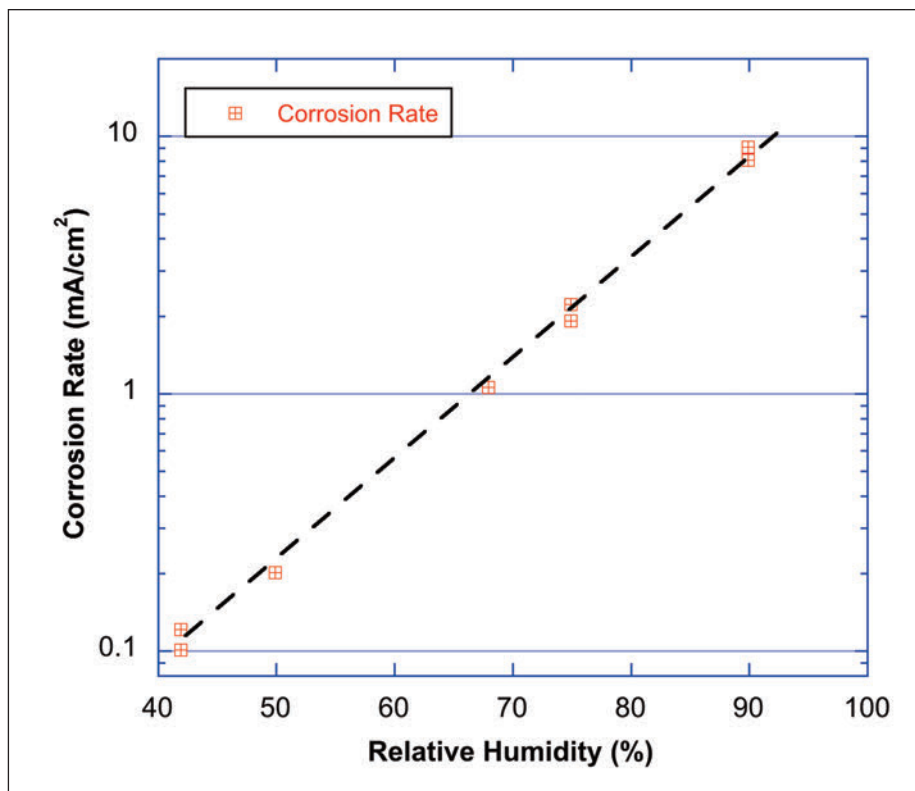


Fig. 2: Influence of relative humidity on the corrosion rate of steel in carbonated OPC mortar adapted from C.L. Page et al.⁴

thus the reaction of CO₂ from the environment with the alkaline components of concrete leading to loss of the corrosion protection of the reinforcing steel, was not a problem for durability. Concrete cover, water / cement ratio and cement content according to the prescriptions for the exposure condition and good execution were sufficient to avoid corrosion due to carbonation. For the new blended cements with SCM – despite they are increasingly used – this is questioned. Due to the reduced clinker content, the pH of the concrete pore solution is lower, the alkali reserve is reduced and questions arise regarding the corrosion protection of the steel². Thus the traditional prescriptive approach with exposure classes and deemed-to-satisfy rules might no more be sufficient in this new situation.

The carbonation of concrete made of new, blended cements is now increasingly studied. It is quite established that the well-known laws that

describe the propagation of the carbonation front into OPC concrete can be applied for new blended cements, too. However the rate of carbonation process, expressed with the carbonation coefficient *K*, seems to be much faster at least for some of the modern binders³. Thus the carbonation front reaches the reinforcing steel much earlier and the steel becomes depassivated (Fig. 1). In presence of oxygen and humidity corrosion can start².

One approach to achieve the required long service life also with modern binders would be to include also part of the propagation period (Fig. 1) – thus the corrosion rate of steel in carbonated concrete becomes of utmost importance. In principle, the corrosion rate will vary according to the exposure conditions and the concrete quality² and work on Portland cement concrete shows an exponential increase of corrosion rate with relative humidity (Fig. 2). Detailed and quantitative information for concrete made of modern binders is lacking. A

research project at the Institute for Building Materials at ETH Zurich “Corrosion rate of steel in carbonated concrete” is addressing this open question. In order to limit the time needed for full carbonation, thin samples made of cement paste and mortar containing different modern binders are produced. On these samples the corrosion rate, oxygen diffusion and resistivity can be measured as a function of composition, exposure condition (relative humidity) and time. Results of this research will allow a much stronger link between durability related performance characteristics of the new cements and the properties of concrete. In particular it will become clear under which conditions the corrosion rate in carbonated concrete can be considered negligible.

1 U. Angst, R.D. Hooton, J. Marchand, C.L. Page, R.J. Flatt, B. Elsener, C. Gehlen and J. Gulikers, *Materials and Corrosion* 63 (2012) No. 12

2 L. Bertolini, B. Elsener, E. Redaelli, P. Pedferri, R. Polder, *Corrosion of Steel in Concrete – Prevention, Diagnosis, Repair*, WILEY VCH second edition (2013)

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4 C.L. Page et al., *Corrosion Science* 12 (1991) 1283

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Photo: Christina Fryle/Varbergs Fotoklubb



Photo: Malin Bellman



Photo: Mimmi Persson

The City of Varberg calling for peace

For the coastal city of Varberg, Sweden, 2015 was the year when the community united in the name of peace and human rights – just as they did at an international peace summit held there 100 years earlier.

As the anniversary of the peace summit approached, here in Varberg we chose a different way to celebrate. The result was the VARBERG CALLING for Peace project, which involved residents actively working for peace and a sustainable society.

The municipality has an active role to play and sees the project helping Varberg towards its vision to becoming the Swedish West Coast's creative hotspot, with the help of local residents.

VARBERG CALLING for Peace is an opportunity, therefore, for Varberg municipality to take a forward-looking, general approach to a sustainable future.

Come to Varberg. Share our vision.



**VARBERG
CALLING
for Peace**



**The City of
Varberg**

www.varberg.se

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How upcoming rail developments are safeguarding talent for the future

Neil Wilkie, Group Head of Fusion People, discusses the impact of rail developments on the job market...

The UK's rail network is undergoing a huge overhaul at the moment with the Crossrail, HS2, Thameslink Programme and the Great Western Electrification project all coming together to upgrade, extend and improve British railway lines.

Most of these projects are well underway and set to continue into the next decade, so what has this investment meant for the job market?

Unsurprisingly, these rail projects that span across the UK have opened up a number of opportunities for both specialists in rail and those in the wider supply chain. Everything from the design of new rail lines to the safety checks that need to be carried out involve people from almost every industry, offering roles in all specialisms.

Last year's engineering report found that despite the increase in people choosing engineering as a career

path, more people were needed to avoid a significant skills gap emerging. Based on forecasted projects, the report explained that 2.56 million people will be in engineering roles by 2022 and that a staggering 257,000 of these would be new vacancies.

As a result, the focus is on engaging younger recruits into engineering through initiatives like 'Tomorrow's Engineer'. This is where the wider industry goals of engineering are aligning with the rail sector itself; the new rail developments have inspired a drive for apprentices and entry level engineers to solidify their skillset and become specialists through their work on these niche projects.

The Crossrail project, with an investment of £43billion is a heavyweight in terms of rail development that has already provided 10,000 jobs and 400 roles for apprentices. By the end of 2026, this figure is likely to triple, opening up opportunities for 30,000 people.



not alone. One training centre takes in 240 apprentices a year with its tailored programme for rail engineers. This may not sound a lot, but more than 10,000 people have successfully completed training at this dedicated centre. The key to safeguarding our rail network is in ensuring there are enough people entering the industry with the right skills and the government are supporting this with their pledge to introduce 2 million apprentices into the industry by the end of their term.

Training and support is not isolated to the younger, inexperienced engineers that enter the rail industry. Projects like the Crossrail and Thameslink enable experienced engineers to become specialists in their niche field. Similarly, dedicated academies offer reactive courses for existing engineers to gain new skills for any industry developments or advances.

The excitement and challenge of the likes of the Crossrail development or the Great Western Electrification have opened up opportunities for thousands of engineers, construction workers and supply chain operators and hopefully inspired a generation of new talent.

However, these new developments will also boost the job opportunities for people working in other industries as the higher volume of trains and faster connections mean that it's easier to commute to the larger cities, where the best jobs are found.

The UK's rail network is undergoing some major changes that will help further connect the nation. To find out more about the UK's rail projects check out these helpful infographics. ■

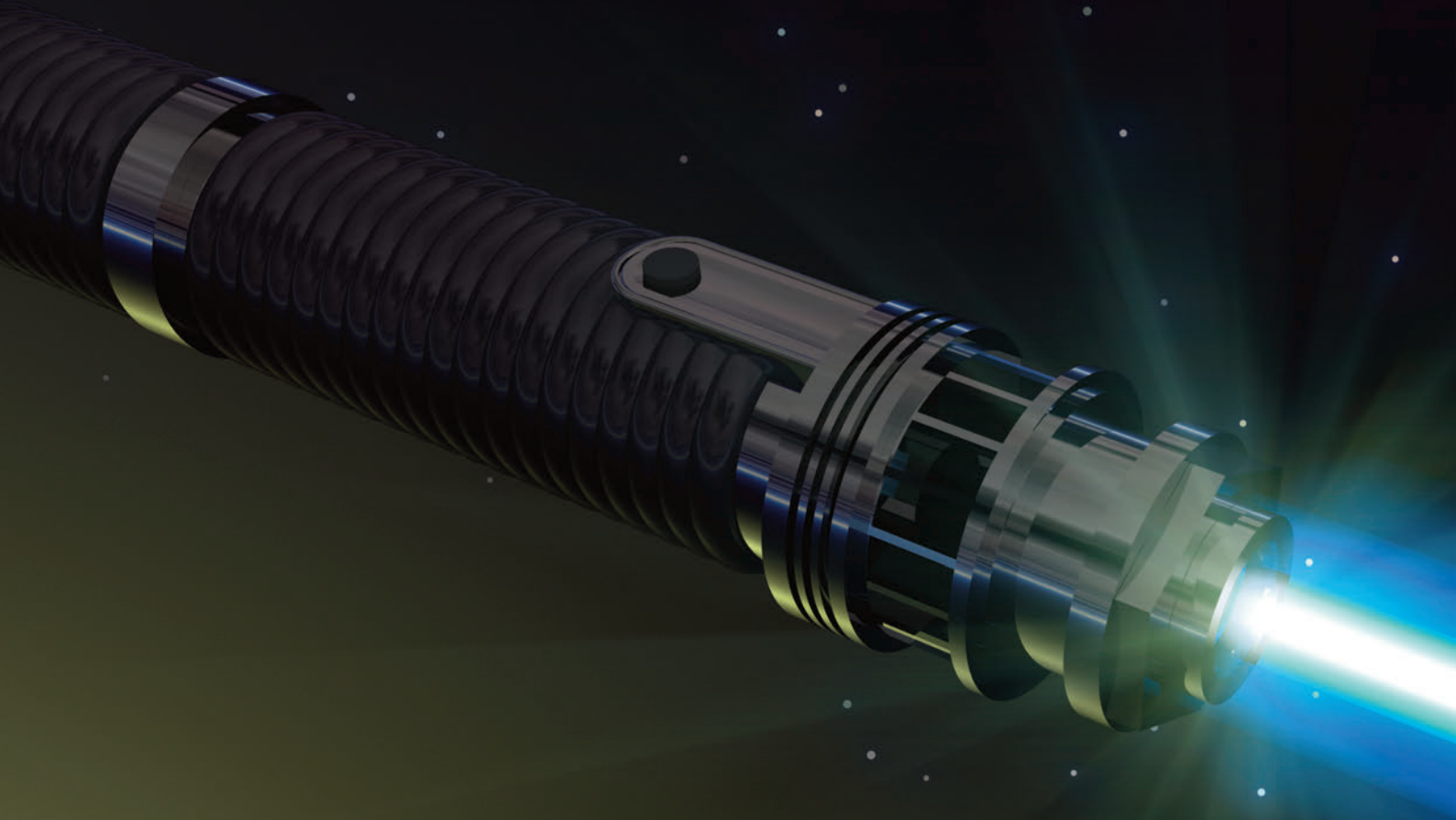
.....
Neil Wilkie
Group Head
Fusion People
www.fusionpeople.com

The Crossrail project even has a dedicated training centre, which equips people with the engineering skills they need for the project and then to further develop their career.

Outside the capital, work is set to begin soon on the High Speed 2 railway network and the technical demands of the project is expected to open up opportunities for more than 70,000 people across the UK. Like the Crossrail project, the HS2 is associated with a further education college where engineers are trained in the appropriate skills for the project to become specialists.

It is refreshing to see such significant rail developments promoting the need to nurture and train engineers within the UK to ensure there's enough talented workers to meet demand in the not too distant future.

These dedicated academies for specific projects are



BIM 4 FM – May the force be with you

Mike Packham, Partner of Bernard Williams Associates and BIFM member provides the highlights from May Winfield's recent presentation examining the dark side of the legal issues surrounding BIM and the FM sector...

As I sit writing this article the latest film in the Star Wars series (The Force Awakens) is hitting the big screens; it is going to be a blockbuster by all accounts. Meanwhile, back on earth in the world of facilities management (and construction for that matter) we have our own blockbuster approaching at a rapid rate of knots (although not as fast as a Star Wars X-wing fighter of course!). I am referring to BIM Level 2 which, as we should all know by now, is due to come into force from April 2016.

I have mentioned in previous ramblings on the subject that I think the message about BIM and Soft Landings is finally getting through to the wider FM

community. This is borne out by a recent event which I attended which was a sell-out. Organised by the BIM4FM group under the title of "BIM Level 2 – Ready, Willing and Able?" the event started with presentations by 3 keynote speakers:

- The process framework; David Churcher, Lead Author of PAS 1192-3;
- The systems framework; Steve Owen, Senior FM Consultant, FM180;
- The commercial framework; May Winfield, Senior Associate, Kennedys.



Her paper started off in a relatively low key manner but quickly got onto the more worrying stuff that we in FM need to give careful consideration to before dabbling in the world of BIM Level 2.

“...it is worth remembering that there is no standard form of FM BIM protocol (although there is the CIC BIM Protocol but this is more aimed at the design and construction stages).”

Thus from a legal perspective, some of the possible risks associated with the use of BIM were identified as arising from:

- Lack of understanding (by all parties in the supply chain but particularly clients);
- Lack of established principles / standard forms;
- Lack of established case law;
- Lack of standardised practices and / or uniform standards;
- New processes and procurement methods.

All of these, of course, have the potential to lead to confusion, inconsistency, misunderstanding and gaps in liability. Not all of these risks can be fully managed “legally” but clear terms and conditions can help to:

- Avoid gaps in liability and misunderstandings;
- Provide clear allocation of risk and responsibility amongst the various parties involved in the project;

It was followed by a lively panel discussion and I think it is fair to say that the audience concluded that they were BIM Level 2 “willing” but not necessarily “ready” or “able”.

By the time this article is published, a summary of the proceedings will have been circulated so I do not want to say too much more on the subject here. However, much has been said about the benefits to be derived from the use of BIM/Soft Landings and indeed some of the potential downsides. I for one though, had not given much thought to the legal side of things and was particularly interested therefore to hear what May Winfield of Kennedys had to say during her presentation.

- Provide certainty of binding terms in lieu of the more usual non-binding requirements for collaboration.

With regards to the terms and conditions themselves, there are a number of “standard” forms of contract that could be pressed into use (NEC, CIOB and so on). However, it is worth remembering that there is no standard form of FM BIM protocol (although there is the CIC BIM Protocol but this is more aimed at the design and construction stages).

“I have mentioned in previous ramblings on the subject that I think the message about BIM and Soft Landings is finally getting through to the wider FM community.”

So what clauses are needed for a BIM supportive contract? May’s presentation identified these as falling into 5 distinct categories:

- Clauses aimed at providing clarity of process and data – in terms of: what models/data is to be issued, by whom and what should the content be; what is the process for making changes; who is responsible for data storage and security (N.B. link to PAS 1192, Part 5).
- Clauses dealing with interoperability, standardisation and consistency – in terms of: what standards are to be used (e.g. PAS 1192 Part 3, BS 8536 Part 1); what data exchange formats are to be used (e.g. IFC, Cobie); the process for information exchange; measures to ensure compatibility of software.
- Clauses on copyright – in terms of: who owns what elements of the model; who owns outputs from the model; what licences are needed for use for permitted purposes.

- Clauses on risk allocation and limitation – in terms of: the use and reliance by the various parties on the data / models provided; unauthorised use and data loss; warranties/indemnification for the integrity of data issued.
- Clauses regarding standard of care – in terms of: the need for consistency across all of the contractual documents (to avoid unnecessary disputes); definition of the standard of care required (e.g. “reasonable endeavours” versus “reasonable skill and care” versus “best endeavours” – all of which have differing legal interpretations).

In summary then, and to return to my Star Wars theme, if applied correctly, BIM and Soft Landings have the potential to deliver many positive benefits and as such can be regarded as a force for the good of FM generally. However we need to beware the “dark side” as represented by the sorts of legal issues referred to above. I suspect that it is only going to be when we get into the post April 2016 period that we are going to fully understand all of the ramifications of BIM Level 2. ■



ADVANCING OUR PROFESSION

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A data centric solution to a disparate problem

BIM (Building Information Modelling) continues to have a number of frustrations with connectivity and interoperability. The use of different authoring tools, by different disciplines at different stages of an assets life can cause difficulties in collaboration and result in lost time in work arounds, inefficiencies and rework as teams work from incomplete and inaccurate datasets.

Compounding the issues is the file based nature of modern BIM, when everyone wants to see different combinations of information, in different configurations to suit the way they work including Clients that wants to receive an intelligent digital asset linked to location, searchable attributed data and associated documents. We are constrained by the file and model structure established at the outset to best enable the design phase.

To resolve this we need to move to a more integrated data centric approach in which the model is simply the indicator of the source of the design information and the manipulation of the outputs and interaction with specialist tools is managed in a common data environment that is able to compile information to suit the task, the user, the access requirements and even the hardware and security considerations that may exist with complex projects for sophisticated clients.

Empowering our clients to use BIM to realise better digital management throughout the lifecycle of the design, construction and operation of assets

for capital intensive industries now seems core to the real changes necessary to respond to this opportunity. Undertaking such an approach drives out waste through data driven workflows that streamline information management and realise the capital cost reduction by making BIM available to all and allowing users to simply do things right first time.

This leads to a better informed world with information available at the point of use appropriate to the task at hand:

- Creating both 2D and 3D model files that provide geometric representation of the real world capital plant and equipment in design.
- Providing locational representation of the content, expressed visually and relevant to the other elements throughout the assets lifecycle.
- Collaborating in an environment that helps the entire team work together to produce co-ordinated outputs.

This data centric approach is core to the Clearbox solution architecture which has at its heart a data driven platform that federates the information around the consistency of the data. The solution provides the intelligent integrated links between location, associated data and documents. Federating these sources of locational information around the data as opposed to the models allows all the information to be seen in one form irrespective of the source and this allows 2D, 3D and multiple authoring



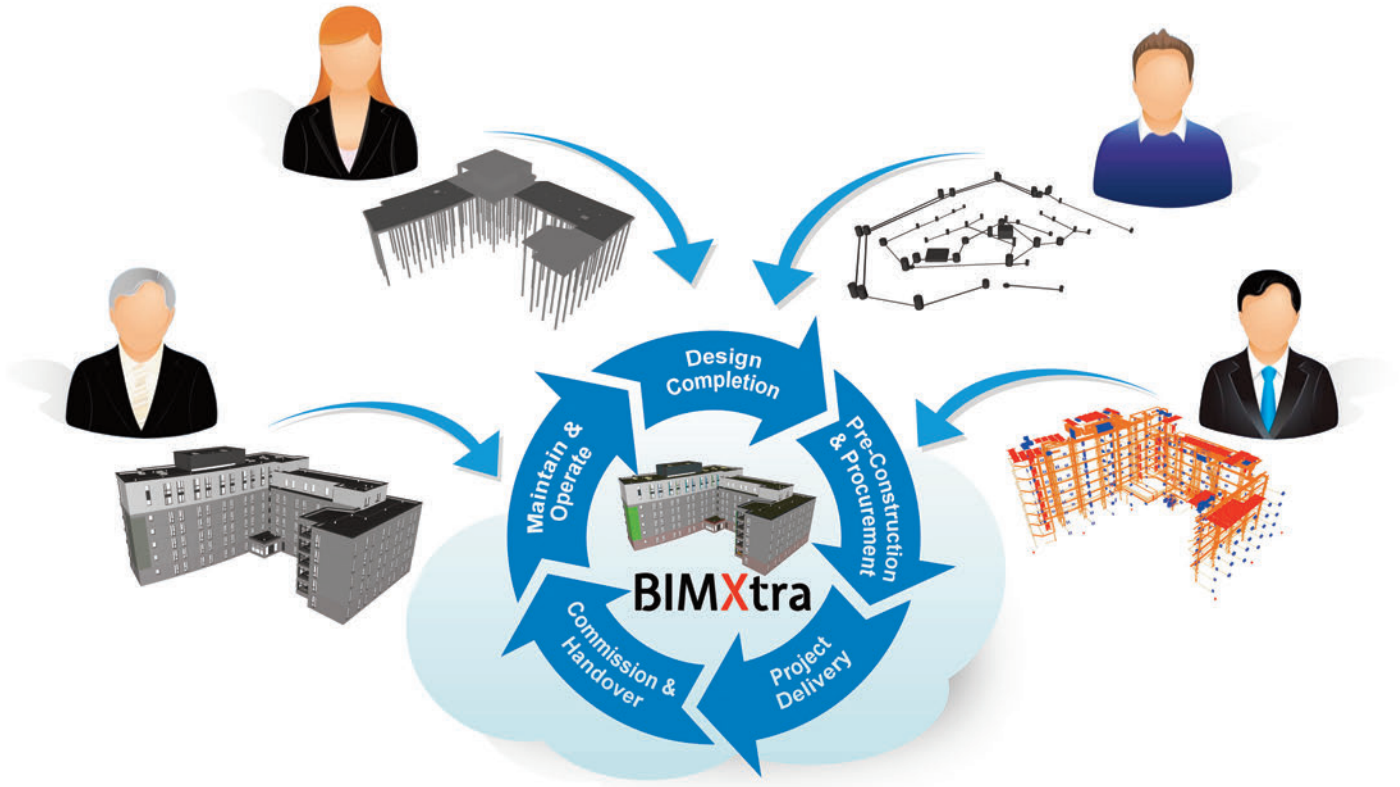
environments to be accessed in plain language as an integrated source of information.

“Much will change from the introduction of BIM and Clearbox plan to continue to stretch the opportunity from BIM as it matures in the market.”

A purpose designed viewer allows visual access to the integrated environment which by virtue of the data centric core can control the viewing and accessibility to ensure most hardware can be used with suitable access control and management of information applied at an object level instead of the traditional file level.

Clearbox aim to provide this end game as “information at the point of use, delivered pre-prepared to suit the task at hand, to enable a great customer experience”. In essence while data management can take place at the most awesome processing speeds in the cloud, the issue of how fast the user gets to what he/she needs is less about the processing power and more about the right configuration of information to suit the task in hand.

For Clearbox the story does not end there because many of the issues



affecting the asset creation, delivery and operation are wrapped in overcoming the unstructured nature of the data we are exposed to and the consequential ambiguity and weak connectivity that exists between the datasets. Our efforts provide structured consistent data early in the process to allow other tools to interface and make better use of the structured datasets managing the impact of change and saving on time spent manually in more traditional transactional processes.

BIMXtra (our cloud based common data environment) sets itself apart by using the object as the common element found in every combination of the datasets required to create the information. By managing change on an object and its associated data and by enabling the addition of a variety of additional metadata on each object the process of managing the information is quickly enabled as structured data in which the limits of what can be processed within a project in this master data management approach are more a function of aspiration and configuration than technical constraint.

The availability of structured data in such an approach is now realised much earlier in the regular course of project delivery than would be the case from more traditional file based approaches. Access to this common source of data and the ability to update subsets of data attached to an object also extends the extent of data processing that is available but then goes on to create files to provide a record of the data transacted, the configurable processes building on the structured approach of BS & PAS 1192 with WIP, Shared and Published areas of information.

As such, real time project controls mapped to the objects record the outputs as an auditable trail of the process and help to drive efficiency, accuracy and availability of consistent information delivered from a consistent business process.

In reality while BIM needs open standards to make the information more transportable between applications the more productive stretch on current tools is the ability to consistently manage the existing information deliv-

ered in a consistent form at the point of use. Much will change from the introduction of BIM and Clearbox plan to continue to stretch the opportunity from BIM as it matures in the market. In reality the benefits are compelling and compare the transformation many business have made applying ERP in place of file based processes to their back of house accounts. We expect to see a significant move to a master data management approach to BIM over the coming years as the versatility, efficiency and familiarity of such approaches grow.



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Defining Digital Built Britain

Paul Oakley, BRE BIM Director examines the current state of play in the drive for coordinated data standards for information exchange, in order to deliver on the Digital Built Britain goals...

The BIM Level 3 vision for Digital Built Britain involves seamless information sharing across semantically linked systems using open data standards. It states that “Over the next decade technology will combine with the internet of things (providing sensors and other information), advanced data analytics and the digital economy to enable us to plan new infrastructure more effectively, build it at lower cost and operate and maintain it more efficiently.”

“What has been established is that we need an international standard made up of both International and Local nationalised requirements for product data templates, developed and approved by the appropriate experts within their field.”

However, on Saturday I was asked the question by an 8 year old which throws the whole concept of this vision into doubt. “What do we call the sides of a rectangle?” I then had to explain that this is the question that I have been asking all over the world, including the plenary at the buildingSMART International Summit in Singapore and the present answer is “whatever you want...” However, wouldn't it be nice if we could all agree on a standard definition, delivered in a standard text case and that these definitions were mapped to an international dictionary (IFD) of terms to allow translation into any language?

Basic shape definitions which would allow shared information sources to update the parameters on BIM objects are only one aspect presently unresolved. There are still many requirements for basic definitions required to allow information exchanges to make the BIM Level 3 dream come true. The reality is many are

presently struggling with BIM Level 2 deliverables, due to a lack of consistent data standards for the most basic things, and many are blaming COBie (Construction Operations Building information exchange) as the exchange mechanism, rather than the poor data management processes they are presently using.

Many commercial library providers have recognised this problem, but have complicated the issue by attempting to differentiate themselves from the opposition and create their own bespoke methodology. Manufacturers attempting to engage within the BIM process are paying large sums of money hoping they have backed the correct commercial BIM Library supplier, such as NBL, BIM Store or BIM Objects. The issue here is that each use their own BIM Objects standard; claim compliance with the British Standards by interpreting them differently and leaving chaos for those trying to deliver coordinated structured project data. This was proven by the recent Product Data Capability Trial undertaken by [buildingSMART UKI](#) and published in the July edition of [OPEN BIM FOCUS](#).

The issue of a coordinated data standard for information exchange has been around for many years. Initial work on IFC Property Sets addressed some of the issues in the late 1990s, but these have not been developed further for many years. [Specifiers' Properties Information exchange](#) (SPIe), [CIBSE](#) and others have started producing Product Data Templates for specific products. BIM for Manufacturers, under the [BIM4M2](#) title have also been looking at the issue whilst BRE have been looking at BIM Object Data Standards to aid with its own digital application solutions and along with bSUKI, have been working with the [buildingSMART International Product Data room](#) attempting to reach a global solutions to this problem.



“Manufacturers attempting to engage within the BIM process are paying large sums of money hoping they have backed the correct commercial BIM Library supplier, such as NBL, BIM Store or BIM Objects.”

What has been established is that we need an international standard made up of both International and Local nationalised requirements for product data templates, developed and approved by the appropriate experts within their field. The buildingSMART product room has been looking at the international work being undertaken within this area and similarities across international boundaries have already been established. BRE is presently creating a tool for the UK to aid Data Product Templates and linking the requirements to the buildingSMART data dictionary. This will help the various groups identified above in undertaking this aspect of work to create and validate Product Data Templates based upon International standards, but also extend these where gaps are established. The PDTs established will have the appropriate rigor associated with them and will be available for manufacturers to implement as they require.

The Product Data Templates are just collections of agreed data that should be provided by Manufacturers, Suppliers and Library vendors. These are structures by property sets which are in turn standard collections of attributes delivered in a consistent manner to aid the information flow.

The intention is to aid the industry by providing application programming interface (api) services to make it easier for both suppliers and consumers of

product data to share information using web service linked tools. Implementation of the product data template (PDT) by manufacturers into product data sheets (PDS) will enable designers using BIM authoring tools to directly link to the latest manufacturer’s information.

The intention of BRE, buildingSMART UKI and many others sharing the dream is to provide the UK industry with a standardised data structure for building products and materials in order to facilitate the Digital Built Britain vision. However, there are still many basic issues for BIM Level 2 presently left unresolved. So what are we going to call those sides of the rectangle? ■



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Managing fire safety in hospitals

Adjacent Government highlights the problem of failing fire alarm systems in hospitals around the UK and how the Department of Health guidance document aims to help to tackle the issue...

When it comes to public buildings such as hospitals and schools, fire safety is one of the key issues that needs to be monitored. In October last year nearly £14m was spent trying to correct fire safety failings at Carlisle's Cumberland Infirmary. In July of the same year the [News and Star newspaper reported](#) how patients and staff were evacuated from the Infirmary following the failure of the automatic fire alarm system. Concerns were raised regarding fire safety at the hospital just days before the fire, which broke on the first floor of the building.

This begs questions regarding the regulation of fire safety in hospitals and accountability for ensuring that all fire systems in place are up to working standards. Following the fire in Carlisle a spokesperson for Health Management Carlisle said the incident was caused by a worker, employed by a sub-contractor, who failed to follow proper procedures during maintenance work on the system.

"We take incidents of this nature extremely seriously. We are reviewing our procedures to ensure this type of incident cannot happen again," he said.

The Department of Health has guidance documents setting out recommendations for the management of fire safety in healthcare buildings to ensure episodes of this nature are avoided. [The Health Technical Memorandum 05:01: Managing healthcare fire safety](#) (second edition) is intended to assist in determining the appropriate fire safety management system to be applied to healthcare organisations.

Following the fire at the Cumberland Infirmary in Carlisle, bosses at North Cumbria University Hospitals NHS Trust have trained 127 fire wardens and introduced hourly fire prevention checks.

An inspection commissioned by Trust bosses revealed that much of the hospital failed to meet the standards required. The News and Star in Carlisle used Freedom of Information laws to obtain a copy of the previously unpublished expert report into the problems, which included:

- Faulty fire safety doors with gaps that would allow smoke to pour from wards into the hospital atrium;
- Incorrectly labelled 30-minute fire doors used in a ward that should have had 60-minute fire doors;
- A defective fire alarm system, which has prompted bosses to introduce the hourly fire safety checks by staff;
- And, a failure by HMC to ensure that its staff were testing the existing fire detection and alarm systems.

In February 2015 it was reported that false fire alarms are costing hospitals in the UK hundreds of pounds in fines. London Fire Brigade began charging repeat offenders in 2014 in order to reduce the time and cash wasted on unnecessary call-outs. Some hospitals were reported to have been visited several times a week, with most false alarms caused by badly maintained systems or things like burnt toast.

Between them the top 10 worst offenders racked up £177,000 in fines, with the NHS facing a six-figure bill in the capital for 2014 due to false alarm call-outs.

[Shadow Health Minister](#) at the time, Andrew Gwynne said: "The NHS can't afford these penalties after David Cameron left hospitals on a financial knife-edge.

"The money is desperately needed for nurses on short staffed wards across London."



Despite a 7.3% drop in numbers following the introduction of the £295 charge for every false alarm after the first nine in a year, London Fire Brigade said they were still responding to one every 15 minutes on average.

Fire detection solutions are an essential part of fire safety, and whether you're public sector, a private household, or a business, your buildings should have these within them. The Department of Health fire safety policy aims to minimise the incidence of fire throughout all activities provided by, or on behalf of, the NHS in England.

All NHS organisations are required to implement the policy and must comply with legislation relating to fire safety; and follow evidence-based best practice guidance where reasonably practicable.

They will also need to ensure that suitable and sufficient governance and assurance arrangements are in place to manage fire-related matters and demonstrate due diligence, as well as having in place a clearly defined management structure for the delivery, control and monitoring of fire safety measures, which is shared across the organisation.

Despite failings at several hospitals including the Cumberland Infirmary in Carlisle, in August 2015 new

[figures released](#) by the Department for Communities and Local Government revealed that fire deaths in England have continued to fall. The figures showed that there were 6% fewer deaths in 2015 than in 2014, which continues a trend that has seen a drop of almost a third (30%) in the last decade.

Fire Minister Mark Francois, speaking about the figures, said people shouldn't be complacent and that fire safety should still be a high priority for households and businesses.

He said: "People are safer than ever before, with deaths from fires at home at record lows – thanks to the combined efforts of households, fire and rescue authorities, and the government and business.

"It is great news that this downward trend in fire fatalities and casualties is continuing but we must not be complacent because one death is a death too many, therefore I urge people to remain vigilant about fire safety and prevention." ■

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Management of fire safety

The Chief Fire Officers Association give an overview of how fire safety management is integral to reducing fire hazards within public buildings...

Many of us take our safety in case of fire for granted. Few of us ever witness a severe fire, our high streets are not filled with burned out shells of buildings and our public buildings seem to be a constant in our lives. For those that know, or have seen the devastation fire can cause, the sights, sounds, smells and feeling of helplessness leave a lasting impression. The feeling of helplessness and loss is perhaps felt more widely in public buildings.

For the most part our safety in case of fire is well looked after. New buildings are subject to building regulations, including requirements for fire safety measures and a process of statutory consultation

means that the Fire and Rescue Authority has to be consulted as to the fire safety of the proposal. For older buildings, there is a strong possibility that the premises was once subject to certification by the Fire and Rescue Authority, when they exercised responsibility for the fire safety measures in buildings.

Today our safety in case of fire is provided in consequence of a risk assessment. The Fire and Rescue Authority is not involved in these assessments (other than inspecting their suitability and sufficiency, according to a risk based inspection programme). Rather the assessment can be done by the person responsible for the premises, regardless of their fire

safety understanding or by a third party. Both methods are fraught with potential dangers. A lack of knowledge and experience can lead to fire hazards being missed or inappropriately mitigated, whereas the third party can lead to those responsible being divorced from the fire safety measures that protect them (assuming the third party has sufficient skills to identify and mitigate the risks).

“For the ongoing fire safety of premises the term ‘fire safety management’ is arguably more appropriate. It suggests the ongoing nature of keeping fire safely under control, which is so important to maintain safe premises.”

The process of undertaking a ‘risk assessment’ might be seen as a one-off process; assess the risk ... job done. (Then review it occasionally). For the ongoing fire safety of premises the term ‘fire safety management’ is arguably more appropriate. It suggests the ongoing nature of keeping fire safely under control, which is so important to maintain safe premises. The constant management of fire safety is vital for the ongoing function of the fire safety measures that are designed and installed to keep people safe.

In common with many subjects, fire safety can be straightforward and relatively simple. Likewise, it can quickly become complicated. For the simple approach the way to achieve fire safety is by continually providing general fire precautions:

- Reduce the risk of fire – keep things that catch fire away from things that can start them etc.;
- Reduce the risk of the spread of fire – extinguish it, close a door on it, keep it trapped;
- Make sure there are enough escape routes (corridors, stairs and doors) for people – they are usually provided but changes in occupancy or use of the building should prompt a review;

- Make sure that escape routes (corridors, stairs and doors) are safe to use when needed – emergency lights in case the fire is in the electrics, fire doors are in the right place and protecting the corridors and stairs etc.;
- Have something in place to detect fire and raise an alarm – fire alarms and detectors of various sorts etc.;
- Make sure people understand what to do if a fire breaks out – employee training and signs for non-employees;
- Have something in place to fight outbreaks of fire (safely) – sprinklers, fire extinguishers, suppression systems etc.;
- Make sure that the effects of any fire will be as small as possible – tell employees how to prevent fires and how to maintain safety and keep the safety measures working properly etc.

When things get more complicated the best course of action is to engage professional help. This is currently an unregulated sector and as such the best way of securing dependable assistance is to use only third party risk assessors who are certificated or registered ¹. If improvement or other works are needed, then both the products and the installers should be likewise third-party certificated. ■

¹ <http://www.cfoa.org.uk/19532>

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Ensuring fire safety

Association for Specialist Fire Protection CEO Wilf Butcher explains the vital role played by passive fire protection within buildings, and outlines issues that must be considered...

Passive fire protection is critically important in ensuring safety in buildings. It is used to protect escape routes from fire and smoke and to maintain the structural stability of a building, giving building occupants adequate time to escape in the event of a fire.

Passive fire protection makes buildings safe by ensuring the building does not collapse and by subdividing it to prevent the spread of smoke and fire. It comprises those elements e.g. fire doors, walls, protection to the structural frame and protection to services passing through walls/floors which are specifically engineered to fulfil this function. In some cases, this may be in addition to their normal function in a building.

It is vital that all passive fire protection measures are correctly designed, specified, installed and maintained if a building is to behave as expected should fire break out. So what are the important issues to consider?

Legislation

Building Regulations usually deal with life safety standards for the design and construction of domestic, commercial, residential and industrial buildings. The provisions are often expanded in Statutory Guidance Documents (e.g. Approved Document B in England and Wales) which give detailed guidance on how to meet the Building Regulations. Depending on local or national regulations, alternative ways to satisfy Building Regulations can use less prescriptive methods, including the engineered approaches embodied in e.g. ISO/TR 13387-1, BS 9999 and DD 7974, which are increasingly used as designers seek more freedom to innovate in building design.

Once a building is occupied, the Regulatory Reform (Fire Safety) Order 2005 applies. This places a



Wilf Butcher,
CEO

requirement on building occupiers/owners /employers to conduct on-going and regular assessments of the fire safety measures within a building to ensure that appropriate fire safety provision is maintained.

The construction process

During the construction process, appropriately specified materials may be substituted for cheaper, less suitable products. To compound matters, follow-on trades for example, plumbers, electricians and dry liners will regularly breach essential fire compartmentation in the process of their work and, whilst competent in their own respective fields of expertise, many of those involved will not have the required skill sets to ensure that they do not significantly compromise a fire compartment's performance in the event of a fire. Third party certificated contractors should always be specified to undertake installation work. This will ensure that works undertaken will use appropriate materials which will be installed correctly.

Similarly, the best guarantee of the quality of passive fire protection products is by third party product certification, which links the tested/assessed product to the actual factory production and ensures traceability



It is vital that all passive fire protection measures are correctly designed, specified, installed and maintained

from raw material to finished product. It is strongly recommended that, wherever possible, passive fire protection products should be supported by third party certification and that clients/developers, main contractors and specifiers should always require third party certification.

Handover

Regulation 38 of the Building Regulations requires that when the construction programme is completed, the main contractor must hand over to the client/occupier the relevant fire safety information, including certificates of conformity from passive fire protection subcontractors. Information on installed passive fire protection will also need to be included in the building's fire safety manual which should be compiled by the designer for the occupier.

Building Control Officers or Approved Inspectors should always ask to see Regulation 38 information when conducting an inspection and should remind contractors to pass this on to the building occupier on completion of the project, refurbishment or extension project. Without this information, it will not be

possible to carry out suitable maintenance or conduct a suitable and sufficient risk assessment.

Maintenance

Most passive fire protection products are robust in nature and require only limited maintenance during their life which can often be the life of the building. However, there are some exceptions and some products e.g. fire doors, fire/smoke dampers and some fire resisting ducts which require inspection/maintenance/cleaning on a regular basis. Provision must be made for this in the building's maintenance programme.

Inspection of those parts of passive fire protection that are not in plain view e.g. firestopping of services above suspended ceilings is also vital to ensure that completed passive fire protection has not been breached by follow on trades who have not made good after their work. It is imperative that any breaches in compartmentation – however caused – are made good as soon as possible. Care must be taken in selecting an appropriately rated repair solution that is compatible with the original installation.

Image: © PS Applications Ltd



Wherever possible, third party certificated contractors should be specified to undertake installation and maintenance work. All Association for Specialist Fire Protection (ASFP) contractors are third party certificated. So, look for the ASFP logo and always appoint an ASFP installer.

Lack of appropriate knowledge both by those that procure fire protection installation services and those that claim to offer such services without a recognised standard of competency, can and does lead to inappropriate installations. If not detected, these will result in a building that is not fit for purpose in terms of smoke and fire performance.

If it is your responsibility to inspect or specify materials and/or appoint an installation contractor, it is also your responsibility to ensure that they can prove competency for the fire protection materials used, or the works to be carried out. You share liability for the usefulness of any system and its operation when it is needed in fire, and that liability will still be there in the event of a court case.

Available guidance

The Association for Specialist Fire Protection offers a wide range of guidance including free-to-view videos and guidance documents. The ASFP has also developed

a new Passive Fire Protection (PFP) Awareness Training Programme, which aims to improve the skills of contractors involved in the installation of remedial passive fire protection, as well as the knowledge base of those involved in the design, supply, inspection and maintenance of passive fire protection. ■

For further information on ASFP training and to access a wealth of advice, technical guidance, videos and publications; all free to download, visit www.asfp.org.uk.



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Fire alarm power efficiency

The Fire Industry Association's CEO Ian Moore, explains the importance of ensuring efficient power for fire and security alarm systems in line with environmental concerns...

Environmental friendliness is second nature to us all now. Going further than moral responsibility, the EU sets much publicised carbon targets to insist we improve green building technologies. Reusable power such as solar, wind and geothermal as the input is a great start, as is maintaining that power by making buildings "efficient" e.g. insulation, LED lighting etc. No opportunity to improve efficiency should be ignored however small it is in comparison with the step changes made by these significant alterations. The built environment accounts for over 40% of overall energy consumption in Europe and over 35% of CO₂ emissions so it is clear that even minor changes when multiplied out will be worth pursuing.

"Design for energy efficiency is now even more complicated with designers and manufacturers being required to consider the whole life cycle implications of product design."

Fire and security systems are now common place in all new buildings. With the focus on technological advances and compliance to a range of standards, there is little attention paid to energy efficiency. Modern fire detection and alarm systems have always had a degree of energy efficiency in their design as they need to have a secondary source of standby power (usually batteries) and in most cases with the requirement of running the detection system for a minimum of 24 hours and more importantly sounding alarms for a minimum of 30 minutes, a significant power requirement is required.

Staying with fire detection and alarm systems; within EN 54-4 (BS EN 54-4:1998 to give it its national name) it is detailed how the batteries should be maintained at the correct level of charge and how fast they must



Ian Moore,
CEO of Fire Industry
Association (FIA)

be recharged. The traditional method has been by trickle charging or float charging the batteries. Basically a float charger will charge a battery at a similar rate as a battery self-discharges, thus maintaining a full capacity battery. However, the main difference between a trickle charger and a float charger is that a float charger has circuitry to prevent battery overcharging.

The more advanced manufacturers incorporate battery management software (including in some cases algorithms) to define how the power is used to charge and maintain the batteries. As an example, EN 54 states that the batteries must be charged to 80% capacity within 24 hours. Batteries do not like fast charging (heat is also an issue, in fact EN 54-4 specifies that the charging characteristic is temperature compensated to achieve the expected life of the battery) so just enough to comply is required to prolong battery life. Once this level is achieved a variety of modes can be applied to limit the amount of power used to charge the last 20% (within an additional 48 hours).



Lead acid battery type is the industry standard but is known not to be the most efficient (or for that matter the lightest or smallest which creates its own problems in storage) so advances in this technology will also reap its own rewards. Maintainers should not be tempted to replace batteries earlier than is required as this will minimise the energy wasted in production or recycling of the battery and reduce the impact on the environment. Measuring the battery capacity using a proprietary tool can allow better judgement to be made of continued battery serviceability.

There has been some great work done by a number of power supply manufacturers in the field of efficiency, but to keep within the strict guidelines of the EN 54 standard there is only so far that optimisation can go. Design for energy efficiency is now even more complicated with designers and manufacturers being required to consider the whole life cycle implications of product design. So it may be that one technology solution uses more material or energy during manufacture that is compensated by consuming less energy during use and end of life disposal or recycling; of course the converse may be true. This should now be part of product design processes.

It's not just new builds that can gain by using more efficient power supplies, some of the efficiencies quoted by various manufacturers will give you a return on investment in a matter of months, therefore replacing what is already fitted (even if working correctly) should not be excluded from the thoughts of users.

So if you're looking to save a bit more energy, then ask the question of your fire alarm and security system supplier – every little bit helps! ■



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Investing in a greener future

EU Commissioner for the Environment Karmenu Vella explains how the EU's LIFE programme can contribute to a low-carbon, resource-efficient and sustainable future...

Natural resources underpin our economy and our quality of life. But the world's population is rising sharply, and coupled with the impacts of climate change, ever greater demands are placed on land, water, food, feed, raw materials and energy. So we need to be much better at doing more with less.

The transition to a resource-efficient and low-carbon society is essential to Europe's future growth. This is why, in addition to its strong policy to tackle climate change, the European Commission has proposed an ambitious package of measures to stimulate the transition towards a more circular economy. By maintaining the value of products and materials for as long as possible and reducing waste, the EU economy can become more competitive and resilient, while lowering pressure on resources and the environment and significantly contributing to decarbonisation at the same time.

EU funding programmes, including the LIFE programme, are in place to support this transition. LIFE is the EU's funding instrument for the environment and climate action, and it has already co-funded more than 650 projects related to the circular economy, with a total budget of over € 1.6 bn. The majority of these projects have tackled waste, with water efficiency as another important priority.

The latest batch of projects to be approved for LIFE funding will mobilise over €100m to support the environment and sustainable economy. Close to half of this investment is in 14 new resource efficiency projects that will demonstrate innovative approaches capable of being replicated across the EU. In fact 2 of these new projects are in the UK: one to facilitate the recovery of high-value critical raw materials like

cobalt, silver, gold and platinum from waste electrical and electronic equipment, and another to reduce the carbon footprint of the garments industry: by 2018 the project is expected to divert over 90 000 tonnes of clothing waste from landfill, saving more than 1.6 million tonnes of CO₂ and 588 million m³ of water.

LIFE time achievements

The LIFE programme has long been leading by example, showcasing resource-efficient and innovative methods at all stages of product and process lifecycles. For example, a LIFE project in Slovenia to reduce waste electrical and electronic equipment (WEEE) collected 267 interactive computer touch-screen terminals which had become obsolete, upgrading 81 of them in order to support education in schools. During various events more than 1000 tonnes of WEEE have been collected and subsequently recycled or properly disposed of.

Recently, LIFE has supported projects that turn unwanted waste fractions into secondary raw materials for manufacturing, such as turning waste glass into a resource for glass containers, ceramics and bricks industries. LIFE projects have shown that it is possible to use recycled materials in construction, lowering energy use and CO₂ emissions.

LIFE has also played a fundamental role in improving the environmental performance of products by funding projects on eco-design and life-cycle thinking in manufacturing. Eco-design projects help make products more energy-efficient and lessen their overall environmental impact. LIFE funding has been used to apply these principles to furniture, fridges, packaging, and even aircraft.

Low-carbon LIFE

The EU's new integrated climate change and energy



framework for 2030 sets more stringent targets for reductions in greenhouse gas emissions, increased use of renewables and greater energy efficiency.

The change of course is already under way. Since 1992, the LIFE programme has mobilised more than €600m in favour of climate change mitigation across a range of key sectors, including energy, agriculture, transport and enterprise. It has also provided more than €300m for climate change adaptation actions, helping to mainstream adaptation in many policy areas.

At least 20 % of the EU's budget from 2014-2020 will be spent on climate-related action. This includes €864m from the new LIFE sub-programme for Climate Action for projects targeting both efforts to reduce emissions and adapt to the impacts of climate change.

During the first year of the sub-programme, the European Commission awarded grants totalling €44m to 30 projects. These range from the restoration of peatlands in Latvia to flood prevention in Italy and from sustainable asphalt manufacturing in Spain to reducing

emissions from dairy farming in Belgium, Luxembourg and Denmark. The projects are contributing to finding new solutions for a low-carbon, resource-efficient and climate-resilient future.

New collaborative initiatives with the European Investment Bank, such as the Private Finance for Energy Efficiency (PF4EE), will use public money to leverage significant private investment in favour of climate action.

Effective small scale projects leading to big results, replicable across national borders, with benefits for all – that's the added EU value of LIFE. What better way of spending EU funds? ■

For more information:

http://ec.europa.eu/clima/policies/budget/life/index_en.htm
<http://ec.europa.eu/life>

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Karmenu Vella
Commissioner for Environment,
Maritime Affairs and Fisheries
 European Commission
http://ec.europa.eu/commission/2014-2019/vella_en

Soil information for European environmental policy

The recent announcement “4 pour 1000” by the French Minister of Agriculture, Stéphane Le Foll, communicating a new concept for mitigating climate change through the reduction of CO₂ by an annual increase in soil organic carbon in agricultural soils by 0.4%, has demonstrated a new dimension of environmental politics. His concept was immediately backed by more than 20 European ministers and further high ranking politicians and decision makers during the World Climate Conference in Paris in December 2015, indicating that clear targets for environmental policy are highly needed. – Indeed, this concept will not only lead to reduced CO₂ emissions but also aims at improving soil fertility to meet the world wide challenge of food security and fosters further environmentally important land and soil functions.

Why could this concept not have been formulated earlier by the science community? Are today's scientists too specialised and no longer able to develop overarching concepts, solving complex environmental problems such as climate change? – What will be the answer of science to this clearly formulated challenge? – How can the concept “4 pour 1000” be put into operation? – On which land surfaces and soils can it be applied successfully, in view of the fact that there are hundreds of different soils and local climatic conditions in Europe? – Moreover, which type of agricultural land

management is needed to reach this goal?

In order to answer all these questions it is of paramount importance to have sufficient physio-geographical and technical-scientific knowledge available. – Looking into the research results accomplished during the last 2 – 3 decades within the research programmes funded by the European Commission, national research organizations and the private sector reveals that a careful evaluation may give the necessary answers. The author is convinced that by evaluating existing research data published in the many EU and further projects – even without clear focus on the concept in question – can indicate land management options and combine this knowledge with detailed European land and soil information data accumulated by EUROSTAT, JRC-ISPRA and national research institutions.

An interesting example of such a procedure is a project supported by the RISE Foundation in Brussels in cooperation with EU projects of the 7th Framework Programme such as “Catch-C” (Compatibility of Agricultural Management Practices and Types of Farming in the EU to enhance Climate Change Mitigation and Soil Health), SoilTrEC (Soil Transformations in European Catchments) and others. Moreover, EUROSTAT, JRC-ISPRA (European Soil Bureau), and national institutions such as for example the Federal

Institute of Geosciences and Natural Resources, Germany, made basic land and soil data of the EU 25 (28) available such as LUCAS Topsoil data, the European Soil Data Base, and the CORINE land use cover. For more information see the report on “The Sustainable Intensification of European Agriculture” (www.risefoundation.eu). This report shows that about 41% of European soils can be used for sustainable intensification of agriculture, taking into consideration that sustainable agricultural management of land and soil does not only mean food and fibre production but also filtering of rain water, producing clean ground water and maintaining soil biodiversity, the basis of the largest gene reserve of our planet. Moreover, this report also made clear that on about 4% of European soils the current agricultural production should be extensified in order to meet sustainable environmental conditions. 43% of the current European agricultural cropping area is not suitable for intensification, and on 12% intensification is restricted due to specific constraints. – Amongst the basic land and soil characteristics for the identification of these results, the amount of soil organic carbon was of paramount importance.

Additionally, the concept of “4 pour 1000” offers further opportunities for solving most important issues in environmental policy, especially the recycling of nutrients and valuable



organic residues in urban and agricultural waste concentrated in areas with intensive livestock production and urban agglomerations. These residues could be used in areas with a lack of nutrients and organic carbon, e.g. in intensive agricultural cropping areas or in regions like the Mediterranean area with a general deficit in organic C in most of the soils due to climatic conditions, especially high annual temperature which increases the biological/microbiological decomposition of organic matter and the production of CO₂. Some promising approaches for solving these problems could be demonstrated in the above cited review sponsored by the RISE Foundation.

Therefore, this concept “4 pour 1000” offers the opportunity for a comprehensive approach by improving land and soil conditions for very diverse goals, ranging from the mitigation of climate change to the improvement of soil fertility for food and fibre production, the maintenance of biodiversity, and a more efficient filtration of rain-

water, providing clean groundwater resources for drinking water purposes.

As a result it can be stated that through the sequestration of soil organic carbon three main basic human needs can be met: acceptable and convenient living conditions through mitigation of climate change, production of sufficient and healthy food, and sufficient drinking water resources.

In order to raise awareness in the broad public and to foster sustainable agricultural land and soil management as defined by the EU Thematic Strategy for Soil Protection [COM (2006) 231], the European Landowner’s Organization (ELO), under the auspices of the European Commission (DG Environment and the JRC) and in association with the University of Natural Resources and Life Sciences (BOKU), Vienna, the Centre for Soil and Environmental Sciences of the Ljubljana University as well as Syngenta International AG created the “Land and Soil Management Award”. This prize rewards professionals working in the

area of land use and soil management (www.elo.org/awards/soil-land-award).



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RESIDUES OF ANTICANCER DRUGS POSE THREAT TO AQUATIC ENVIRONMENT

It is estimated that in Europe more than 3000 different pharmaceuticals are in use which represents consumption of around 100 000 tons per year. Part of these compounds is released to the aquatic environment predominantly through patients' excretion either in form of the parent drugs or as metabolites. The crucial question is what happens to pharmaceuticals after they have been used. Are they degraded in wastewater treatment plants? Do active forms reach rivers and drinking water? What are the concentrations and do they affect aquatic organisms or even human health?

A group of pharmaceuticals that is of particular concern are anticancer drugs, also termed as cytostatics or antineoplastics, that are used for cancer treatment. These drugs are designed to kill cancer cells, for example by interfering with the genetic material and the processes governing their replication. However, these effects are not restricted to cancer cells because the organisation of genetic material as well as the mechanisms of cell replication remained through the evolution highly conserved and are thus similar in different organisms. Therefore, if present in the aquatic environment, the residues of these compounds can potentially harm aquatic organisms in particular during the expected chronic exposure.

These questions have been systematically addressed in the frame of EU FP7 CytoThreat project coordinated by Prof. Metka Filipič from the National Institute of Biology. Within the four years of intensive research new highly sensitive chemical analytical methods were developed that enable detection of the residues of the most consumed anticancer drugs in different environmental samples, and the systematic analysis of hospital and municipal waste waters samples confirmed constant presence of the residues of several anticancer drugs although their concentrations in the effluents were low; in the range of several ng/L.

The comprehensive ecotoxicological studies of selected anticancer drugs (5-fluorouracil, cis-platin, etoposide and imatinib) in different aquatic organisms were focused on detecting adverse effect of exposure to low, for environmental contamination relevant, concentrations of the drugs. Indeed upon chronic exposure in certain aquatic organisms (daphnids and zebrafish) adverse effects, including reduced reproduction, damage to genetic material and molecular changes in gene expression were observed at these low concentrations. These findings are not relevant only for aquatic environment but also for humans because through the use of surface waters for the preparation of drinking water and



the use in agriculture the residues of anticancer drugs can potentially enter the food chain and affect also human health.

The results obtained in the Cytothreat project are the first that showed that residues of anticancer drugs which, compared to many other environmental contaminants, occur at much lower concentrations represent threat for aquatic environment. However, there are still many knowledge gaps that do not allow for a reliable environmental and human health risk assessment. Therefore, further research, which should focus on environmental monitoring to obtain data on the distribution of these compounds and ecotoxicological studies to obtain toxicological data for other existing and new anticancer drugs as well as their mixtures are required and should be supported.

More information: www.cytothreat.eu

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Glycol – a rare resource

Areas of Expertise:

We have developed a globally unique purification method whereby we purify used glycol so that it can be re-used. In this manner, we will save the Earth's resources since glycol is extracted from crude oil and is a non-renewable resource. In addition, glycol is a scarce commodity since demand is consistently higher than the supply. Glycol is used in a number of different industries and there is an abundance of areas of use. Below is a list of some of the most common segments and areas of use for glycol.

Research Interests:

We have developed a globally unique purification method whereby we purify used glycol so that it can be re-used.

From used glycol we produce, with our globally unique model, new re-usable glycol with concentrations up to 98.5% depending on our customers' requirements. With our re-used glycol, chemical companies are able to offer more ecofriendly options.

Today, most used glycol is incinerated. We currently collaborate with a number of recycling companies to take a more ecofriendly step toward managing glycol.

Recyctec has agreements with some municipalities for glycol management. Municipalities work according to the so-called 'waste hierarchy', which provides a hierarchy for the order in which various methods for managing waste should be used. It is based on the EU directive and is a method for



achieving the EU's environmental objectives. In co-operation with us, they will be able to contribute to taking glycol management from step four to step two in the waste hierarchy, meaning instead of energy extraction (incineration) of the glycol, we jointly take the step to re-use.

With Recyctec's assistance, airports are able to gain both financial and environmental advantages. Airports will be able to become nearly self-sufficient since the glycol can be re-used time and time again with Recyctec's help.

Working alongside Recyctec, the automotive industry can actually impact today's glycol management by ensuring the quality of the handling process and filling with re-used glycol. For example, each new vehicle that rolls out from an automotive plant can be refilled with re-used glycol, which will

enable automotive manufacturers to take another step in keeping their environmental promises.

Unfortunately, glycol is in short supply and demand is always greater. Glycol is also a non-renewable natural resource, meaning the supply will run out. This is one of the reasons that the re-use of glycol is becoming increasingly important.



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USING A GLOBALLY UNIQUE METHOD,
WE PURIFY USED GLYCOL
 SO THAT IT **CAN BE RE-USED**

We have developed a globally unique purification method

whereby we purify and concentrate used glycol so that it can be re-used. In this manner, we will save the earth's resources since glycol is extracted from crude oil and is a non-renewable resource. In addition, glycol is a scarce commodity since demand is consistently higher than the supply.

Glycol is used in a number of different industries and there is an abundance of areas of use.

Our vision is to spread our knowledge throughout the world and thus contribute positively to our common environment and to a better world.

Our business concept is to refine used glycol and restore it to an industrial product using an efficient and unique eco-friendly method.

EU's WASTE HIERARCHY



Read more about us? Visit www.recyctec.se



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Probiotics on poultry gut health research

The chicken industry has become one of the fastest growing livestock industries around the world due to the demand for high-quality protein by consumers. Today, modern-day broiler chickens can reach a body weight of 2 kilograms by 35 days, which represents an increase of an astonishing 5000% of their body mass. This remarkable and outstanding performance is the result of intensive genetic selection for growth rate, rigorous programs of health and management, as well as meticulous feed and nutrition programs. Feed efficiency, which is the capacity to transform vegetable protein into animal protein is considered the “money saver”, since ~ 70% of the total production cost is directly related to the feed. Therefore, any chronic sub-clinical disease that affects the gastrointestinal tract such as coccidiosis, or necrotic enteritis, is economically

more upsetting than acute infections. Likewise, dietary factors that modulate the immune system, gut health and gut microbiota are considered crucial when formulating diets and managing feeding practices. Every year, genetic lines are working to increase performance of broiler chickens. As a result, we see that the growth period and feed efficiency are continuously improved. Hence, health care and nutrition of these birds are becoming more demanding. Perhaps, that is the reason the fields of immunology, microbiology, and nutrition have joined in a surprising way in the last two decades. Several investigators have shown how dietary ingredients have a profound effect on the composition of the gut microflora, which in turn, controls the physiology of all animals. As such, nutritional components of the diet are of critical importance not only for meeting the

nutrient requirements of the host, but also for the microbiome. During their coevolution, bacterial microbiota has established multiple mechanisms to influence the eukaryotic host, in a beneficial fashion. The microbiome encrypts a variety of metabolic functions that complements the physiology of their hosts.

Over a century ago Eli Metchnikoff proposed the revolutionary idea to consume viable bacteria to promote health by modulating the intestinal microflora. The idea is more applicable now than ever since bacterial antimicrobial resistance has become a serious worldwide problem both in medical and agricultural fields. The impending ban of antibiotics in animal feed due to the current concern over the spread of antibiotic resistance genes makes a compelling case for the development of alternative

prophylactics. Nutritional approaches to counteract the debilitating effects of stress and infection may provide producers with useful alternatives to antibiotics. Improving the disease resistance of animals grown without antibiotics will not only benefit the animals' health, welfare, and production efficiency but is also a crucial strategy in the effort to improve the microbiological safe status of poultry.

“Today, modern-day broiler chickens can reach a body weight of 2 kilograms by 35 days, which represents an increase of an astonishing 5000% of their body mass.”

In recent years, gut health research has been extensively studied in human health programs, where nutritional interventions, such as probiotics, are used to ameliorate inflammatory and allergic diseases. Nevertheless, today, gut health is a major topic for research not only in humans but also in animals and it is now generally conceded that maintenance or enhancement of gut health is far more complex than just the modulation of the gut microflora through probiotics. This is not surprising considering that the gut harbors more than 640 different species of bacteria, contains over 20 different hormones, digests and absorbs the vast majority of nutrients, accounts for 20% of body energy expenditure and it is also the largest immune organ in the body. Therefore, anything that affects the health of the gut will undoubtedly influence the animal as a whole. Consequently, 'gut health' is highly complex and encompasses: The macro and micro-structural integrity of the gut; the balance of the microflora; and the status of the

immune system. Now days, beneficial bacteria-host interactions are considered an integral part of development and evolution. While largely studied because of their harmful effects on human health, there is growing appreciation that bacteria are important partners for invertebrates and vertebrates. Probiosis, although not a new concept, has only recently begun to receive an increasing level of scientific interest. In agriculture, probiotics and direct fed microbials used in animal feed are becoming accepted as potential alternatives to antibiotics for use as growth promoters, and in selected cases, for control of specific enteric pathogens. A probiotic is defined as a live microbial food supplement which benefits the host by improving its intestinal microbial balance. The presence of normal gut microflora may improve the metabolism of the host animals in various ways, including absorptive capacity, protein metabolism, energy metabolism, fiber digestion, and gut maturation. Balanced gastrointestinal microflora and immune-stimulation are major functional effects attributed to the consumption of probiotics. Many probiotic effects are mediated through immune regulation, particularly through balance control of pro-inflammatory and anti-inflammatory cytokines.

During the last 15 years, our laboratories have worked toward the identification of probiotic candidates for use in poultry. A defined lactic acid bacteria base probiotic culture (FloraMax-B11®) has demonstrated accelerated development of normal microflora in chickens and turkeys, providing increased resistance to *Salmonella* spp. infections. Published experimental and commercial studies have shown that these selected probi-

otic organisms can reduce idiopathic diarrhea in commercial turkey brooding houses. Large scale commercial trials indicated that appropriate administration of this probiotic mixture to turkeys and chickens increased performance and reduced costs of production. Further studies demonstrated that the administration of this probiotic one hour after *Salmonella* Enteritidis challenge had no effect during the first 12 hours on increasing cecal colonization by this pathogen. However, marked and rapid decreases were observed between 12 and 24 hours post-challenge. Later, using the same challenge model and microarray analysis of gut mRNA expression, gene expression differences in birds treated with this probiotic were observed compared to saline treated birds, suggesting that this probiotic shares anti-inflammatory and anti-oxidant properties that may be related with gut barrier integrity.



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The circular economy opportunity

The Ellen MacArthur Foundation sheds light on the circular economy and why it is an opportunity not to be missed...

Today's linear economy – in which resources are extracted, made into products, sold and ultimately thrown away – arguably faces its biggest challenges, on a number of fronts. A range of global trends suggest that the future economy could be circular, with opportunity awaiting those progressive enough make an early shift.

In a context of cheap and accessible energy and materials, the linear model inherited from the Industrial Revolution proved hugely successful and fuelled the unprecedented economic development seen throughout the 20th century. With new discoveries, increased efficiency and new technologies of the 1900s, commodity prices steadily declined over the course of the century. However, and as first observed by investment expert Jeremy Grantham, an inflection point in this trend occurred in 2002, when prices started to rise. This has to be nuanced somewhat given today's depressed commodity markets, yet the long-term upward trend seems to be widely acknowledged. What might be even more problematic is the rising volatility of prices, another feature of

today's business landscape. The inability to predict resource and energy prices around the corner can be devastating to companies with high fixed costs, who rely on economies of scale. In that context, gradual efficiency gains will not suffice, and it looks as though "business as usual" is seriously questioned by the reality in which it operates.

It would seem that the 'rules of the game' for our economy are changing, and business leaders, innovators, academics, students and scientists are looking for a positive way out; a new model through which we can re-think progress in the 21st Century. One option is the circular economy, a model that has been gaining traction around the world in recent years. Such a system is regenerative by design, and primarily relies on optimising 2 distinct material flows, biological and technical. Products and services in this model are designed to enable efficient circulation, with biological materials returning to the food and farming system, and technical materials being kept in production and use loops without loss of quality. A circular model generates new revenue streams,

reveals overcapacity and maximises asset utilisation whilst ensuring, as leading Performance Economy thinker Walter Stahel puts it, that the “goods of today become the resources of tomorrow, at yesterday’s prices”.

As well as the decline of cheap materials, energy and credit, there are other changes underway that are supporting the transition towards a circular economy. Testament to this is the momentum behind the ‘sharing economy’, and the huge number of new businesses founded on creating visibility of idling capacity of a range of assets. Empty rooms can be booked through AirBnB, journeys through Lyft (who recently struck a deal with General Motors), and even musical instruments through Sparkplug. Clothing Company Le Tote provides access to women’s fashion for a flat monthly fee, in the same way people use streaming platforms instead of owning physical media. Technological advances are facilitating these business models – finding and booking the nearest communal car or bike has only been made convenient with smartphones and mobile networking. Product tagging and tracking and the growing ‘Internet of Things’ are also enabling manufacturers or service providers to keep an eye on their products; how much they’re being used, if they’re performing properly and when they’re about to go wrong. This makes product recovery feasible, and opens up new customer service or aftermarket opportunities.

Global trends are providing a fertile environment for a shift in the economy. In addition to being a new lens for innovation, increasing circularity could offer a significant economic advantage too. In 2012, the Ellen MacArthur Foundation published the first in a series of reports entitled Towards the Circular Economy. These reports have concluded that a circular economy would not only help decouple economic development from finite resource inputs, but also represent an opportunity in excess of \$1trillion. As our first report shows, for Europe the greatest potential offered by circular processes lies precisely in the Union’s strongest points – the high-value manufacturing sector, where up to \$630bn of net material savings can be achieved per year through improvements in design, business models, reverse cycles and system conditions such as education and policy.

Launched in June 2015 at the European Commission’s stakeholder conference on the circular economy, our latest publication produced with the McKinsey Center for Business and Environment and supported by SUN1 reveals that by adopting circular economy principles, Europe can take advantage of the impending technology revolution to create a net benefit of €1.8 trillion by 2030, or twice the benefits seen on the current development path (€0.9 trillion). This would be accompanied by better societal outcomes including an increase of €3,000 in income for EU households. This would further translate into an 11% GDP increase by 2030 versus today, compared with 4% in the current development path. The circular economy would also have significant impacts on the environment for Europe: carbon dioxide emissions would halve by 2030, relative to today’s levels (48% by 2030 across the three basic needs studied, or 83% by 2050). Primary material consumption measured by car and construction materials, real estate land, synthetic fertiliser, pesticides, agricultural water use, fuels, and non-renewable electricity could drop 32% by 2030 and 53% by 2050, compared with today.

In a world of uncertainty, many are asking what the future economy will look like in the context of population growth and resource constraints. Our research and analysis tends to indicate that a circular economy framework could offer guiding principles for re-thinking and redesigning our futures. There are promising signs of a shift taking place, but reaching this goal will require pioneering ambition, combined with varied collaboration to deliver the benefits of a system that rebuilds economic, social and natural capital. ■

1 Siftungsfonds für Umweltökonomie und Nachhaltigkeit

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The importance of soils

Matt Aitkenhead, a Member at the British Society of Soil Science sheds light on soils and their role in society and economic development...

The importance of soil to people who work the land or study it is obvious, but this importance often remains hidden in political and economic debates. Partly due to the fact that it is usually hidden from sight, and partly because it is so common and apparently unchanging, we take soil for granted. We also assume that it will continue to provide our food, regulate our water supply and climate, and buffer our biodiversity regardless of our actions, and almost always without realising that it is doing all of these things in the first place.

“The EU’s Soil Thematic Strategy has since 2006 had four pillars of awareness raising, research, integration and legislation relating to soil. One of its key actions was a proposal for an EU Soil Framework Directive which would have legislated for soil protection across the EU.”

This assumption is fundamentally wrong. Over a third of the world’s agricultural soils are degraded, and require restoration or greatly altered management to return to their previous productivity levels. Soils with high levels of organic matter (peat) are being drained, eroded and burnt; these soils store a massive amount of carbon that is making its way back into the atmosphere through our action and inaction. The conflict between economic pressures and sustainable soil management is looking increasingly one-sided, and the economic benefits being gained today are nothing compared to the losses we will face tomorrow.

One of the biggest challenges in how to manage soil appropriately is the sheer variety that we see within soils. The FAO soil classification system recognises 32 broad groups of soil, and there are thousands of subtle but important variations in each of these

groups. If a grid was laid around the Earth and each cell of this grid was 1 metre across, then it would be possible to describe the characteristics of the soil under each cell. This detailed description would be different for every single cell, and every cell would be found to provide a range of services and some small quantifiable benefits. Carbon storage? Water supply? Agricultural production? Biodiversity conservation? Those, and a whole host of others.

Every 5th of December is World Soil Day, and 2015 was declared by the United Nations Assembly as the International Year of Soil. This was an opportunity to raise awareness of the importance of soils, and it was seized by organisations involved with soil education, soil research or soil use and management. The British Society of Soil Science was one of many organisations working to emphasise the importance of soils economically and to society. The UK’s soils research community is pushing hard for increased emphasis on soils in education at all levels, and will be making the most of hosting the 4-yearly World Congress of Soil Science in Glasgow in 2022 to keep the current momentum as strong as possible.

Soil scientists must consider many different aspects of soil, as it links the physical, chemical and biological sciences so closely. In addition, we increasingly think of soil in terms of its benefits to society, and so must consider social and economic aspects as well. The links between healthy soils and healthy societies are unbreakable – without healthy soils, society cannot develop sustainably and fairly. The costs of degraded soils are many, some more obvious than others. The risks of agricultural failure, flooding and disease are all increased, and through these so are the problems of failed states, international conflict and mass emigration.



The EU's Soil Thematic Strategy has since 2006 had 4 pillars; awareness raising, research, integration and legislation relating to soil. One of its key actions was a proposal for an EU Soil Framework Directive which would have legislated for soil protection across the EU. This draft Directive was withdrawn in 2014 following sustained blocking from a minority of EU states. Key objections included paying for the remediation of contaminated land (the 'polluter pays' principle), which was linked to the proposed requirement to provide a soil status report when selling land. Given that the potential number of contaminated sites in Europe could be as high as 2.5 million, this proposal was lobbied against intensively in some areas and by particular groups.

What can soil science do to help improve the health and legislative protection of soils? Our main role in this is to provide evidence for the condition of soils locally, nationally and globally and to identify ways to

improve the worsening situation in an economically reasonable manner. The challenge here lies within the phrase 'economically reasonable' – what may seem unreasonable and indeed economically nonsensical now may become necessary in an increasingly desperate situation in the future. Alternatively, we could start to think about what is best for everyone in the long term and acting upon it. ■

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A new era for soil mapping

From its inception less than 150 years ago, soil mapping was subject only to small, gradual changes. This changed radically about fifteen years ago, when digital soil mapping was introduced. While conventional soil mapping is characterised by experienced soil surveyors walking in the field and delineating soil mapping units by hand with the help of soil drillings and aerial photographs, digital soil mapping mainly takes place behind a computer screen. It makes use of mathematical and statistical models to predict soil characteristics from explanatory environmental variables, such as geology, climate, land use and terrain features.

These models need to be calibrated with soil observations, but the strong reliance on explanatory variables means that similar accuracy levels can be reached with considerably fewer observations, leading to a dramatic reduction in field and laboratory costs. For instance, we know that soil organic carbon concentration depends heavily on climate, mineralogy and land use. Thus, predicting the soil organic carbon concentration at any one location can greatly benefit from knowing these environmental variables.

While these variables may not have been readily available in the past, nowadays they are abundant at ever-increasing spatial and temporal resolutions, given the constant growth, both in quantity and quality, of satellite imagery. Digital soil mapping also increasingly benefits

from electromagnetic measurements collected by airplanes, unmanned aerial vehicles (i.e. drones) and non-invasive soil sensing instruments mounted on tractors and sleds. The exponential growth of digital soil mapping is also explained by rapid developments in statistical machine-learning techniques that can detect complex patterns in big data, and by the constant increase in computing power. While 10 years ago digital soil mapping still was an experimental technique, mainly developed and used by academics, nowadays it is an operational technique used by soil mapping organisations all across the globe to deliver soil maps for professional applications.

The figure shows a map of the topsoil organic carbon content for Africa as obtained using digital soil mapping. In this particular example, the map was derived from 130 layers of environmental variables and calibrated using 28,000 soil point observations. The statistical model used was a Random Forest machine-learning algorithm. A zoom-in on Mount Kilimanjaro shows the very fine spatial resolution achieved.

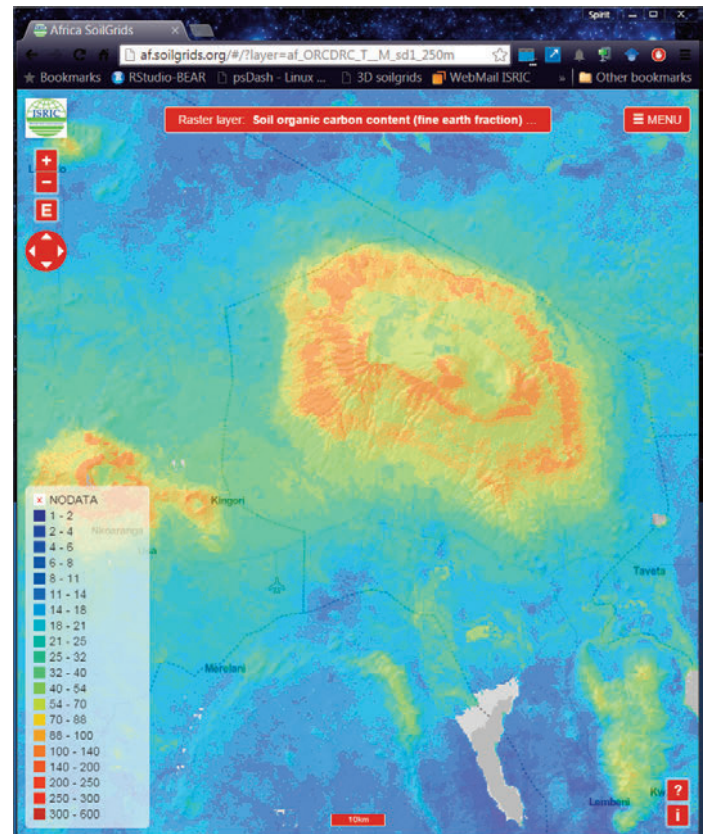
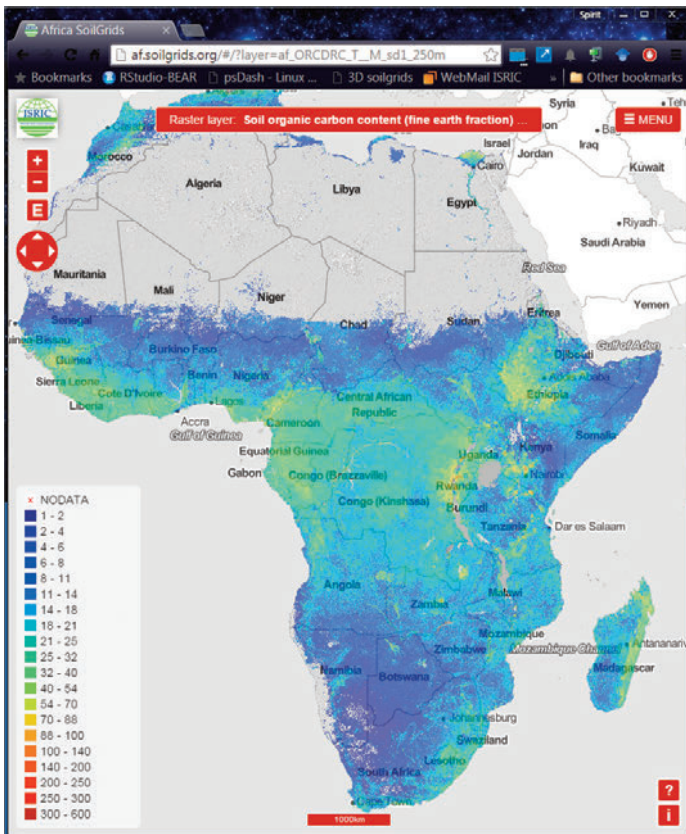
This map, which was produced by ISRIC in the framework of the AfSIS¹ project, is just one example of a set of over 100 maps of various soil properties at various depths. Among the other soil properties mapped are soil nutrients, available water capacity, and rootable depth. These soil properties are extremely useful for agronomic applications and fertiliser



Rik van den Bosch, Director

recommendations which are not easily derived from conventional soil maps.

Digital soil mapping is now a core activity of all major soil institutions in the world, as well as collaborative initiatives such as GlobalSoilMap² and the Global Soil Partnership³. Important advantages compared to conventional soil mapping are that it is cheaper, reproducible, can be automated and produces maps that are easily updateable. In many cases the uncertainties associated with the predictions are also quantified. Digital soil maps can be tailored to specific needs, by adjusting the scale and resolution, while resulting maps are served through web-services that extend to mobile devices (e.g. the Soil-Info app⁴). The latter also facilitates the uploading of new soil data, which may then be used to recompute maps and further improve accuracy. Indeed, it is envisaged that crowd-sourced soil data may become a major input to digital soil mapping projects in the near future.



Topsoil (0-5 cm) organic carbon content in permilles for Africa and a zoom-in on Mount Kilimanjaro (from Hengl et al., 2015⁵)

The popularity and growth of digital soil mapping also has important implications for users of soil information. Soil mappers are now able, much better than before, to provide researchers, industry and policy makers with the soil information they really need. For instance, while conventional soil mapping is time consuming and hence not very suited for monitoring soil change, this is much easier in a digital soil mapping world where updated soil maps can be produced almost on the fly.

The ability to monitor soil change over large areas may well prove an invaluable asset for the implementation of the 4p1000 initiative⁶, which aims to demonstrate that soil carbon sequestration can make a major contribution to combatting climate change. Digital soil mapping can help provide periodic assessments of the world soil carbon stock and changes therein, as required for the evaluation

of the success of the 4p1000 initiative.

Digital soil mapping has caused a revolution in soil mapping that has not yet come to an end. It will not take long until we reach the milestone of having three-dimensional soil property maps at 100 m resolution for the entire globe, and once this is achieved the digital soil mapping community will continue to increase the accuracy and diversity of their maps. It is important that users of soil information recognise and appreciate these important developments, because adequate soil information is crucial for solving the five big problems of our time: food insecurity, climate change, environmental degradation, water scarcity, and threats to biodiversity.

ISRIC – World Soil Information is determined to make a major contribution to these efforts because it is at the heart of our mission, which is to

serve the international community with information about the world's soil resources to help address major global issues.

- 1 www.africasoils.net
- 2 <http://www.globalsoilmap.net/>
- 3 <http://www.fao.org/globalsoilpartnership/en/>
- 4 <http://soilinfo-app.org/#/>
- 5 <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0125814>
- 6 <http://4p1000.org/>



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A Global Perspective on Agriculture Research

The USDA National Soil Dynamics Laboratory (NSDL) has a long history of research on developing sustainable agriculture. Originally founded as the Farm Tillage Machinery Laboratory in 1933 on the Auburn University campus in Auburn, Alabama, USA, it was initially charged with researching tillage, associated traction practices, and machines used in cotton production. The lab was instrumental in the development of engineering principles for modern agricultural equipment design. Currently, NSDL's mission is to develop tools, practices, and products to better manage soil for environmentally sustainable and economically profitable agricultural production systems. While the research is centered around Southeastern USA production systems, implications of findings clearly have a more global prospective, especially in the context of efforts to understand how agriculture influences global change.

The Laboratory solves agricultural problems in three major areas:

- Conservation systems;
- Organic waste management; and
- Global change.

Specific objectives include developing conservation systems that reduce drought risk and sequester soil carbon, developing environmentally sound waste management systems, and determining the effects of atmospheric CO₂ levels on above- and below-ground processes that affect crop



production, soil carbon storage, and trace gas emissions.

Currently, there are many uncertainties concerning agriculture's role in global environmental change including the effects of rising atmospheric CO₂ concentration. Agricultural practices have the potential to increase soil C storage which can positively influence soil quality and help mitigate this rise in atmospheric CO₂. Research at NSDL is examining the effects of atmospheric CO₂ on both biomass production and soil C sequestration.

The concentrations of trace gases (nitrous oxide and methane) in the atmosphere are also increasing with agriculture being a primary contributor. The NSDL has a multi-disciplinary research team investigating ways that agriculture can help reduce greenhouse gas (GHG) loss through improved practices and fertiliser use in cropping and horticulture systems. This work is evaluating new, innovative application techniques that reduce

GHG emissions, including determining fertiliser N use efficiency and fate of fertiliser N in these systems as well as changes in C and N cycling processes. This work showed that soil C storage is sensitive to soil N dynamics and that the decomposition of plant material grown under elevated CO₂ depends on crop species and indigenous soil properties. It has also led to research on the use of microbial inoculations to reduce nitrous oxide emissions.

Research at NSDL develops conservation systems that improve soil quality, conserve natural resources, and increase production efficiency by considering input costs and profitability. A major focus is to evaluate the use of alternative fertiliser sources, such as poultry litter (a poultry manure and bedding material mix), compared to commercial fertiliser in tillage systems designed to enhance soil organic matter accumulation, crop productivity, and grower profitability. Application of poultry litter to soil can improve soil

conditions and provide nutrients needed for plant production. This seems to be a viable option for South-eastern USA producers due to rising costs of inorganic fertilisers and the fact that the growing poultry industry generates large amounts of manure. Field and laboratory studies are being conducted to develop improved methods to utilise waste products for soil and crop benefits while minimising environmental degradation since improper manure application can increase hypoxia, eutrophication of

surface waters, human health problems, and GHG emissions. Furthermore, using poultry litter in conservation agricultural systems could sequester atmospheric C in soil. Research has shown that the use of poultry litter in long term research plots resulted in increased soil C levels and thus higher atmospheric C sequestration. However, best management practices must be developed for poultry litter application that maximises nutrient uptake and minimises GHG loss.

Tillage and fertilisation practices used in row crop production can alter GHG emissions from soil. A new prototype implement for applying poultry litter in subsurface bands in the soil was used in studies to determine the impact of management practices and fertiliser source and placement methods on GHG emissions. As part of this effort, a new method was developed for calculating Effective Gas Flux from soil following band application of manure or fertiliser. Banding of fertiliser resulted in the greatest concentration of gaseous loss compared to surface application and conventional tillage resulted in a higher concentration of CO₂ and N₂O loss. These results suggest that poultry litter can be used to sequester soil C, but application by banding has the potential to increase GHG emissions.



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THE EVOLUTION OF YIELD IN CORN

*Dr. Ronnie Heiniger
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Why is Corn Yield so Important?

The key to feeding a growing world with less demand on scarce resources and lower environmental impacts lies in increasing yield. Research has shown that increasing corn yield results in better efficiencies in nutrient and water use thanks to the fact that corn plants that yield more also have bigger root systems and more effective leaf area. The challenge for corn producers is to find management practices that allow them to maximize yield given the soil and environmental constraints they are operating with. Among the many management options that corn producers have what practices will provide the best return on investment in terms of increasing yield with the lowest cost and risk. This publication discusses some of the key principles and practices corn growers should consider when seeking to increase yield in corn.

It is All About Intercepting Light

At the most basic level corn is a starch factory that depends in turning light energy into starch. Therefore the most critical practice in managing for higher yield is maximizing light interception. There are three management practices that can be used to increase light interception. These are growing longer season hybrids, increasing seeding rate and plant population, and decreasing row spacing. Of these three the most effective practice is increasing seeding rate and plant population. While growing hybrids that require a longer growing period increases the amount of light intercepted it also increases water requirements and does not improve root mass or leaf efficiency. Using narrow rows only increases light interception for a short period of time. In contrast high plant populations increase light interception across the entire growing period, result in improved efficiency in light interception, and along with other key management practices increase root mass in the field. Figure 1 shows the impact of increasing plant density on the morphology of corn plants. As plant population increases the corn

plant grows taller resulting in more effective placement of leaf area to intercept sunlight. This results in optimum yield potential. However, there is a limit to this response. As plant density increases so does the need for water and nutrients. When the demand for water and nutrients exceeds the ability of the environment to provide these to the plant the corn plant responds by reducing its height and yield potential is reduced. Note that in Figure 1 there is a narrow range of plant densities over which the plant reaches maximum height and productivity. Corn producers must precisely match plant population to the environment of the field.



Figure 1. Change in plant density from 29,343 plants ha-1 on the left to 107,593 plants ha-1 on the right.

Supporting Plant Density with the Right Management Practices

As is apparent in Figure 1 planting at a higher seeding rate is not the only step producers should use to achieve higher yield. Higher plant densities result in individual plants that have smaller root systems and thinner stalks.

These negative effects must be compensated for. There are two key practices that must be used in a systems approach along with higher seeding rates to make higher corn yield possible. These two key practices are starter fertilizer and multiple applications of nitrogen. The root is the first plant part to be developed in the growth cycle of the corn plant. The faster the corn plant grows from germination to flowering the more root mass will be produced. Since the root system is the key to better nutrient and water use efficiency this is a critical component of a high yield corn plant. Starter fertilizer which contains small amounts of nitrogen and phosphorus increases the early growth of the corn plant (Figure 2). Research shows that increasing early growth by using starter fertilizer results in a plant with more root mass and thicker stalks overcoming the negative effects of higher plant populations.



Figure 2. No planting or starter fertilizer was used on the four-row plot on the left while 22.5 L ha⁻¹ of 11-37-0 was applied in a 2 x 2 band at planting to the four-row plot on the right.

Likewise, a corn plant depends on nitrogen to maintain leaf chlorophyll levels and efficient conversion of light into starch. Unfortunately, most growers only apply nitrogen at the beginning of the season or, at most, twice at planting and again at canopy closure. Since nitrogen is mobile in the soil and subject to loss these applications often don't cover the full season nitrogen demands of the plant (Figure 3). Growers often apply more nitrogen than the plant actually needs to cover the fact that some nitrogen will be lost by the time the plant reaches the reproductive stages. A better system for producing high yield corn is to apply small amounts of nitrogen throughout the season. This approach allows growers to just meet the needs of the plant at a given time resulting in little or no waste while ensuring optimum growth and

yield. Furthermore, nitrogen rates can be adjusted as the growing season progresses to match changes in weather (particularly rainfall) resulting in maximum nitrogen use efficiency.



Figure 3. Nitrogen was applied at four different times during the growth cycle of the corn plant to the four-row plot on the right while nitrogen was only applied at planting to the four-row plot on the left.

In Summary – A High Yield Corn System

Capturing more light while increasing root mass and light use efficiency requires a systems approach to corn production. The future of high-yield corn production lies in precisely matching plant population with the environment of the field and then supporting that population with starter fertilizer and regular feeding with small amounts of nitrogen. This approach has the potential to increase yield resulting in less demand on land resources. Research at the Vernon G. James Research and Extension Center at North Carolina State University over the past three years documents that this systems approach consistently produced maximum corn yield ranging from 21.1 to 23.7 mt ha⁻¹. Only by using a systems approach can growers increase water and nutrient use efficiency in corn production resulting in better utilization of scarce resources and improving the amount of carbon fixed in a corn field resulting in less climate impacts.

The hurdles of Biological Control to control the Red Imported Fire Ant. Part 1.

M. Guadalupe Rojas, Juan. A. Morales-Ramos, Jian Chen, Michael Grodowitz, and Margaret Allen...

The red imported fire ant, *Solenopsis invicta*, is one of the most successful invasive ants and it is regarded as one of the world's worst invasive alien species (Lowe et al., 2000). Native to South America, *S. invicta* has been introduced into many countries and regions, including the United States, Australia, China, the Philippines, Thailand, Taiwan, Hong Kong, Macau, among others (Ascunce et al., 2011). Their spread has been greatly facilitated by the increase of global commerce and the consequent breakdown of biogeographic barriers. Fire ant invasion often causes damage to the environment, human economy and health. For example, over 40 million people in the USA are at risk of being stung by imported fire ants (Drees, 1998). In addition to local dermal reactions, fire ant stings are a major cause of serious anaphylactic reactions (Xu et al., 2012). Fire ants attack pets, livestock, and wildlife (Vinson, 2013) and reduce biodiversity, particularly other arthropods (Cook, 2003). Annual economic costs associated with imported fire ants alone reached 6.5 billion dollars in the USA. Management of pest ants has continued to depend heavily on synthetic insecticides despite efforts toward developing alternative control technologies. The red imported fire ant is the number one pest for which homeowners in Texas buy and apply pesticides (Russell, 1999). A solution for alleviating the heavy dependence on synthetic insecticide is to imple-



ment Integrated Pest Management (IPM) strategies that combine different control practices to overcome the shortcomings of individual practices. Biopesticides, pest control agents based on pathogenic micro-organisms or toxic natural products, have become a critical component of IPM in recent years (Chandler et al., 2011).

Biological control of fire ants

A tremendous effort has been made over the past few decades to mitigate fire ant problems using biological control agents. These agents include parasitoids, such as phorid flies (Callcott et al., 2011), fungi (Bextine and Thorvilson, 2002), bacteria (Bouwma et al., 2006), microsporidia (Oi et al., 2005), viruses (Valles and Hashimoto, 2009), and nematodes (Brinkman and Gardner, 2000).

Fire ants construct elaborated underground nests which can extend to 2-3 m in depth. The underground habitat harbors a multitude of infectious microorganisms which can cause high disease incidence leading to extreme mortality in ant populations. To counter this, fire ants have evolved a number of strategies to combat pathogens (Cremer et al., 2007); among those are grooming and necrophoric (removal of dead bodies from the nest) behaviors, and chemical defenses. Active inclusion of antimicrobial plant resins into nest materials affording protection from microbes has also been reported (Schluns et al. 2009). The most studied antimicrobial strategy is the secretion of antimicrobial compounds through various glands most importantly from Dufour glands and its venom. As early as 1958, Blum et

al. (1958) documented antimicrobial properties of fire ant venom. Since then hundreds of manuscripts have been published on fire ant venom chemistry detailing various components, biosynthesis, antimicrobial properties, behaviors associated with venom dispersal, incorporation in nest materials, among others (Vander Meer 2012). Lastly, internal defense through immune system response is the least studied antimicrobial strategy. Mackintosh et al. (1998) isolated and characterised two antibacterial peptides in *Myrmecia gulosa* that are synthesised in response to bacterial challenge. Orivel et al. (2001) identified 15 novel peptides from the venom of ant species *Pachycondyla goeldii*. These peptides, named ponerinins, exhibited a defensive/inhibitory role against microbial pathogens arising from prey introduction and/or ingestion.

“Annual economic costs associated with imported fire ants alone reached 6.5 billion dollars in the USA.”

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Climate Change: Ignore the ocean at your peril

Niall McDonough, Executive Secretary at the European Marine Board outlines why the ocean should be part of the climate change discussion...

The United Nations Framework Convention on Climate Change COP21 meeting in Paris in December delivered an ambitious agreement on mitigating the effects of climate change. Before Paris, many commentators were worried that the agreement would not go far enough towards the aim of keeping the global temperature rise below 2°C above pre-industrial levels by the end of the century. The agreement finally reached a far more ambitious target of 1.5 °C. Following the disappointment of the 2009 COP15 in Copenhagen, this was undoubtedly a triumph.

Whilst not wishing to downplay the importance of this commitment from 195 countries to address the causes and the effects of global climate change, one issue continues to cause concern. That is the almost complete absence of the relationship between the ocean and climate in the COP21 negotiations and in the final agreement. The word “ocean” appears once in the preamble to the agreement and Article 5 stresses the need for “...action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases..”, of which the ocean is one. This represents a poor return after many years of

advocacy from an increasingly frustrated community of scientists and NGOs.

So why should the ocean be part of the international discourse on climate change? In reality, the poor attention to the role of the ocean in the climate discussions is symptomatic of a larger failure of human society and political opinion to understand the ocean’s importance as a planetary life-support system. The ocean is, unquestionably, the dominant feature of the surface of our planet. It covers 70% of the earth’s surface, supports around half of global primary production and harbours an enormous diversity of life (and a large fraction of the earth’s biosphere, that part of the planet that can support life). It also provides an array of essential goods and services which support human health and wellbeing¹, not least of which is its capacity to reduce the global effects of climate change. Since the industrial revolution, the ocean has absorbed more than a quarter of human emissions of carbon dioxide and 90% of the additional heat resulting from the greenhouse gas effect. But how long can the ocean continue to take up excess heat and carbon and at what cost to the health of ocean ecosystems?

The ocean is warming, sea level is rising and sea ice in the polar regions is rapidly shrinking. Large areas of the global ocean are also becoming more acidic because of carbon-dioxide uptake, while reduced ventilation is leading to lower oxygen levels in localised areas. In 2015, warmer than average sea temperatures resulting from the El Niño phenomenon led to the third global coral bleaching event (the first 2 were in 1998 and 2010). Damage to coral reef ecosystems from such events has major implications for marine biodiversity and can affect fisheries that provide food for many developing nations. Without drastic action to reduce the causes of climate change addressed in the Paris agreement, these growing pressures and changes will have unforeseeable consequences for marine life, ocean health, and for human wellbeing².

Ocean scientists are at the front line in the quest for knowledge to understand the role of the ocean in the earth and climate systems, and the implications of changing oceans for our environment and wellbeing. As a research arena, the marine environment is difficult and costly to access (especially open ocean and deep water environments), and is highly unpredictable. In times of financial constraint it is often difficult, therefore, to argue for funds to support marine research, especially more fundamental research designed to improve our understanding of marine systems and processes.

So what do we need? In very simple terms, a change in mindset. This is not just another research sector looking for a piece of the funding pie; it is about raising our efforts across a whole range of areas necessary to understand and sustainably interact with the last great frontier of our planet. In practical terms we need much greater progress in a number of particular areas:

- An advanced ocean observing system, generating open access data and information across a range of key variables to underpin ocean modelling, forecasting, sustainable commercial activities, management and decision making;
- Enhanced funding and support for basic ocean science; yes a strong maritime economy is important, but its sustainability is dependent on that of the natural system upon which it depends. For this we need to understand pressures, impacts and resilience in relation to marine ecosystems;

- More effective training for the next generation of marine scientists and professionals, giving future marine graduates a greater interdisciplinary knowledge and skill set to address complex real world challenges;
- Better communication and education on the importance of the ocean and marine science using innovative outreach methods and tools (for information on “Ocean Literacy” see the EU funded Sea Change project³);
- The emergence of future ocean leaders, capable of motivating society and decision makers to respond with concrete actions and investments;
- A major European flagship ocean research and capacity-building project, combining elements from all of the above.

Research has a major role to play in ensuring that human interaction with the seas and coasts is sustainable, generating benefits for today’s population, while protecting our marine environment so that future generations may also enjoy those benefits. Although elements of the above list are in place, a business as usual scenario is not sufficient to achieve this. For more detail on ocean research challenges, visit the European Marine Board website⁴ where all our science policy publications are available to download free of charge. ■

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2 The Ocean-Climate Nexus Consensus Statement by the European Marine Board and the US Consortium for Ocean Leadership: www.marineboard.eu/ocean-climate-nexus/

3 www.seachangeproject.eu

4 www.marineboard.eu

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Making the most of ocean data

It's hard to see underwater. That is not just a problem for learning to swim; it is also a problem for getting a full picture of the world's oceans. Satellites in space give us good information on the ocean's surface. Sea surface temperature is obtained from radiometers that measure microwave or infrared radiation. And sea surface height can be measured in a similar fashion, which gives a basic picture of the water column beneath because it shows how much it has expanded or contracted away from its mean. But satellites cannot see under the surface and so do not tell us about the complex activity of water, chemicals and life below. This opacity of the ocean to observation from above presents us with a major scientific challenge: how to collect enough data, and use what we can get effectively, to make an accurate and full assessment of ocean conditions.

Lagrangian data assimilation is a mathematical subject whose aim is to address this situation. Its goal is to extract the most information we can from measurements taken by instruments underwater.

Enormous advances have been made over the past few decades in the design of instruments that give good readings from inside the ocean. ARGO floats are designed to record the water properties, such as temperature and salinity, in a water column down to



about two kilometers. They transmit their collected data to satellites while at the surface, and obtain coverage by drifting for ten or so days between profilings. Sea-borne drone-like vehicles, called Autonomous Underwater Vehicles (AUV), and gliders, which have less power to maneuver but will stay in action much longer, together give us the ability to take readings in specific ocean regions. But given the vast expanse of oceans covering the surface of the Earth, and the complex activity we know to be happening in the ocean, we have relatively little from data to go on.

This lack of observational data means that we have to find a way to fill in the gaps. A very crude approach would be to interpolate between data points. This will only work, however, if we

have a reasonable amount of data, which in reality we do not. But there is something else going for us that can be used in this situation: the underlying physics of the ocean as a fluid is well understood. Indeed, the motion of ocean water obeys the classical equations of fluid mechanics derived by Navier and Stokes two hundred years ago. The state-of-the-art in ocean state estimation is to use data from observations in concert with computational models based on these fluid equations. This process is called data assimilation (DA) and Lagrangian DA is the version of this theory that is specifically targeted at data obtained from instruments that move underwater. The view of a fluid as seen from a moving fluid particle is called Lagrangian and the use of the term here originated with the ancestors of



these underwater vehicles and instruments which moved, in principle, only under the flow the of water.

The assimilation of data in models of the atmosphere is now routine; and has led to the considerable improvement in weather forecasts we have seen over the past thirty years. But data from the ocean is a different kettle of fish and the theory is far behind. Nevertheless, we have shown in varying contexts from simplified models of idealized fluids to models of the Gulf of Mexico that tailoring methods for the assimilation of data from underwater brings significant benefit.

There is a glaring problem in using the data obtained underwater: since the vehicles taking the measurements cannot be seen, even by satellites or other above-surface instruments, we cannot track them and so their location when taking the measurements is unknown. They can measure a lot: with modern sensors on board the vehicles can measure a variety of physical properties, including temperature, salinity, and pressure. There are also biomass sensors that can give an

assessment of the local biota. The limiting factor nowadays is the cost of the sensors, not what they can measure. Yet they cannot tell us where they are.

So, is this large data-set useless? Obviously not as good educated guesses can be made about the location of the vehicle or instrument. For ARGO floats, they surface and transmit their data to a satellite. The profile it has taken is of the water column beneath the surfacing location, which the satellite can detect. There is a correspondence between pressure and depth and so complete position information can be associated with measurements. But we are not so fortunate with the data from underwater vehicles, such as AUVs and gliders.

These underwater vehicles are moving around according to a mission plan and the information as to where the vehicle should be when taking a measurement, according to the plan, can be used to associate position with measurement. But the best laid plans may be wrong as the flow of the water can throw the vehicle off-course. This is a problem with using the mission

plan as a guessing guide, and it will become even more of an issue as missions become longer in duration with more capable vehicles using longer running batteries.

Lagrangian DA promises the most effective way of addressing this thorny problem. With this mathematical technology, the position of a measuring instrument can be estimated along with the various other physical variables that are drawing on information from observation and model alike. It works so well because it takes into account the special nature of these ocean observing platforms and their Lagrangian character. In proof-of-concept experiments using this approach, we have shown that the integrated platform of Lagrangian DA specifically designed for ocean observations holds the promise of significant improvements in ocean estimation.



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Through the ocean darkly

Carol Anne Clayson, Director of the Ocean and Climate Change Institute at the Woods Hole Oceanographic Institution details the impact the oceans have on climate systems...

In the final draft agreement adopted by the 21st Conference of the Parties in Paris last year, the ocean is mentioned only once – and that is only in passing and only in the preamble. This is understandable in light of the fact that the ocean works largely unseen to regulate and maintain Earth’s climate. But we ignore the ocean’s importance to climate and human society at our peril. As we move forward with the crucial goal of keeping human-caused warming to below 1.5°C and ensuring that developing countries are able to meet the challenges of a changing climate, we must also pay attention to understanding how human activity is affecting, and will continue to affect, our planetary life-support system.

Climate change has been described as one of the greatest challenges of our time. When one considers the possible effects brought on by increased warming, including drought, flood, famine, and mass migration, that is almost certainly the case. Predicting the timing, location, and impacts of changes that have their root in human action, as well as those caused by natural variability, is central to our ability to develop effective solutions that anticipate immediate and future needs. Any serious effort to address climate change and mitigation must include investment in more ocean research.

The ocean drives our climate system in many ways. It covers more than two-thirds of Earth’s surface and holds the majority of water that eventually falls on land as rain or snow. The ocean drives air and water circulation patterns that heavily influence global and regional weather patterns and climate.

The ocean is storing roughly 90% of the increased heat added to our climate system. Measurements of this stored heat, while incomplete, show the trend clearly

because it is so much larger than the uncertainties in the observations. To put it bluntly, global warming is ocean warming. This is especially troubling because even if we were to curtail human-caused greenhouse gas emissions overnight, heat stored in the ocean would affect global atmospheric temperatures for decades or centuries to come, since the ocean retains this heat much longer than the atmosphere.

The ocean also stores about half of the man-made carbon dioxide (CO₂) emitted from 1800 to 1994. However the ability of the ocean to buffer CO₂ appears to be decreasing over time for reasons still not well understood. In the meantime, the steady increase in dissolved CO₂ is already causing harm to marine life by decreasing the seawater pH and hampering the ability of some organisms to grow shells or skeletons. The loss of highly productive ecosystems that rely on coral reefs and tiny zooplankton will have widespread impacts throughout the ocean and on land. The complexity of the problem combined with our lack of data means that we are, in effect, walking blindly into a dark room that is our future.

Although ocean science has advanced in recent decades to the point where we can identify areas of concern such as these, key pieces of our understanding of the global climate system and the ocean in particular are still missing. Our knowledge of the deeper ocean is limited because of significant gaps in the data. We have almost no consistent, long-term data from deeper than 1 mile down – in a global ocean that is, on average, more than 2 miles deep.

The processes that drive the transfer of heat, carbon, and water between the ocean and the atmosphere and between the upper and lower regions of the ocean are even more poorly understood, again due to



a lack of observations. We also lack the information necessary to assess how much more heat and CO₂ the ocean can absorb, and even how much of the current variability is naturally occurring or human-induced. Understanding and predicting these exchanges is vital to predicting how much, how fast, and where temperature, sea level, ocean pH, and other key aspects of our climate system will change over the long-term.

Addressing these gaps will require greater investment in ocean research. Current funding levels are woefully insufficient to begin filling the gaps or to sustain the number of researchers needed to collect and analyse the data and to update the models to prepare us for the future. Even when data is available, opportunities to take advantage of it are being missed. For example, United Nations Framework Convention on Climate Change (UNFCCC) accounting mechanisms do not currently include information about how and where the ocean is transporting and storing carbon.

The key to understanding our future lies in understanding the ocean. Without an increased level of funding for ocean research and an effort towards a global ocean observing system similar to

our investments in atmospheric measurements, our current scientific efforts to advance our prediction of global climate change will not yield the hoped-for results that negotiators so optimistically announced just a few months ago. ■

Carol Anne Clayson is the director of the Ocean and Climate Change Institute at Woods Hole Oceanographic Institution and a senior scientist in the physical oceanography department.

The Woods Hole Oceanographic Institution is a private, non-profit organization on Cape Cod, Mass., dedicated to marine research, engineering, and higher education. Established in 1930 on a recommendation from the National Academy of Sciences, its primary mission is to understand the ocean and its interaction with the Earth as a whole, and to communicate a basic understanding of the ocean's role in the changing global environment.

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Rapid change of the Arctic climate system and its global influences

Photo by K. Tateyama

Dr Takashi Yamanouchi from the National Institute of Polar Research highlights the Green Network of Excellence (GRENE) Arctic Climate Change Research project and its impact...

The Arctic has become a hot topic not only in the scientific sector, but also in society, due to the abrupt retreat in summer sea ice area associated with global warming, rapid warming in surface air temperature, reduction of glaciers, melting permafrost and many other changes, recently. We started a Japanese initiative – “Arctic Climate Change Research Project” – within the framework of the Green Network of Excellence (GRENE) Program, funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), in 2011. This Project targeted understanding and forecasting “Rapid Change of the Arctic Climate System and its Global Influences.” Four strategic research targets are set by the Ministry:

1. Understanding the mechanism of warming amplification in the Arctic;
2. Understanding the Arctic climate system for global climate and future change;

3. Evaluation of the impacts of Arctic change on the weather and climate in Japan, marine ecosystems and fisheries;
4. Projection of sea ice distribution and Arctic sea routes.

Through a network of universities and institutions in Japan, this 5-year Project involves more than 300 scientists from 39 institutions and universities. The National Institute of Polar Research (NIPR) works as the core institute and The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) joins as the supporting institute. There are 7 bottom up research themes approved: the atmosphere, terrestrial ecosystems, cryosphere, greenhouse gases, marine ecology and fisheries, sea ice and Arctic sea routes and climate modeling, among 22 applications. The Project will realise multi-disciplinary study of the Arctic region and connect to the projection of future Arctic and global climatic change by modeling.



Photo by S. Sugiyama

Surface darkening and melting of Greenland ice sheet

modeling, land processes, the atmosphere, cryosphere and carbon cycle groups, and discuss our integrated strategy for investigating underlying mechanisms and relative contributions from different factors relevant to Arctic change and global impacts. This Arctic amplification was predicted decades ago by numerical simulations and verified by observations more recently. While albedo feedback is the most cited, many other processes operate simultaneously and were also suggested as important in previous studies. It is challenging to quantify systematically the relative importance of such processes in Arctic warming, yet necessary in order to understand the mechanism.

The diagnosis from the experiments in the MIROC3 GCM quantified the relative importance of individual feedback, and provided insight into what processes contribute to enhanced Arctic warming above the global average and what processes contribute to the enhanced Arctic surface warming. We apply the CFRAM (Climate Feedback-Response Analysis Method) to model output by including additional terms omitted in the previous study, in order to investigate the seasonality of processes contributing to Arctic warming. The smallest warming occurs in June-July, the largest reduction of sea ice concentration occurs in September, and the largest warming occurs in October-November-December (Yoshimori 2015).

In addition to scientific outcomes, results also contribute to the stakeholders. Understanding of mid-latitude weather links will help to forecast extreme weather (cold winter and heavy snow storm) in our societies, sea level rise, impact on marine ecosystems including fisheries, and possibilities for Arctic sea routes.

The successor of the project, ArCS (Arctic Challenge for Sustainability), which lays delivering emphasis on robust scientific information to stakeholders for decision making and solving problems, was started in FY2015. ■

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The project has been running since the beginning of 2011 and in those 5 years pan-Arctic observations have been carried out in many locations, such as Svalbard, Russian Siberia, Alaska, Canada, Greenland and the Arctic Ocean. In particular, 95 GHz cloud profiling radar in high precision was established at Ny-Ålesund, Svalbard, and intensive atmospheric observations were carried out in 2014 and 2015. In addition, the Arctic Ocean cruises by R/V "Mirai" (belonging to JAMSTEC) and other icebreakers belonging to other countries were conducted and mooring buoy observations were also carried out. The data retrieved during these observations was accumulated in the Arctic Data archive System (ADS) and served with interfaces for analysis. In addition, modeling studies have been promoted from fundamental process model to general circulation model.

Through these observations and analyses, new research results have come to light. For example, the recent surface temperature rise in the Arctic is about twice as much as the global average. There is no doubt that ice-albedo feedback can accelerate warming of the ocean and atmosphere and melting of sea ice. However, beyond that the Arctic change is likely to result from a complex combination of different factors. We will provide a joint perspective from

The Arctic Basin – a challenging shipping lane

The central parts of the Arctic Basin (the waters at and around the North Pole) may, in a few decades, be nearly ice-free during the warmest months of the year. This provides new possibilities for transport routes by water. However, thinner sea ice may provide new challenges for shipping in the Arctic due to increased variation from year to year in the extent of the sea ice.

The expected growth in traffic will increase the risk of long-term damage to marine flora and fauna. As of today, the international regulatory framework is not in place to meet this challenge. Neither is the necessary capacity for

rescue operations. At the Fram Centre in Tromsø, Norway, a Flagship Research Programme, headed by the Norwegian Polar Institute, addresses these challenges and opportunities.

The German ship *Beluga Fraternity* was in 2009 the first non-Russian ship to pass through the North-East Passage (partly along the Russian coastline) on its way from South Korea to Western Europe. This was a milestone in international shipping which provided an idea of the possibilities that lie ahead in an ice-free Arctic Basin.

Polar nations are not yet ready to fully handle such a new shipping lane

between the continents, Norway included, but the likelihood that the Arctic Basin will be navigable for ships during parts of the year, for the next 10 to 20 years, is so big that finding solutions to the challenges of increased traffic is much needed. These challenges are both many and complicated. Safety, search and rescue are vital issues, as well as mitigating damages to the environment due to accidents. These issues are of crucial importance to all the 5 nations that border the Arctic Basin. More oil and gas installations may be constructed in the Barents Sea and in north-west Russia during the years to come, and this business activity will lead to increased navigation.



Person on a pressure ridge in the Arctic Ocean

Photo: Nick Cobbing, Norwegian Polar Institute



Pancake ice in the Arctic Ocean (thin ice formed in rough seas)

Photo: Paul Dodd, Norwegian Polar Institute

In addition, less ice in these waters will attract more cruise-liners and lead to more scientific cruises and fishing. Traffic will be further increased as container ships and freighters make use of the new intercontinental shipping lanes across the Arctic Ocean.

The Svalbard archipelago (with Spitsbergen as the main island) is the Arctic Basin's northern-most outpost of civilization. Due to its strategic geographical position it is easy to imagine the archipelago as a future base for monitoring, safety, search and rescue and oil pollution services.

The issue of varying ice conditions between summers provides a special challenge. The thickness of the sea ice is now typically 2m, whereas is used to be up to 3.5m only few years ago. This thinner ice is to a greater extent driven by weather conditions. Hence, the weather will play a more important role in determining the ice conditions, meaning that there may be a practically

ice-free Arctic Basin one season, while there will be a substantial ice cover the next. The years 2012 and 2013 were good examples of this; while September 2012 was an all-time low for known ice extent, there was an increase of 50% in September 2013. It may seem like a paradox, but this shows that with less sea ice in the Arctic, the need for ice prediction and knowledge about sea ice is growing.

This means that the need for further climate research and technology development is increasing. The Norwegian Polar Institute has monitored the thickness of the sea ice between Greenland and the Svalbard Archipelago for 24 years. For almost 6 months from January 2015, the Institute's vessel Lance was frozen into the ice north of the archipelago to serve as a floating platform for climate research. Scientists from Norway, Russia, UK, Germany, France, South Korea, USA and Japan were on board with their projects.

This expedition provided new and important knowledge about climate conditions and physical processes in the Arctic sea ice.



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Understanding glacial archaeology

Associate Professor Ivar Berthling from the Department of Geography at the Norwegian University of Science and Technology explains why cold ice patches turn out to be landscape hot spots...

The mountains and polar areas of the world hold large quantities of surface ice. The most striking are the rivers of ice that are referred to as glaciers, which, in general, are well documented and monitored – and now retreating due to global warming. Smaller ice bodies are typically omitted from glacier inventories and have consequently, to a large degree, escaped scientific interest. Such ice patches are known to reside also far below the equilibrium line of glaciers – meaning the zone on a glacier where summer melting is balanced by winter accumulation of snow – and one might think that they are doomed remnants of former glaciers. Surprisingly, however, these ice patches seem to have been rather stable through time, a fact glaciologists explain as a negative feedback effect. As ice patches shrink, their shape interacts with topography to increase the potential for trapping wind-blown snow in winter and decrease direct solar radiation during summer. We now know from Norway that ice patches may hold at least 6000 year old ice, and in North-America it may in places be even older – in Yukon one ice patch formation has been dated to as early as 8300 years before present. The ice of seemingly insignificant small ice bodies thus may be older than in largest mountain glaciers where ice is subjected to flow from the upper to the lower areas. Despite the self-regulating feedback effects, at some climatic tipping point the ice patches will disappear from the landscape, leaving few traces behind.

This remarkable stability of the ice patches has been realised quite recently, much due to the very interesting and growing field of science often referred to as glacial archaeology. Glacial archaeology is said to have started with the discovery of Ötzi the Iceman. Ötzi was found partly melted out of ice, but owed his remarkable preservation to the fact that this ice had



Stone Age arrow shaft just melted out to the surface of the Storbreen ice patch on Dovrefjell, Southern Norway

neither been moving nor significantly melted away almost since the day of his death, more than 5000 years ago. The non-deforming nature and the longevity of the ice that kept Ötzi intact are also characteristics of ice patches that help explain the well-preserved nature of archaeological artefacts, especially hunting equipment, presently melting out of ice patches in several areas around the world. A stone-age arrow melting out on the surface of an ice patch demonstrates in a simple way how the ice must be older than the arrow.

The mountains of southern Norway are a current hot spot for such discoveries. There, an information center has been established around the Juvfonne ice patch, and a tunnel excavated through the ice patch enables tourists to walk back 6000 years in time – which is the age of the basal ice in this ice patch. This is only one of the areas in southern Norway where ancient arrows, arrow shafts and even bows have been recovered, sometimes directly from the ice. The



The Kringsjølfonna ice patch east of Oppdal, Southern Norway. The dirt on the surface is a mixture of reindeer dung and mineral and organic material deposited by wind during winter, and successively enriched on the surface during melting. Similar layers still within the ice, accessible by ice coring, provides a portal for exploring past environmental conditions. Situated at only 1450 m a.s.l. and now less than 10 m thick, this ice patch is particularly vulnerable to global warming

explanation for this abundance of weapons on these locations is another significant characteristic of ice patches, namely the role of small ice patches as refuge for reindeer (caribou in North-America) during summer months when these animals seek cold spots to escape parasitic insects. This animal behavior was obviously known to the humans living in or near reindeer habitats. During warm days, the chance of encountering reindeer on the ice patches is high, and considering the alternative of roaming vast mountain areas in search of animals, the ice patches were obvious preferred hunting grounds. And they have been for millennia, with the effect of building a significant 'archive' of hunting equipment within the ice. This equipment, once lost, is now coming out of the ice again. As global warming proceeds, much older ice is exposed – and this goes for the age of the artefacts as well.

The ice patches in essence brought animals and people together; they were topographic elements of particular importance – a landscape hot spot! With reindeer recurrently seeking shelter on ice patches, not only hunting equipment was deposited on the ice. Animal remains, such as antlers and reindeer dung, are widespread and presently emerging from the ice. Both offer genetic information on the reindeer population at the time of disposal, but also evidence of flora and microbiology at the time. Other animals such as lemming and insects are also found, and macrofossils from vegetation is blown onto the snow surface during winter and incorporated in the ice later.

The ice can even be considered a separate ecosystem with specific species thriving on its surface such as many sorts of snow algae. Very old virus and bacteria have been discovered both in melting permafrost and preserved within the Antarctic ice sheet. Such old ice is not present in the majority of the ice patches around the world, but their specific ecological function makes them nevertheless a potential well for research that may even prove to have economic prospects: snow algae are presently utilised in cosmetics. The ice patches can also represent a viable training ground for testing equipment to be used for sampling for microbiological elements in more extreme areas, such as Antarctica or even Mars.

In conclusion, the ice patches seems to hold an ecosystem with an uncertain future, which calls for the attention of scientists, as well as natural and cultural heritage management simultaneously. There is an obvious need for documenting their biodiversity while they are still intact, but there is also a potential for exploiting the frozen portal to our recent past that the ice patches represent. Biotic remnants are, after all, best preserved while kept frozen. ■

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COP21 – a historic agreement but the real work starts now

Petr Zahradník, Lutz Ribbe and Isabel Caño Aguilar members of the European Economic and social committee (EESC) highlight the key role of civil society in driving the low-carbon economy transition...

The Paris COP21 has led to a historic agreement to hold the increase in the global temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C.

Prior to COP21, the European Economic and Social Committee (EESC), the voice of Europe's organised civil society in Brussels, called for a legally-binding, ambitious framework applying to all parties to the Convention on the basis of common but differentiated responsibilities. The COP21 outcome has largely satisfied our expectations. However, significant efforts will need to be made in the coming years to translate these ambitious commitments into concrete actions.

The challenges of implementing the agreement can be illustrated by the case of Europe. The EU Member States have been among the main advocates for decisive action to mitigate global warming and have set ambitious decarbonisation goals for 2020 (20% GHG reduction compared to 1990), 2030 (40%) and 2050 (80-95%). One of the key policy frameworks created to achieve these goals is the European Energy Union (EEU).

The EEU is an interesting policy framework because it covers – as a multinational undertaking – a wide range of sectors (energy, transport, construction) and pursues not only the goal of decarbonisation but also of energy security and affordability, while ensuring economic competitiveness and job creation in the renewable energy sector. It can therefore be expected to foreshadow some of the challenges that can be faced in implementing the Paris Agreement, including the development of an effective Emissions Trading System (ETS), agreeing on binding national GHG emissions reduction targets, and the phasing-out of national subsidy schemes that distort energy prices.

Most importantly however, the Energy Union can be expected to provide a glimpse of the opportunities, innovations, and challenges of governing multinational decarbonising efforts. At present, the governance of the EEU revolves primarily around obliging Member States to produce energy and climate policy plans and an annual monitoring of progress. The EESC continues to promote the idea of a European Energy Dialogue to ensure that it is civil society that drives an EU-wide transition to a low-carbon economy and society.

The importance of having civil society in the driving seat was notable during the COP21. The conference was historic not only because of its final achievement but also due to the unprecedented mobilisation of civil society and non-state actors. They stated, consistently and with conviction, the need for an ambitious, collective effort for a just transition to low-carbon and climate resilient societies and economies.

We have seen in the last months that the real action on the climate is taking place outside of the political decision-making and international negotiations process. This division between the negotiators and the non-party stakeholders, including among others civil society and the subnational authorities, was discernible prior to Paris.

However, it must be said that COP21 succeeded in bringing the 2 worlds closer together. In the run-up to Paris the mobilisation by non-state actors was given a platform of the Lima to Paris Action Agenda (LPAA) to showcase commitments and partnerships of cities, regions, businesses and civil society organisations, including trade unions, which reduce GHG emissions and build greater resilience. LPAA ensured significant visibility for concrete projects very often initiated close to communities and citizens. As a result, the outcome of



COP21 clearly recognised the efforts of all non-party stakeholders to address and respond to climate change.

By now almost all parties to the Convention have announced measures to limit or reduce their GHG emissions, so-called INDCs (Intended Nationally Determined Contributions). We know that even if these commitments are fulfilled, temperatures would still rise by around 3°C, far exceeding the level promised by the Paris Agreement. However, most analysts expect countries to exceed their pledges and a substantial part of this is due to action taken by non-state actors. A number of important announcements made in Paris such as the commitment of the RE100 group of major companies to source 100% of electricity from renewables, 1000 mayors pledging to deliver 100% renewable energy to their communities or an 80% reduction in GHG by 2050, and the launch of the Global Alliance for Buildings and Construction, to name just a few, provided a strong signal to investors about the unfolding transition.

COP21 has been a success of multilateralism and an important step forward in setting the global framework for climate action. But the job is not done; it merely got a kick-start and a strong push. The role of civil society will be more important now than ever. It is our obligation to put pressure on governments to fulfil

their commitments and accelerate the transition. It is also our role to mobilise non-state actors to work together by delivering concrete solutions in businesses, workplaces, organisations, cities, regions and communities as well as to take ownership of the climate agenda by forming strong alliances. The EESC is calling for an intensive and structured dialogue, so that society's fundamental willingness to develop new structures and solutions can be carried forward. ■



European Economic and Social Committee

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E3-Modelling research finds first-mover advantage for the European Union as frontrunner in climate action

In Paris, delegates from the 196 UN parties met in December 2015 to negotiate a global climate agreement. Countries accounting for roughly a quarter of global emissions met the March deadline to provide targets for curbing Greenhouse Gas Emissions (GHG) while at the same time some of the leading economies have missed the deadline, including Canada, Australia and notably China, lowering expectations for a universal climate agreement by December. However China signed an agreement with the USA on coordinating climate mitigation strategy. In contrast, the EU submitted ambitious emission reduction goals for 2030 well within a decarbonisation pathway.

The stakes are high, as the world is at present on a path to possible above 4°C global warming by 2100. Hitherto preventive action – including efforts to build a carbon market or to subsidise renewables – has been confined to the developed world and is largely insufficient. The European Union is clearly a frontrunner but many question the macroeconomic and industrial adverse effects of unilateral action.

E3-Modelling, based on modelling services to clients such as European Commission, Governments and business stakeholders, published research showing that in contrast with skepticism the EU's economic and industrial benefits can be effectively reaped from pioneering climate action.

Abatement of GHG emissions & carbon leakage

As stated on numerous occasions by the President of E3-Modelling Prof. P. Capros, “the basis for the deep decarbonisation of the global economy rests in efficient and equitable effort sharing. Lack of consensus on an international agreement for reducing Greenhouse Gas Emissions eventually leads to asymmetric climate policies which not only increase the cost of reducing emissions, but also dent the effectiveness of climate policy, through carbon leakage¹.” In particular, studies performed by E3-Modelling staff conclude that an international concerted action to reduce GHG emissions at safe levels by 2050, would require 1.5% of global GDP. In the case where only OECD countries embark in GHG mitigation, the carbon leakage rate is estimated to be close to 25%. If China participates to the abatement effort of OECD countries then carbon leakage rate can be reduced to 3%, underlying the importance of allying developed and emerging economies in pursuing GHG emission reduction policies.

EU as a first mover

Europe has long been a leader in pursuing a global climate deal, and has early outlined – with support from our economic and energy modelling research (PRIMES and GEM-E3 models) – a robust set of targets for drastically curbing the region's emissions by 2030. Indeed, the

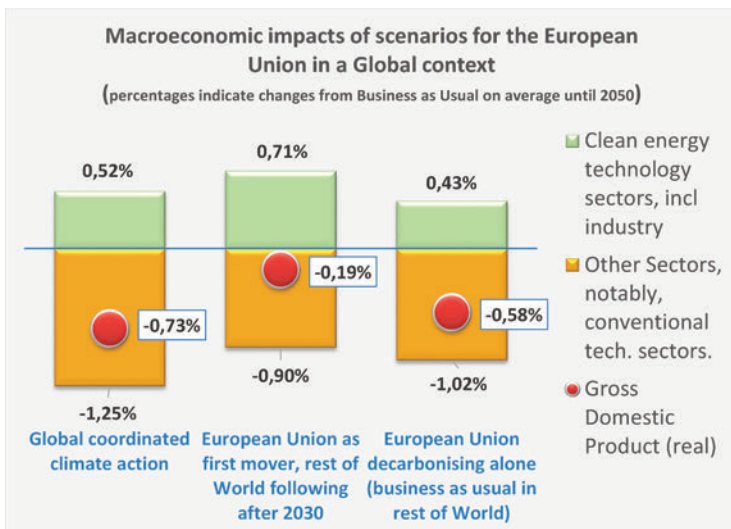
Conference of Parties (COP21) submission of EU countries' targets has formally put forward a binding, economy-wide target of cutting the region's GHG emissions by at least 40% below 1990 levels by 2030. The EU COP21 submission has been largely based on modelling work undertaken by E3-Modelling staff, with the use of two highly sophisticated and well established in the European context models: the PRIMES energy market model and the GEM-E3 computable General Equilibrium Model.

The EU can be considered as a first mover in global GHG mitigation. The net impact on EU economy is uncertain as early movers incur costs, but may also benefit from gaining a cost comparative advantage on producing low carbon technologies; the costs depend on the loss in competitiveness that leads to a decrease of their shares in global markets. A recent study performed by E3-Modelling shows that the net potential gain to EU from undertaking a first mover action can be up to 0.54% of its GDP.

Modelling tools operated by E3-Modelling

The main energy-environmental-economic modelling work of E3-Modelling rests upon a series of highly sophisticated in-house models:

PRIMES, a workhorse energy market model developed and maintained for



all individual European countries and the internal electricity and gas markets is a sophisticated market-oriented engineering-economic model with modular structure by sector, with high sectorial resolution including for transport sector. The model has been extensively used in assessing the 20-20-20 energy and climate policy package, the EU's decarbonisation Roadmaps and the recent climate and energy policies for 2030.

In contrast with optimisation models, PRIMES is an agent and market oriented model aiming at representing the reality of actors' behaviors and their interplay in markets, for energy commodities and for the emission allowances (EU ETS). PRIMES is rich in engineering information and includes detailed representation of energy and transport infrastructure. Its sub-models cover power market operation in high resolution, investment and design, gas market strategic analysis, energy efficiency in houses and buildings, industrial energy use and cogeneration, district heating, biomass/waste sector and new technologies including bio-energy, renewables, smart grids, power-to-gas, power-to-liquid and synthetic fuels, as well as storage. The Energy Roadmap publications and the Eurelectric Power Choices scenarios, carried out using PRIMES illustrate the capabilities

of the model in simulating deep restructuring of energy systems in demand and supply sectors, the dynamics of investment and equipment turnover in all sectors, while projecting impacts on markets (incl. EU ETS), commodity prices and costs by agent.

The GEM-E3 general equilibrium macroeconomic model is a sophisticated multi-sector and multi-country model used for economic impact assessment and macroeconomic studies. GEM-E3 fully linked with the energy model PRIMES analyse closed-loop energy-economy-environment assessments. The world energy projections, with focus on hydrocarbon world markets, is handled by E3-Modelling using the PROMETHEUS stochastic world energy model. GEM-E3 has been the model of choice for numerous country-specific macro-economic studies for a variety of cases, including Romania, Switzerland, North Africa countries, and others.

Modelling of Energy Economy and Environment

The researchers of E3-Modelling have provided scientific support and policy advice for the European Commission on many occasions including most recently the 2030 Energy and Climate Communication (January 2014), but have also provided support to the

German Ministry of Economic Affairs and Energy in the run-up to the agreement. They also regularly provide support to the Belgian Government, as well as to numerous non-governmental groups such as Eurelectric, AEGPL, EUROGAS. E3-Modelling participates in international cooperative projects such as the EMF and partners with renowned world institutes such as MIT, IIASA, PIK, FEEM, etc. in order to validate and enhance its modelling tools and regularly publishes its findings in international peer-reviewed journals.

At E3-Modelling, our aim is to communicate to policy makers and stakeholders around the world the quality output of leading scientific research in the areas of energy and the environment, helping them take informed decisions when formulating their optimal pathways towards a low carbon economy.

E3-Modelling is a spin-off company based on research activities performed at the National Technical University of Athens.

More information about E3-Modelling can be found at www.e3modelling.gr

¹ The part of emissions reductions in abating countries that may be offset by an increase of the emissions in non-abating countries



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How much does it cost to save the world?

Georgina Dowling, Associate at Ramboll UK outlines the importance of investment in infrastructure to help tackle climate change...

In December, 195 nations reached a landmark agreement 'to keep a global temperature rise this century well below 2°C and to drive efforts to limit the temperature increase even further to 1.5°C above pre-industrial levels' (UNFCCC, Paris COP21). To support developing nations, governments committed to \$100bn of climate finance by 2020 with a new goal from 2025.

How does this translate at a local level? The effects of Storms Desmond, Eva and Frank are predicted to cost the UK £1.3bn according to the ABI and this is in a country with formal flood planning. Internationally, the cost of doing nothing is even more daunting.

From a public sector perspective, the potential value of losses of a future with 6°C warming are projected at \$43 trillion in present value, or 30% of current assets, according to a 2015 report from The Economist Intelligence Unit.

A clear message from COP21 was that commitments at city and corporation level are critical in ensuring a collective response to tackling climate change. However, financing at a city level can still prove elusive and increasingly, city decision makers are turning to alternative financing methods, such as foundations, city networks, the private sector and more recently, green bonds.

In principle, green bonds are designed to address a wide variety of environmental matters but are backed by the issuer's entire balance sheet resulting in flat pricing. That is, the bond price is the same as ordinary bonds but it funds projects that have positive environmental and/or climate benefits. The market is growing exponentially with \$37bn in green bonds issued worldwide in 2014.

As an economic expert, Henrik Stener Pederson, Ramboll Management Consulting is helping cities analyse climate investments which must serve more than one purpose to be attractive:

'Investments must be directed at energy and transport infrastructure, climate adaptation, cloudburst mitigation and blue-green infrastructure that reduce CO₂ emissions and enhance quality of life. Only by designing multipurpose solutions can we support long-term, sustainable development.'

Copenhagen has developed an ambitious climate plan, for which it was named European Green Capital 2014. Jorgen Abildgaard, Executive Climate Project Director of the City of Copenhagen, argues that a city needs a system that allows knowledge sharing between cities and companies, and a new financial vehicle.

'Finding financing for this transformation is running into a lot of problems. We need financial systems that invite cities to invest massively in infrastructure and other climate solutions. In Copenhagen, we look at the secondary benefits. For instance, if you can pinpoint the health benefits of a project, you have an argument to bring to the negotiation table.'

From 2010 to 2011, Copenhagen was hit by 3 destructive cloudbursts, the last causing \$1.18bn in damage. Economic analysis estimated that inaction would result in such costs tripling in 100 years, so Copenhagen included cloudburst mitigation in its climate plan aiming to protect the City and use water as a recreational urban resource.

In the Middle East, the megacity of Jeddah, Saudi Arabia, has also found the cost of doing nothing to be an incentive for investment. An environmental degradation study by Ramboll shows that Jeddah will

lose 2-4% of its annual GDP unless something is done to address the rapid population growth, water scarcity and pollution. To meet the challenges and improve public life, Ramboll developed an environmental and social masterplan, including environmental impact assessments and cost-benefit analyses, to help resolve current and future environmental and socio-economic problems and serve as a decision maker's guide.

Back in the UK, the cost of the Christmas floods could trigger stakeholders to consider the approach taken in Canada's largest city, Toronto.

Following the 2 worst storms in Toronto's recent history costing more than \$1.7bn, the shattering losses and costs of inaction motivated more than 50 public, private and non-profit organisations to join the WeatherWise Partnership. Convened in 2011 by the City of Toronto and CivicAction, a business-orientated NGO, the multi-sectoral action group identifies risks associated with extreme weather and prioritises areas for action and investment by businesses, communities, organisations and governments.

To date, the initiative has resulted in a range of studies within such priority areas as electrical systems risks, critical infrastructure interdependencies and engineering vulnerabilities within roads, drainage and housing. Preliminary results have led to tangible resilience actions including instalment of basement backflow preventers and window well guards to reduce flood risks, as well as the use of cool, reflective materials on roofs to reduce urban heat island effects.

As Pedersen states, 'Cities need to understand the full costs and benefits of action and inaction. The cost of doing nothing is measured not only in material damages but also in lost investments, competencies and – in the worst case – lives.' ■

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The outcomes of COP21: Did it deliver?

Professor Jim Watson, Director, UK Energy Research Centre gives an overview of COP21 and whether it delivered on the promises...

The Paris climate change conference has been hailed by many as a big success for climate change action – particularly after the spectacular failure of the Copenhagen conference in 2009.

There are many reasons why. The world's 2 largest emitters of greenhouse gases – the USA and China – were able to offer more ambitious pledges than at Copenhagen. Furthermore, climate change provided them with an opportunity to co-operate closely, and proved to be a welcome antidote to the more antagonistic relationship they've had on some other foreign policy issues.

The bottom-up nature of the Paris deal also made a big difference. The search for a top-down deal in Copenhagen, with burden sharing between countries, has been replaced by a system of national pledges to take action. When putting this approach into practice, the French hosts received a lot of praise for the way they handled the negotiations.

Another key feature of Paris was the breakdown of the increasingly artificial divide between developed and developing countries. This historical divide has been challenged by the rise of the so-called 'BRICS' economies, especially China. The agreement that emerged still recognised differentiation between the roles and responsibilities of different countries. But for some, it did not do enough to help the poorest communities to cope with the effects of climate change.

Now that the dust has settled, do the plaudits for the Paris Agreement stand up? From a diplomatic perspective, the answer is 'yes'. The Executive Director of the UNFCCC has gone as far as to say that it offers 'a huge flame of hope' for international diplomacy. However, there remains a huge amount of work to do to ensure that the ambitions in the text are realised.

The combined impact of the national pledges that were made before Paris illustrate this starkly. If implemented, analysts have shown that we should expect at least 3°C of warming on average. This is far higher than the goal reflected in successive international agreements of a limit of 2°C above pre-industrial levels. More challenging still is the agreement to 'pursue efforts' to limit warming to 1.5°C. Whilst this aim is understandable given the vulnerability of some countries to sea level rise, it will be very hard to achieve, and is likely to require large-scale investments in negative emission technologies.

Just as important as the overall target is the mechanism to review national pledges every 5 years with a view to strengthening them. In principle, this mirrors the UK's Climate Change Act and its system of 5 yearly carbon budgets. The big difference, of course, is that the UN version is not subject to the same level of statutory oversight and monitoring.

Ultimately, action at national and international levels will be needed to redirect flows of finance into low carbon technologies and infrastructures – and to help the most vulnerable communities to adapt. Low carbon investment has been on the rise in recent years. But a step change in scale is required – both to create markets for existing technologies and bring down their costs, and to support research into new ones. The pledges at Paris help, but they can only deliver a small part of what is required. ■

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Turning global promises into local action

Alexandra Latham, Communications Officer at the European Geothermal Energy Council details how geothermal energy can play a role in the fight against climate change following COP21 in Paris...

Last December global attention focused on a closed room of lead negotiators who, after years of preparation, met to work out the final details of a landmark global agreement on climate change. Now, the work of implementing the COP21 Paris Agreement must begin; local and national governments need to decide how they will live up to their promises.

A well-functioning energy sector which is responsive to changing demands is essential for all, and as the sector which currently accounts for 60% of global emissions, it must be a cornerstone in the fight against climate change. The energy transition is already underway but there are concrete steps national, regional, and local governments can take to increase its speed and effectiveness.

Firstly, we must look again at our potential for domestic renewable energy, and its role in creating secure and sustainable systems. Renewable resources exist everywhere but it has been difficult to fully understand the potential and advantages in the past- particularly for geothermal energy.

Geothermal energy, the energy stored as heat beneath the surface of the earth, can be used to produce electricity as well as heating and cooling for use in buildings and industry, particularly the agro-food industry.

The geothermal industry has produced a number of interactive maps of potential in Europe; the GeoElec map (geoelec.eu) shows the potential for electricity production in 2020 and 2050 and the GeoDH map (Geodh.eu) shows the potential geothermal district heating. As Geothermal Heat Pumps (GSHP) can be used everywhere in Europe, local mapping and studies are most appropriate.



There must be greater access to information about the full range of options available, but that is not enough; the growth of renewable energy is only possible through legislative measures and policy mechanisms which facilitate its integration into the energy system currently dominated by fossil fuels.

Progress is being made in this area too, as tools to help policy makers build successful schemes are being developed, based from the experiences of regions and countries who have taken the first steps.

The FROnT project (front-rhc.eu), for example, looks specifically at energy used for heating and cooling. It is currently measuring the success of existing support schemes in a number of European countries, establishing the true costs of heating and cooling, and examining consumer behaviour when making energy choices, in order to create comprehensive guides for future schemes. The ReGeoCities project (regeocities.eu) looked specifically at geothermal



technology, and how regional and local authorities can streamline processes for the installation of GSHP, producing guidelines for cities across Europe to implement. As heating and cooling accounts for more than 50% of energy use, improving policy in this field is an efficient and cost effective way for governments to reduce energy imports and carbon emissions, and increase the sustainability of building stock.

“Geothermal energy, the energy stored as heat beneath the surface of the earth, can be used to produce electricity as well as heating and cooling for use in buildings and industry, particularly the agro-food industry.”

Europe is the home of geothermal energy; it was first developed here and continues to be the world leader in technology and expertise and must work to continue to be so. With both the skills and the increased use of geothermal energy, and as incremental steps are

taken at all levels of government, Europe can soon deliver secure and sustainable energy to its citizens.

Still, the contribution it makes can be much larger as knowledge and experience in geothermal is being exported around the world. Many developing countries, including notably those in the East African rift valley, have particularly strong geothermal resources. It will be European knowledge helping to give new populations access to electricity across the world whilst improving food security through innovative energy uses in agriculture, meeting many of our global challenges. ■

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Energy efficiency is infrastructure

Fraser Wallace, Policy Advisor for the Sustainable Energy Association argues that the government need to urgently recognise energy efficiency as infrastructure as part of the new National Infrastructure Commission...

In the first full week of November last year, George Osborne, Chancellor of the Exchequer, attended the launch of a new [National Infrastructure Commission](#). Its formation represents a significant coup for Osborne. It is headed by Lord Adonis, who is now working with the Conservative Government, despite being formerly Labour Transport Secretary. The Infrastructure Commission is the brain-child of Osborne, and at its launch he hoped it will, 'invest in the things that make our economy more productive.'

George then cited upgrades of road and rail, flood defences and superfast broadband as key examples of where this investment should be directed.

In the second week of November, George Osborne spoke at Imperial College London, where he described his priorities for the Comprehensive Spending Review. This review will see significant cuts to government departments; Transport, Environment, and Communities and Local Government have already agreed to reduce their budgets – 8% lower annually for the next 4 years.

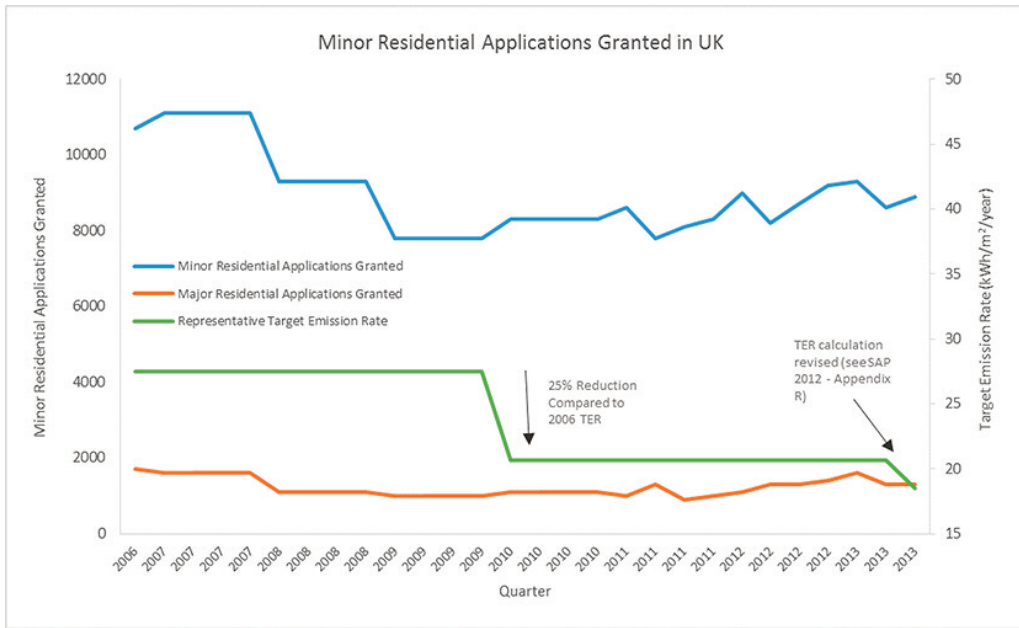
Wherever government money is spent, the Chancellor argued it should deliver:

- Economic Growth;
- Improved Security;
- Wider Opportunity.

This is where the interests of the energy efficiency business community and the Chancellor collide. Indeed, they collide at a point where all concerned with public health, the environment and the economy can agree. It is possible to deliver policy of mutual benefit to these varied interest groups. Energy efficiency can improve the economy, reduce carbon emissions and improve social outcomes. It's like knocking down 3 targets at a coconut shy with one throw.

George's stated objectives are laudable – and energy efficiency businesses can assist in delivering them. However, the government's plan for delivering these objectives is in danger of tripping over itself. Perhaps too much attention is being given to the urgent, and insufficient care is being focused on the important.

Government recently scrapped the implementation of the Zero Carbon Homes policy on the grounds that



Fraser Wallace, Policy Advisor

this would stimulate the housing industry, and increase productivity. Unfortunately, the evidence simply is not there when it comes to arguing reducing Building Standards and planning requirements promote that valuable and important goal – economic growth. The graph included in this article highlights that rates for grants of applications for both major and minor housing developments appeared to be unaffected by a previous drop in ambition when it came to reducing carbon emissions from our housing stock.

Conversely, work undertaken by [Cambridge Econometrics](#) (the economic and fiscal impacts of making homes energy efficient) reveals that every pound spent on energy efficiency schemes is likely to return £1.27 in tax revenue to the exchequer. This spend would also add to GDP – 0.6% by 2030. A national roll out of energy efficiency measures would also see increased employment by up to 108,000 net jobs per annum over the period 2020-2030.

That opportunity that exists for energy efficiency to assist the Chancellor to deliver his economic vision is clear. He should use his National Infrastructure Commission to deliver it. [Frontier Economics](#) have demonstrated the spend required of an infrastructure based approach and the benefits derived from that development would be similar to other large projects underway today. The government’s roll-out of Smart Meters is costing £11 bn in order to improve efficient use of energy and consequently, also reduce carbon

emissions. The deployment of Smart Meters is one example of a scheme delivering such important, long term, entrenched improvements.

The total discounted investment in energy efficiency required from government is estimated to be £40,214 mn to overhaul our outdated building stock. It seems incredible that as yet, energy efficiency is not a declared priority for the new National Infrastructure Commission.

As such, the [Sustainable Energy Association](#) is calling for – along with partners such as the [Association for the Conservation of Energy](#), the [UK Green Building Council](#) and the [Energy Bill Revolution](#) – this opportunity to be taken up.

Join our call and contact your local elected representatives to let them know you agree. ■



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Competition in connections

Competition in electricity connections is integral to the market; here James Veaney, Head of Electricity Connections and Constraint Management at Ofgem tells Editor Laura Evans why...

Connecting homes and businesses to the electricity grid is a great responsibility. That role belongs to Distribution Network Operators (DNOs), located across Great Britain. The DNOs own and operate the distribution network of towers and cables that bring electricity from the national transmission network into our homes. They are split into regions across the UK, comprising of: Electricity North West; Northern Powergrid; Scottish and Southern Energy Power Distribution; SP Energy Networks; UK Power Networks and Western Power Distribution. The 6 groups operate 14 different license areas between them.

Ofgem estimates that the value of the connections market is in excess of £500m per year, with hundreds of thousands of connections completed each year.

Over the last 5 years competition in this market has developed well. However, there is still further work to be done and Ofgem, the government regulator for gas and electricity markets in Great Britain, is responsible for encouraging competition in these markets.

Competition plays a vital role to ensure the consumer gets the most bang for their buck. Ofgem has done a lot of work in recent years to help speed up the process of getting connected, ensuring it is more efficient. In terms of the consumer it's about driving down the cost and getting the most out of the service provider.

"We have been really interested in how we can make the processes as efficient as possible and we see competition playing a critical role in achieving that," explains James Veaney, Head of Electricity Connections and Constraint Management at Ofgem.

"DNOs have an obligation to offer terms for a

connection. We've done a lot of work in recent years to speed up the process to make it more efficient and to help them to be more innovative in how they connect people to the network."

Competition is essential in this kind of market to ensure consumers get the best deal for their service requirement. In 2010 the organisation launched an initiative called the Competition Test in response to concerns regarding competition in this market.

"We told the networks that to pass this test they had to submit evidence to us of effective competition," explained Veaney. "This process ran for 3 years until the end of 2013 with the intention that the companies would present us with an indication of the steps they had taken to try and facilitate competition in the market and the impact these were having."

Following this review the organisation did see improvements had been made in the level of competition. However Ofgem still felt it was not satisfactory so a review of the market was carried out in 2014. This resulted in the first ever code of practice for DNOs being brought in. The code sets out what they must do to improve competition and if it is not followed DNOs could face enforcement action from Ofgem.

"We identified a number of factors that we thought were relevant to enabling competition," says Veaney. "Some of this was around customer choice, customer awareness, and willingness to enter the market.

"Some of these were within the DNOs' control so in 2014 we issued our remedies to those issues and this involved introducing a new licence condition on the networks to have in place a code of practice which is enforceable by Ofgem.

“This Code of Practice was developed in agreement with the independent companies that compete against the DNOs. It basically sets out that DNOs must reduce the extent to which competitors depend on them for essential services and that where competitors rely upon the DNO for services, these have to be provided to them on the same basis as the DNO would provide them to its own connections business.”

The code requirements include:

Point of Connection

To complete an independent connection, providers currently rely on the DNO to state the location on its network where the new connection can link to. Some DNOs may take too long to determine the point of connection and provide technical information to help the competitor.

The code states that for the majority of straightforward connections the DNO must provide the same amount of technical information, on the same timescales, to a competitor as it would to its own connection business. The DNO must also allow an independent company that has the necessary technical accreditation to determine where it will connect, which will significantly speed up the process.

Accrediting engineers from independent connections companies

DNOs must ensure that once an engineer is certified to work on or design a connection in one region, the accreditation and authorisation is applicable across Great Britain. Designs produced by suitably qualified independent engineers will also not have to be approved by the DNO.

Inspection of connections work

DNOs must have in place an inspection and audit regime which is consistent for all connections they will adopt (both for where they have been responsible for the work or where an independent company has undertaken it).

Veaney is confident that following the review and the introductions of the code of practice that competition will improve. However, as with every sector and market there are challenges.



“Part of our work here has been trying to turn these companies into outward looking customer and stakeholder focused organisations. This has taken some encouragement to turn that around,” he said.

“Getting the organisations in a room with their competitors – some of whom have had a difficult history with those companies – to try and work collaboratively on a code of practice, which ultimately the DNOs know is enforceable against them. I think we’d anticipated it would more of a challenge.

“I think the DNOs recognised this was going to happen and that it wasn’t going to be an issue that was going to go away. Now we’re committed and we’ll be to going back to this in 2017 to review the market again, to see how well it’s working, and to ensure is it having the impact it should.” ■

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Sustainable Energy & Utility Model Metropolitan, Brookfield Utilities UK

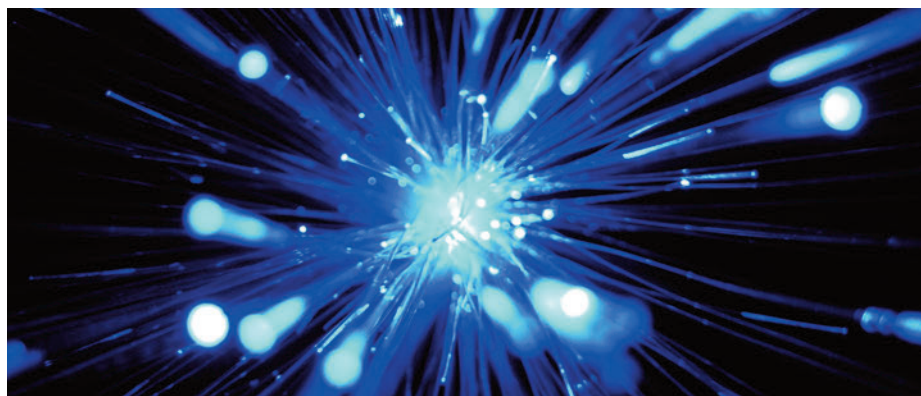
Brookfield Utilities UK ('BUUK') are part of Brookfield Asset Management, a NYSE and Toronto top 500 listed global investor in infrastructure founded in 1899 with \$186bn assets under management. BUUK is the UK's leading provider of energy and multi utility infrastructure, making c2,500 new utility connections each week. BUUK has a portfolio of over 1.4m utility connections across over 22,000 sites in the UK.

Metropolitan, a wholly owned subsidiary of BUUK, specialise in the sale and delivery of sustainable energy solutions. Metropolitan provide design, build, contract and project management capability, with assets owned and operated by BUUK. Metropolitan provides a one-stop-shop bringing all the necessary skills and knowledge together, installing the energy plant, heat network, gas supply and electricity export connection to the grid.

This integrated approach delivers benefits from the design stage through to installation. The infrastructure is delivered at a strategic level, with off site reinforcement built in and the enabling site plant installed. The site networks are then extended as required and buildings plugged in.

BUUK include installation of the energy centre and setting up the Energy Services Company (ESCo). BUUK invest in the energy plant and all site networks, reducing the cost to the developer.

The district energy model separates supply (ESCo / energy centre) and



distribution (heat network). BUUK own and invest in the district heating network. The model is unique as developers have the option to invest in the ESCo, which is fully managed by BUUK.

BUUK have extended this model to the retrofit / local authority market. This is a catalyst in helping communities become sustainable through the delivery of low carbon heat. Heat networks distribute heat from a complete variety of sources. Networks can build up separately and then be linked to form a city wide solution.

By owning the ESCo the local authority has control over customer heat charges. This can help address fuel poverty through a 'not for profit' ESCo approach. Equally, some local authorities support a more balanced 'reasonable profits' approach offering fair heat prices and the ability to use surplus operating profits from the ESCo to support other essential council services. Local authorities can select their preferred ownership route for the ESCo based on the needs of the local community and their social and political drivers.

An example of a Metropolitan project is the Argent site at King's Cross in central London where BUUK own the heat distribution network alongside the regulated electricity, gas, water, wastewater and fibre networks and provide a managed ESCo on behalf of the client. At full build out the development will consist of up to 2500 homes and 6m sq feet of commercial property. The King's Cross heat network also forms part of the London Plan, a strategy to interconnect all heat networks across central London to improve resilience and leverage the benefits of adding other available heat sources.

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Has the tide begun to turn?

Rhodri Glyn Thomas a Member of the European Committee of the Regions (COR) highlights why policymakers should start paying much more attention to ocean energy...

Within the next few years, thousands of homes and businesses across south Wales will, hopefully, be lit using the power of the Atlantic's tides. It has taken a long time for Swansea's 'tidal lagoon' to reach its current stage – planning permission has been granted – and some funding questions remain, but, once details of government subsidies for the £1 bn project are resolved, 5 similar projects across Wales and the west of England could also get off the drawing board.

The potential of the technology behind the lagoon – based on the tidal range, with electricity generated by the fall and rise of the tide – is substantial (the developer estimates that the 6 projects could eventually generate as much as 8% of the UK's energy).

What is more, this is not even the most promising form of ocean energy.

So why do national policymakers talk so little about ocean energy? There is one understandable reason: it may be 20-30 years before the technology with the greatest potential – wave power – is ready for deployment, so it is easy enough to regard the development of ocean energy as a task just for researchers, not for policymakers.

But, in addition to tidal lagoons, one other technology is close to commercialisation – 'tidal stream' technology, which produces electricity as tidal currents pass through turbines. Policymakers therefore already need to put in place policies that ensure that the

technological solutions, when they come, can be deployed swiftly. Good policymaking could also speed up the research-and-development phase.

Those are reasons why the European Committee of the Regions, an assembly of local politicians from across the EU, asked me last year to draw up proposals for a Europe-wide policy to develop ocean energy.

My report identified 5 categories of issues that policy-makers should address: technology, connections to electricity grids, the environment, funding, and administrative or governance issues (an important example is access to data about our seas). But my report also considered a set of other questions: What policies might mobilise funding, reduce costs, encourage pooling of knowledge, enable innovation, and create a predictable investment climate? It suggested that effective policies will require co-operation between regional governments, state governments, and the European Union's institutions.

These are just proposals – the European Committee of the Regions is a consultative body to the EU, with no ability to decide EU policy – but 2 important trends suggest our ideas are timely and could be absorbed by decision-makers.

Firstly, many sub-state governments are interested in ocean energy. Wales has earmarked €100m (£74m) to support marine energy; other strong advocates are regions in France, Spain, Belgium, Denmark, the Netherlands and Sweden. Secondly, in its Strategic Energy Technology Plan, the European Commission has recognised ocean energy as one of the main technologies that could help transform Europe into a low-carbon economy. A natural next step would be for the EU to create an industry platform for ocean energy, something that would ensure that the EU pays concerted attention to the industry over the long term. For me, it would also be logical to enhance and co-ordinate co-operation between policymakers and public authorities in the Atlantic region.

Where momentum is lacking, though, is at the state level. Two state governments in the EU have ocean-energy strategies (Ireland and Portugal); 8 others, including the UK, feature ocean energy in their renewable-energy action plans. But this interest is too little

and too weak. Consider the British government. It is behind on renewable-energy targets agreed with the EU, yet it has cut support for wind and solar energy.

In the absence of clear political and financial support state governments, investors are wary, because economic growth is slow and because the ocean-energy industry is not playing on a level playing field: governments continue to subsidise fossil fuels and nuclear power and to ignore the social and environmental costs.

The basic commitments needed from state governments are to stop favouring old energy industries and to nurture the ocean-energy industry as they have the wind and solar industries.

The economic benefits of ocean energy should make ministers' calculations easier: ocean energy could be a major new industry, with benefits across the country. Climate change, of course, should also be a consideration. At climate talks in Paris in December, European governments made some very ambitious commitments to governments around the globe; but, to make those promises meaningful, they need to adopt policies that enable new energy sources to flourish.

At the moment, Europe – and, in particular, Wales – is ahead in efforts to develop ocean energy. But these are still relatively early days, and it is easy enough to imagine a strategically minded country on another continent securing the financial rewards of a global shift towards clean energy. ■

Rhodri Glyn Thomas has been a Plaid Cymru member of the National Assembly for Wales since 1999, representing Carmarthen East and Dinefwr. He is a member of the European Committee of the Regions, whose 350 members – all elected regional politicians or representatives of local governments – advise the European Union on policies affecting Europe's regions and cities. His report on "Developing the potential of ocean energy" was adopted by the European Committee of the Regions in October 2015.

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Hydropower vs ecology

Society's conflicting demands for more renewable hydropower and improving the ecological status of European lakes and rivers: Is it possible to meet both requirements?

The water management authorities face a contradicting dilemma in EU directives regulating the management of water resources in Norway and Europe. The European Water Framework Directive (EU WFD) and the Nature Diversity Act seek to preserve and improve the ecological status of lakes and rivers, whereas the European Renewable Directive and the el-certificate market promote increased production of renewable energy to reduce greenhouse gas emissions.

Norway has the potential to export renewable and flexible hydropower energy, and to serve as a “green battery” for Europe, but the above-mentioned market drivers and environmental considerations call for knowledge based and applied solutions that optimise the trade-off between renewable energy production and the preservation of local environmental conditions, and multiple user interests in existing and planned hydropower projects.

The RIVERCONN research project

The research project “Hydropower and Connectivity in Inland Rivers” – RIVERCONN, funded by the Norwegian Research Council, aims to provide new knowledge of the ecological requirements of migratory fish species in inland rivers in Norway. The key species are the salmonids European grayling (*Thymallus thymallus*) and brown trout (*Salmo trutta*). The E.

grayling are declining in numbers across Europe and are even redlisted by some countries. Many grayling populations in Norway are still viable, but several new hydropower projects give rise to a growing concern amongst fishermen as well as environmental management authorities. Hydropower dams have already fragmented many river systems in Norway, and they represent barriers or hindrances for migratory fish species. In the Glomma river, which is the largest river in Norway, 12 hydropower dams are established in the main river. These obstacles and river development raises an important question for both the hydropower companies and the water management authorities: What is the ecological significance of preserving migratory life histories? Is the preservation of a variety of naturally evolved life histories relevant to the EU WFD?

Why stress fish migrations and life histories?

Fish migrations are adaptations that allow fish to utilise several habitats to optimise survival, growth and reproduction, i.e. obtain greater net benefits and thus lifetime reproductive output. Hence, human actions that reduce or prevent fish migrations, reduce habitat quality and water flows are expected to cause reduced individual and population fitness. As a consequence, this may lead to declining populations and poor resilience capacity. Mitigation measures have primarily

focused on the stocking of hatchery reared fish to sustain and support sport fishery in regulated inland rivers in Norway, and partly on safeguarding upstream migration past hydropower dams. However, the obvious requirements for wild fish to perform return migrations past hydropower installations have by far been neglected. The EU WFD focuses on improving the ecological status of lakes and rivers, and one of its main goals is to restore the ecological connectivity of fragmented river systems. The Norwegian water management authorities have clearly stated that stocking hatchery-reared fish does not improve the ecological status of degraded water localities. Hence, it is urgent to develop new measures that safeguard natural recruitment and production of wild fish populations.

Traditional mitigation measures in fragmented rivers, such as the stocking and construction of fishways, need to be evaluated in light of new knowledge and legislative recommendations regarding their ecological effects. Fishways in European rivers have rarely been evaluated for functionality, and dysfunctional passage routes may cause high mortality and traceable evolutionary responses in wild fish populations. The scientific literature also reports an increasing body of studies showing that compensatory fish stocking programs may have limited positive or even detrimental effects on wild fish populations.

Suspension of compensatory stocking of brown trout in large river in Norway

In 1991, the environment authorities ordered the hydropower companies in the Glomma to release more than 50,000 two-year old hatchery-produced brown trout annually. The main goal of the stocking program was to maintain the important sport fishery in the river. However, relatively few resources were allocated to evaluate the effects of the program, which is also due to common practice. Fish stocking is a relatively inexpensive and simple measure to mitigate the negative consequences of hydropower development. However, the authorities and fishermen experienced a lack of success. The artificial produced brown trout had higher mortality and grew slower than wild fish. Few cases of large and attractive stocked fish in the catches of anglers were reported. In 2010, NINA implemented boat electrofishing as a new survey method in large rivers like Glomma, and the results showed that few stocked trout survived their first winter in the wild (NINA Report 1056). A big proportion were eaten by the piscivorous northern pike, and 80% of pike diet constituted more than 80% hatchery-reared trout in some reservoirs during the weeks after release. At the same time, boat electrofishing surveys gained new knowledge about the wild populations of grayling and trout, and NINA concluded that their population status should be improved despite the hydropower production. In addition, one could not exclude that the fish stocking could have a negative effect, e.g. because of undetectable outcome from competition for food and shelter, on the wild fish populations. In 2014, the water management authorities decided to revoke the stocking program.

The decision was made without major protests from municipalities or fishermen. For many anglers, both locals and visitors, wild fish are increasingly more sought after compared to stocked trout.

Is it possible to improve the ecological status in regulated rivers?

Society has decided to produce renewable hydropower in Glomma, and undamming the river is not yet considered a relevant question in Norway. The concept of environmental design seeks to optimise the trade-off between continued hydropower production and environmental considerations and preservation, e.g. how to safeguard migrations or habitat requirements of fish without losing too much hydropower. This is a research-demanding challenge, but NINA and partners in the "Centre of Environmental Design of Renewable Energy" (www.cedren.no) have developed this concept in regulated salmon rivers in Norway. Our advice to the water management authorities in Glomma is to start the process to develop this concept also for fish species like the European grayling and brown trout. To succeed with the concept of environmental design, we first have to reveal the ecological bottlenecks necessary to improve the ecological status of grayling and trout, and thereafter work out the most effective mitigation measures. Some emphasis should be placed upon threshold values for spillwater release necessary to maintain ecological connectivity. The results from the RIVERCONN-project imply that it will be mandatory to pay much effort into improving facilities for safeguarding two-way fish migrations past many hydropower dams in the future.

In conclusion: It is beyond doubt that hydropower developments generally have a negative impact on river ecosystems, but there is a great potential to reduce negative effects using environmental design to reveal ecological bottlenecks and work out goal-oriented mitigation measures. This will demand a more proactive approach applying dose-response trials designed by fish ecologists, hydropower companies and water management authorities in Norway. Supplementary stocking of hatchery-produced fish in the Glomma river is a past regime, and we should probably realise that preserving wild fish and ecological functionality after hydropower development in complex river systems like Glomma are far more demanding and expensive than continuing the supplementary stocking program. But on the other hand it will be more effective and the ecological status will be improved according to EU WFD.



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Addressing the energy storage bigger picture – The Interreg IVA SPIRE Project

The Interreg IV project SPIRE (Storage Platform for the Integration of Renewable Energy) managed by the Special European Union Projects Body provided £2.9M to address scales of energy storage required in the Ireland/Northern Ireland Cross Border Region. The project led by Ulster University's Centre for Sustainable Technologies brought together the Centre for Renewable Energy at Dundalk IT (CREDIT) and through an Official Journal of the European Community tender process, Gaelectric Energy Storage Ltd.

The aim of the project was to assess the likely volumes of energy storage required by the all-Ireland Single Electricity Market (SEM) given its likely high penetration rate (>40% by 2020) of non-dispatchable, variable wind energy. A series of scenarios examined the impacts of wind energy on the SEM developed to 2050 and incorporated alternative technologies such as advanced gas turbines and CCGTs and interconnection to other markets.

The scenarios are supported by a series of research initiatives examining different scales of energy storage, namely a) Large utility scale (represented by Compressed Air Energy Storage – CAES); b) Industrial site scale (through flow batteries and ice banks) and c) Domestic scale (through heat pumps and energy thermal storage).

CAES would be incorporated into local salt deposits at Larne, Northern Ireland, UK and proposed compressions of air to >100bar during periods of

excess wind capacity. Solution mining of a cavern at depths of about 1700m would provide 200-300MW of storage capacity and the air would be used to offset combined cycle gas turbine air compressors, thus increasing local power station efficiency.

A program of test drilling was initiated and results indicated that salt deposits at shallower depths (~900m) had greater geological complexity that first anticipated. The salts at greater depths were more suitable. CAES systems appear to be more cost effective than other large scale storage systems.

Intermediate scale energy storage supports wind turbines operating on large sites. Dundalk Institute of Technology used its 850kW wind turbine coupled with an ice-bank for cooling computer laboratories and 500kWh flow battery to evaluate system performance. The complexities of urban installations of wind turbines were evaluated through novel deployment of lidar technologies to examine the variable air flows around buildings. Results indicated that electricity and heat combinations worked well for building applications.

Ulster University developed a heat pump and thermal storage facility on its "Terrace Street" test houses. These are fully instrumented Victorian terraced houses lived in by families that are now converted successfully from gas boilers to high temperature heat pumps and 600 litres of water-based thermal storage. Initial results are promising with thermal comfort being

maintained, running costs reduced and pricing signals from the electricity system operator integrated to optimally utilise the storage when electricity demands are high and charge when electricity demands are low.

Finally, these three sets of performance characteristics were integrated into the SEM electricity market model developed in PLEXOS which indicated though a series of scenarios, the likely scales, costs and benefits on the SEM of different combinations of storage up to 2050. Demand side management with heat pumps and energy storage coupled with CAES looked promising but the overall conclusion was that there is capacity for many different approaches provided that they were assisted in their deployment through payments under ancillary services.

The author would like to thank staff, partners, Steering Committee Members (DCENR, Invest NI, Eirgrid) and the Special European Union Projects Body for their support through this challenging but fulfilling project.



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SPIRE

Storage Platform for the Integration of Renewable Energy

www.projectspire.eu

The EU INTERREG IVA funded Storage Platform for the Integration of Renewable Energy (SPIRE) project commenced in July 2013 with lead partner the Ulster University and partner Dundalk Institute of Technology. The Centre for Sustainable Technologies at Ulster is coordinating the project, which aims to assess the feasibility of storage technologies at large, medium and small scales.

The cost of energy is increasing due to a number of linked but separate issues. Security of energy supply is strategically critical in the face of increasing international prices, supply issues and geopolitical unrest. Energy supply depends on -

- the demand for energy services, and
- how that demand is delivered.

Energy service demand is driven primarily by economic activity and low energy prices can serve to remove barriers to economic activity. Ireland has excellent renewable energy resources and unlocking these potential resources requires energy storage.

The focus of the SPIRE Project was to minimise the barriers to the deployment of renewable energy by providing viable answers to energy storage challenges within a compact timeframe.

The technologies investigated by the project were heat pumps and thermal storage at a domestic level, flow batteries and ice banks at a commercial/industrial distributed scale and compressed air energy storage at the large utility scale. Ulster leads on modelling, scenario development and demand side management options with heat pumps and thermal storage, Dundalk leads on flow batteries and ice banks, while Gaelectric Energy Storage LTD. were appointed as



lead contractor to develop practical and theoretical assessments for compressed air energy storage.

Each technology strand engaged in cross-cutting themes in demonstrating Economic, Environmental, Cooperation and Social impacts that will see this region becoming a centre for excellence in energy storage development and exploitation.

The results and findings of the project will be published on <http://www.projectspire.eu/>

The SPIRE project will span 24 months from July 2013 to June 2015 and has been offered grant aid of up to £2,932,733 out of a total project cost of £3,737,076 under Priority 2, Theme 2 (Infrastructure: Energy) of the INTERREG IVA programme 2007-2013.



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This project is part-financed by the European Union's INTERREG IVA Cross-border Programme managed by the Special EU Programmes Body

How to make the Digital Single Market consumer-driven

Agustin Reyna, Senior Legal Officer at BEUC – The European Consumer Organisation outlines the 3 key areas needed from the Digital Single Market Strategy...

Success of the European Commission's Digital Single Market (DSM) strategy ¹ published last May depends on the tangible benefits it will deliver to consumers. It is crucial that the strategy guarantees 3 principles: trust, choice and protection.

- Strengthening trust means that consumers should benefit from a high level of protection within an efficient and enforceable legal framework. Consumers must be able to count on certain rights that would apply to both online and offline transactions. These rights should be technologically neutral and as far as possible future proof.
- A Digital Single Market should be built on choice. This includes the choice of goods, services and digital content, platforms and traders, payment methods, delivery operators and internet access providers. The internet is by nature borderless; consumers do not necessarily make a distinction between purchases from a local retailer or from a trader in another member state. Consumers want to access these products. It is fundamental that the European Union grants this access by bringing down artificial barriers within the single market.
- The third pillar is about guaranteeing protection against unfair and anticompetitive businesses behaviour. Building trust and guaranteeing choice are insufficient if consumers cannot exercise their rights and protect themselves when problems arise.

The European Commission unveiled the first set of proposals ² that stem from the Digital Single Market strategy: one on portability of online subscriptions for travellers in the EU, accompanied by a plan on the next steps of the copyright reform, and 2 proposals

on consumer contractual rights for digital content products and goods bought online.

So will these proposals actually improve consumers' lives?'

The proposal on portability of online subscriptions is definitely a step in the right direction. Consumers feel frustrated when they travel and cannot access certain services like online video subscriptions that they have bought in their home countries. This proposal will only benefit consumers travelling within the EU. More needs to be done to tackle the problem of geo-blocking and territorial discrimination, which is when consumers are unable to access online services from other member states, even if those contents like films, TV programmes and series are not available in their own countries in the first place.

On copyright, the European Commission is looking to revise the Satellite and Cable Directive. As expressed in our response ³ to the consultation on the revision of this directive, BEUC believes that the problem of geo-blocking in the audiovisual sector can and should be solved through clarifying and facilitating the clearance of rights for the purpose of cross-border access of audiovisual services and consequently bringing wider and more competitive choices to consumers.

The proposal on guarantee rights for digital content is another positive development for consumers. This proposal introduces for the first time specific rights for consumers at EU level when music files, eBooks or films malfunction or cannot be accessed. BEUC asked for this in the past and welcomed the Commission's decision to come forward with a draft law which



modernises and adapts consumer rights to the online environment.

Unfortunately, these positive developments are offset by the proposal on online purchases of tangible goods. This draft law would give consumers different rights when they buy a physical good, such as a bicycle, a PC or a fridge, online or in a shop. For example, if a Swedish consumer buys a stereo in a shop in Stockholm, he or she would enjoy a 3-year guarantee period in case the product turns out to be defective. But, if the consumer buys the same stereo from the same retailer online he or she will only have a 2 year legal guarantee under the Commission proposal. This fundamental flaw does not match the objective of developing a digital single market which the consumer can trust because they could end up losing protection they already have ⁴ when shopping online.

The European Parliament and national governments will soon start working on these proposals. They must rise to the challenge of defending consumer rights.

To do this, they should support the proposals on portability and digital content rights and address the flaws in the proposal on online purchases of tangible goods. Any strategy which sets out to improve consumer rights but ends up weakening some of them will fail. ■

- 1 http://www.beuc.eu/publications/beuc-pr-2015-006_digital_single_market.pdf
- 2 http://europa.eu/rapid/press-release_IP-15-6261_en.htm
- 3 http://www.beuc.eu/publications/beuc-x-2015-116_are_beuc_response_satcab_consultation.pdf
- 4 <http://www.beuc.eu/publications/european-commission-unveils-first-digital-single-market-proposals-mixed-results/html>

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GDPR adopted: what now?

The European co-legislator reached an agreement on the General Data Protection Regulation in Strasbourg on the 15th December 2015. While the formal adoption still remain to happen, the rest of the world can start working on what it actually means.

We will have two years to dissect these new rules, interpret them and find solutions to implement them. Considering all of this, two years is not a very long time, so we better not waste any.

The first work to do is to read the text. Following over 5 years of negotiations, and many different wordings for each provision, what has actually

been adopted? Here is a review of the most important provisions for the data-driven marketing industry:

The definition of consent has always been one of the central issue of the text. While the European Parliament has always called for an explicit consent, it seems that the negotiators finally settled for the Council's position, which requires an "unambiguous consent", also specifying that it should be given by "a statement or by clear affirmative action". While being built on almost the same principles as the definition of consent in the 95/46 Directive, the new text provides more specification on what constitute a valid consent and how to collect it. It is not a systematic call for the tradi-

tional tick box exercise, as solutions which meet the expended criteria for a valid consent may also be considered. However, marketing organisations should bear in mind that the rules on consent will tighten up. Information must be provided concisely, in a transparent and intelligible way, and be easily accessible using clear and plain language.

"Administrative fines is a concern for all data controller, in particular, how important they can be. While the Commission and the Council argued for fines up to 2% of companies' global turnover if they don't comply with the rules, the European Parliament advocated for a 5% threshold."

A last minute decision from the co-legislators, raised and still raises a lot of concerns among the industry. The text foresee that minors under the age of 16 will need parental consent to provide personal data. The text also provides Member States with the possibilities to adopted legislations lowering the age requirement as low as 13. However, this provision raises a lot of concerns, especially among social media, regarding the ability for teenagers to access their services without needing parental consent.

The most important issue for FEDMA and the European Data-Driven indus-



try over the past five years has been the ability for controller to access personal data on their legitimate interest. After having been heavily restricted by the European Parliament, the final version is back to a wording similar to the one in the existing directive, maintaining the ability of marketers to access data lawfully. However, the legislation provides some specification as to which criteria should be taken into account when assessing the possibility to use its legitimate interest. A marketer will have to take into consideration the reasonable expectations of data subjects based on the relationship with the controller. However, the same recital clarifies that the processing of personal data for direct marketing purposes may be regarded as carried out for a legitimate interest. This provision will require the development of guidance in order to ensure proper implementation, in particular, what is a reasonable expectation, in various context.

Similarly, the provision on profiling, renamed “automated individual decision making, including profiling”, will require some interpretation and guidance to facilitate its implementation. Unlike the previous wording suggested by the European Parliament, the final article on profiling provides a more balanced approach. There is no ban on profiling, but the text requires specific safeguards for profiling which produces legal effects concerning him or her or similarly significantly affects him or her. Also on the issue of profiling, and on the request of the European Parliament, the text clarifies that when an individual opt-out from direct marketing, he or she can also

opt-out from profiling related to such direct marketing. It will be interesting to look at both technical and self-regulatory solutions to implement this provision.

“We will have two years to dissect these new rules, interpret them and find solutions to implement them. Considering all of this, two years is not a very long time, so we better not waste any.”

Administrative fines is a concerns for all data controller, in particular, how important they can be. While the Commission and the Council argued for fines up to 2% of companies’ global turnover if they don’t comply with the rules, the European Parliament advocated for a 5% threshold. Negotiators settled for a threshold of 4%. Also, negotiators decided for mandatory appointment of Data Protection Officers. However, SMEs are exempted of this obligation as long as data processing is not their core business activity.

The biggest ambition of the Regulation is to create a One Stop Shop for companies. The European Commission defended this as the biggest added value of the text for the industry. However, the agreement found has already been the subject of heavy criticism. While Data Protection Authorities (DPAs) will have to collaborate further, they all keep to a certain extend their powers to investigate in cross border cases, thus limiting in practice the benefits of the One Stop Shop for companies. The Article 29 Working Party, will become the Euro-

pean Data Protection Board, which will be the place of DPAs collaboration. The Board will be managed by the European Data Protection Supervisor.

So, what now? The biggest part of the journey is only starting and the challenge is to look at the text and decides on the best way to turn it into concrete practices. It is something that need to be done at European level. To deliver its added value, the GDPR should be complemented by harmonised interpretation and the development of common implementation solutions, such as codes of conduct and self-regulatory programme. Looking at the number of key provisions for the data-driven Marketing industry where interpretation is needed to facilitate their implementation, there is no doubt that the coming FEDMA code of conduct on data protection will provide added value. Only by facilitating the implementation of the new rules, we will turn them into reality. The GDPR is merely a basis on which to build up responsible data management.



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CSR: delivering on the digital transformation agenda

Can digital services reap rewards for councils and taxpayers? Alan Mo, Research Director at Kable discusses how digital infrastructure is helping local authorities...

In his Spending Review, Chancellor George Osborne found £1.8bn for digital transformation and earmarked £450m for the Government Digital Service.

But just 24 hours after the review, some local government technology advocates were unhappy that the government's approach to digital transformation – though laudable – appears to be too Whitehall-centric.

In a statement, the public sector managers group Socitm said, "The government is investing £1.8bn in digital transformation, but the focus is on central government delivered services such as digital tax accounts and building one payment mechanism for all central government services. This shows limited aspiration when there are so many benefits to be derived from developing holistic, citizen-focused, digitally transformed services, co-designed and co-delivered locally."

Socitm believes it is, "Relationships not transactions that need to be addressed, where users become part of the solution in redesigning services and drawing on diverse resources to transform the way in which their needs are met and outcomes are radically changed for the better."

Digital transformation can become a nirvana for cash-strapped local councils. However, the problem remains in defining, designing and delivering it.

A recent local newspaper article reported that more than £800,000 has been committed to transforming the digital infrastructure of 2 councils. It went on to ask: will this investment reap returns for taxpayers?

The same question could be asked of councils up and down the country. But 'digital' means different things to different organisations. While some local authorities are looking to adopt extensive change programmes,

the less-ambitious but necessary reality for most is a desire to shift high volume transactions to more cost-effective channels.

Kable found that the top services local authorities are prioritising for channel shift over the next 12–24 months are environmental services (such as reporting fly-tipping and anti-social behaviour), waste, council and democracy, leisure and culture.

Lots of local authorities trying to understand the benefits of channel shift are conducting audits looking at their cost per transaction. However, differences in salaries and service scope and complexity mean the cost per transaction for one council for a particular service is likely to differ from that of another.

Despite these differences, recent analysis by Kable of these audits has shown that the average cost of face-to-face contact, £10.16, is more than 3 times more expensive than telephone contact, with both channels significantly more expensive than carrying out an online transaction, which costs just 20p.

The figures make a strong argument for councils to move to create self-service channels for citizens, many of whom now expect 24x7 access to council services, just as they expect it from utilities. If your kids' library books are overdue, you expect to be able to renew them online.

Yet despite these apparently compelling reasons for change, digital transformation remains difficult to achieve, with several blockers getting in the way of progress.

The first is no surprise: funding. Despite its promise, digital transformation carries an element of experimentation. Finding the money to innovate can be hard, despite the potential financial rewards for success. Councils must be able to free up money and have the will to invest in digital services.

Some certainly appear to have it. Birmingham City Council, for example, recently issued a pre-tender for a soft market exercise for the provision of a secure

online customer portal to authenticate citizens in order to access public services such as benefit applications.

A further blocker is the human factor. Council leaders must ensure both employees and citizens support initiatives. Senior leaders should own, run and drive process change, not delegate it. If you simply delegate channel shift to the customer service, IT or Web teams, you'll probably get an overly technical view of transformation rather than necessary organisation change.

For digital transformation to be effective, not only must leaders be able to drive the process, but the rest of the organisation also needs to be behind the initiative. Effective digital transformation is more likely when there are digital champions throughout the organisation to drive the process. Service line managers – in social care, housing, and transport, for example – need to define the process, and champion it within their lines of business and with the service users that they engage with.

Two other hurdles also have to be considered: legacy and the lack of co-ordination across government. Local government typically purchases several different applications to support the way it delivers services. But because those applications are configured to support those services, that in turn tends to reinforce siloed ways of working. Councils have to want to break free.

The final hurdle concerns co-ordination. Digital enthusiasts are passionate about what they do. But that volunteering ethos only goes so far, and there is a need for digital best practice to be developed and shared. Finding the best mechanism to achieve this remains an issue – as does paying for it. ■

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Making Europe safe for all

Adjacent Government highlights comments from the EU Commissioner for Home Affairs, Dimitris Avramopoulos from a speech in 2015 regarding the European Agenda on Security...

In today's world what does security mean? Feeling safe in your own home, your own town or even your own country. In the last few months Europe has felt the full force of terrorism, with the atrocities in Paris and previous attacks seen in Copenhagen. These events are surely enough to make anyone fearful in their own country.

The European Commission however, are committed to ensuring people feel safe and confident wherever they may live or move within Europe. The European Agenda on Security has been put in place to instil this further.

In November 2015, the EU Commissioner for Home Affairs, Dimitris Avramopoulos spoke at a European Parliament Plenary Session about the way forward to prevent these kind of events from happening again.

"In the aftermath of the events in Paris and the developments in Brussels we are all more than concerned. Our Society is abhorred by the terror extremists are trying to poison us with.

While we are all still in grief for the innocent people that lost their lives in Paris, we cannot allow this to turn into a general psychosis. We cannot allow fear to prevail. Because fear is also a threat.

Our only way forward is to act to prevent these actions from happening, to ensure the security of our citizens and our democracies.

The European Agenda on Security adopted in April this year (2015) set out the principles and key actions in this area. The Agenda, is the reason we are not just reacting to events now.

We are implementing and accelerating the actions we had already in the pipeline to strengthen our resilience to terror.

An important example of one such action is the crucial new rules to control firearms that we have proposed.

Let me however start with our work on prevention.

Our strongest partner and guarantor for the delivery of effective preventive measures is the Radicalisation Awareness Network. More than 2000 local practitioners with different backgrounds from all over Europe are working on treating the root causes of radicalisation.

Since 2011, the RAN has produced policy recommendations as well as practical guidance and training material to better prevent and address radicalisation, on schools and the prison and probation environment; on the foreign terrorist fighter phenomenon and on the development of counter narratives etc.

The RAN has now been reinforced, with the Centre of Excellence up and running since 1st October 2015, which will support the RAN and help it expand its reach further, even to priority third countries such as Middle East/North Africa and Western Balkan countries.

Many of the perpetrators of these vicious acts are EU citizens, born and bred in our societies.

This means that our work has to start right here. In our countries, in our societies, in our neighbourhoods.

Let me refer to the abuse of the internet and social media for terrorist purposes:

I expect partnerships with the industry to lead to concrete outcomes in preventing and countering radicalisation leading to violent extremism.

The EU Internet Referral Unit established within Europol is instrumental in this regard.

It can build on the expertise of the European Cybercrime Centre within Europol – which has many years of experience in dealing with illegal content.

So we are by no means starting from zero.

In this context, I welcome the call to reinforce the mandate and resources of the European Cybercrime Centre to enable it to face these new challenges.

Our inter-institutional discussions to finalise the Europol reform will also touch on this.

“Our only way forward is to act to prevent these actions from happening, to ensure the security of our citizens and our democracies.”

The second priority is to support the development of effective counter narratives:

There is progress in this area, through initiatives such as the Syria Strategic Communication Task Force, which supports EU countries develop messages and carry out targeted communication campaigns.

The Commission is both financially and politically supporting the continuation of this project.

The report touches on several other important elements that we are working on:

We are working to improve evidence and intelligence sharing across the EU, in full respect of fundamental rights.

We will look as a matter of priority into all available options to strengthen our tools against terrorist financing: this includes measures for freezing terrorist assets.

And I will very soon propose a Directive to strengthen our framework on the criminalisation of terrorist offences, particularly the travel with terrorist purpose and terrorist financing.

This is how we will tackle the problem of Foreign Terrorist Fighters.

I will also report on the implementation of the Commission’s Communication on the prevention of radicalisation.

I hope that we will continue our constructive dialogue on matters of security and more specifically the pending proposals and envisaged initiatives.

We will need your full support and engagement on the difficult way ahead. Europe needs to be united and defend its values with the necessary rigor.

You well know about the on-going work on different counter-terrorism measures.

Today our discussion focused on counter-radicalisation: It focused exactly in one of the root causes of the problem, and where the solution should come from as well.

This report will serve as a basis for a continued exchange of views about our prevention policy.

In our collective effort to fight radicalisation we must by all means avoid to stigmatise any community, ethnicity, or origin - whether they are Muslims, refugees or migrants.

As I said, and as many of you repeated as well, almost all perpetrators of the last attacks on European soil were home grown. And religion, any religion, has nothing to do with their acts.

Radicalism has. Hate has.

Relating terrorism with migration is steering up hatred and leads to a vicious cycle.

I am proud to participate in a discussion in a Parliament where Members from all the democratic spectrum defend our values of respect, of tolerance and of acceptance.

That is why I once again welcome Ms Dati's report, and this occasion.

I would also like to praise Mr. Kirkhope's intervention, I hope that common sense will prevail in our working together to face the common threat.

And for this we have different means that the Commission is working since months to put at the disposal of Member States:

- Exchange of information;
- Closer cooperation among Law Enforcement Authorities and Agencies;
- Stronger legal framework against terrorism and detection of terrorist threats;
- Effective management of the external borders;
- Stricter rules on firearms;
- Targeted cooperation with key third countries.

But the basis of an effective response is addressing its roots, and that is the central subject of today's debate: countering radicalisation.

Both in the real world and the virtual world.

Both by legislation and by schemes of cooperation with the private sector.

Both at local level and with the exchange of best practices among Member States." ■

This is taken from a speech – http://ec.europa.eu/commission/2014-2019/avramopoulos/announcements/speech-commissioner-avramopoulos-european-parliament-plenary-session-prevention-radicalisation-and_en

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SAFEPOST Project

An innovative approach to EU postal security...

The Postal Security Challenge

In 2001, five people were killed and 17 people injured when anthrax spores were delivered by mail in the US. Today, narcotics and counterfeit drugs smuggling by mail is growing with an increasing number of seizures; in China in 2009 145 kilos of illegal substances were captured in eight months.

It is estimated that there is one illegal or dangerous item for every 30,000 senders or every 180,000 packages.

The SAFEPOST Project is designed to assess the threats and risks for European postal services, through an understanding of all door to door delivery services, covering the whole supply chain. It aims at defining Europe wide solutions and testing these through pilot demonstrators.

The European Postal Sector:

- Postal Sector represents 1% of EU GDP, worth 90 billion Euros;
- EU delivers 40% of Global postal volume;
- 52 European Public Postal Operators:
 - Sort 135 billion items per year;
 - Link 800 million people daily;
 - Employ 2.1 million people;
 - Operate 175,000 Retail counter services.

The Need

European Postal Operators have state of the art screening and information sharing solutions to resolve security issues and improve standards throughout the postal supply chain.

Throughout the postal supply chain the need for implementation of innovative common postal security procedures is identified by operators, both public and private.

To this end SAFEPOST will:

- Develop a common understanding of all supply chain operations;
- Identify generic security threats from:
 - Terrorism & Organised Crime;
 - Theft;
 - Smuggling;
 - Transporting hazardous & dual use materials;
 - Animal & Plant Health.
- Propose enhanced screening technology & practices;
- Improve national and international information exchange;
- Identify opportunities for process optimisation during collection handling, transportation and delivery.

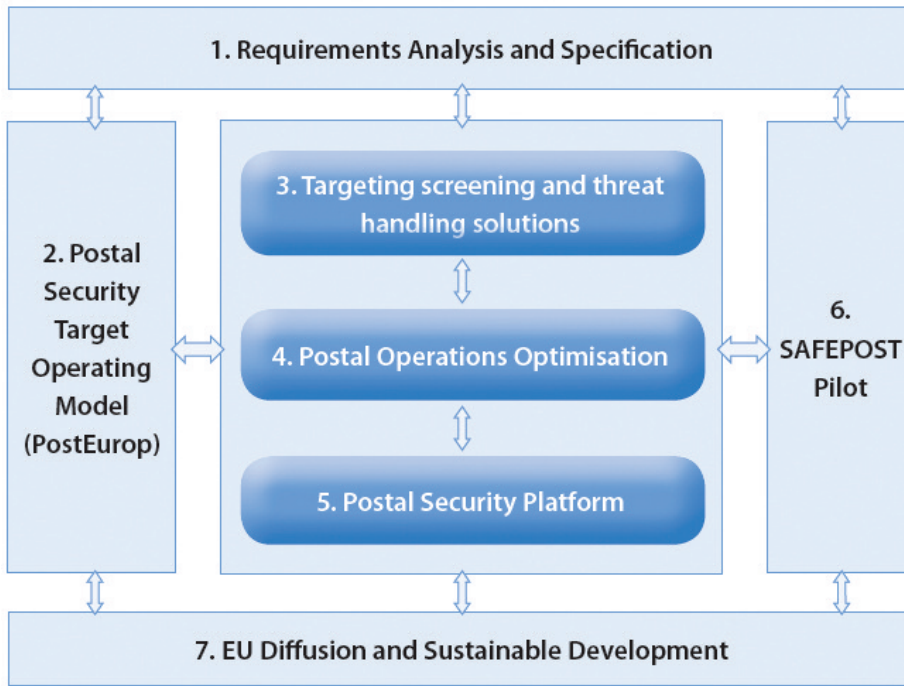
The Solution

SAFEPOST will:

- Introduce a SAFEPOST Framework Model to include:
 - A process model for collection, handling, transportation and delivery;
 - A fully documented Risk Model highlighting the relationships between threats, losses and consequences.
- Examine cutting edge and emerging screening technology to include:
 - Chemical Biological Radiological Nuclear & Explosive detectors;
 - Image comparison using computerised tomography;
 - Quantum cascade laser technology;

- Gas chromatography;
- Raman spectroscopy;
- Terahertz technology;
- Antibody biosensors;
- Automated Target Recognition technology;
- Optical Character Reader technology.

- Propose improved information sharing through:
 - Optimisation at sortation centres;
 - The development of trusted security stamps;
 - Improved tracking and tracing through automatic identification technologies such as labelling, bar coding and RFID The introduction of trusted receptacle seals;
 - The development of National Single Windows for information sharing. The creation of an ICT Platform;
 - Increased cooperation between operators and law enforcement agencies;
 - Improved joint risk management between Regulators and Providers.
- Investigate process optimisation to enable:
 - Enhanced tracking and tracing of vehicles and postal items;
 - Improved vehicle routing and prioritisation;
 - Implementation of screening technology;
 - Maintenance and improvement of postal flow;
 - Improved Security Standards through:
 - Risk assessment & Performance Management;
 - A common SAFEPOST framework model;
 - Accredited certification;
 - Common message standards.
- Execute Pilots to demonstrate how postal security and information sharing can be improved.



SAFEPOST is a four year project which is split into seven work packages described in the model shown above.

SAFEPOST – the key drivers: Common Postal Security Space

The common postal security space and ICT Platform will use a generic SAFEPOST framework, or operating model, which aligns EU Policy and Legislation with IT security management and industry wide best practice processes, through a shared network. The security ‘space’ will be integrated with the latest screening systems, target and threat handling reasoning and information sharing via a universally trusted postal security stamp.

Screening Systems

The project will examine and demonstrate cutting edge technology solutions for distributed and centralised screening systems, which avoid disruption of the postal flow. These will enable postal items to be examined both externally and internally, using explosive and trace vapour detector sampling, image recognition and comparison, radiation detectors and various laser and spectroscopic technologies.

Targeting & Threat Handling Reasoning

SAFEPOST is developing a target and decision support system which will combine information from disparate sources to conduct risk assessments. The goal of this information gathering is to assess the risk that a parcel is a potential threat throughout the entire door to door postal delivery supply chain. The system will discover potential threats in real time and will assess those not detectable by physical screening. When a threat is detected, action is needed immediately. This system will help users to decide on which plan to follow based upon the threat, time and resources available.

The Postal Security Stamp

The PSS connects the SAFEPOST system together. It envisages postal items and receptacles having universal security stamps which capture, place of origin, destination, content information, screening history, image comparison data, track and trace mechanisms. The information can be traced with live data held centrally for access by authorised stakeholders.



PSS: Virtual Postal Security Stamp
II: Intelligence information

The SAFEPOST Risk Model identifies:

- Loss Events including:
 - Threats causing loss events;
 - Consequences;
 - Preventative controls;
 - Reactive controls.
- Gaps where controls do not match the threat probabilities and loss event consequences;
- Links between common threats, follow-on loss events and common controls;
- Quantification of consequences;
- The effectiveness of control measures and the consequence costs;
- Security & Operations Performance Management.

The SAFEPOST ICT Platform

In order to be effective, a security network needs to acquire data, manage, interrogate and share it efficiently among a wide variety of stakeholders with differing needs at different geographical locations. The SAFEPOST ICT Platform will help the security stakeholders in different parts of the postal delivery supply chain to establish their own data exchange systems and communications with other providers or national and EU applications. Essentially it will help stakeholders establish inter-



Dr Antonino Scribellito
European Affairs – Senior Project Manager

operable applications consistent with the PostEurop Security Framework.

The SAFEPOST Pilots

As a practical demonstration of SAFEPOST’s methodology, pilots have been run at GEOPOST (Group La Poste), Iceland Post, Correos and Hellenic Post to show how the developed solutions can work effectively in actual operations.

The pilots showed how the Postal Security Stamp data will work, the operation of the ICT Platform and information sharing between stakeholders including , routing, tracking and vehicle prioritisation optimisation software and various screening technologies.

Seeing the high level significance of the SAFEPOST project, at the EU level supply chain stakeholders, the exploitation plan and dissemination phase will be conducted in cooperation with UPU, specifically with UPU Restricted Unions (for example: AICEP – International Association of Portuguese-Speaking Communications, BPU – Baltic Postal Union, CEPT – European Conference of Postal and Telecommunications Administrations, PUMed – The Postal Union for the Mediterranean, NPU – Nordic

Postal Union, PUASP – Postal Union of the Americas, Spain and Portugal, RCC – Regional Commonwealth for Communications) in order to involve the world wide level security supply chain stakeholders. One of the main objective of the dissemination meetings will be to spread the results and outputs of the SAFEPOST Project to wider audience at world level where the SAFEPOST Project extended demonstration meetings will take place in South America such as Brazil, Uruguay, Argentina and so on.

The SAFEPOST Partners:

- PostEurop, Association of European Public Postal Operators, Belgium.
- BMT, BMT Group Limited United Kingdom.
- GEOPOST (Group La Poste), France.
- FOI, Totalforsvarets Forskningsinstitut, Sweden.
- Tellusecure, Tellusecure AB, Sweden.
- MJC², MJC² Limited, United Kingdom.
- Inlecom, Inlecom Systems Ltd, United Kingdom.
- Correos, Sociedad Estatal Correos y Telegrafos SA, Spain.
- ATOS, Atos Spain SA, Spain.
- NEN, Stichting Nederlands Normalisatie – Instituut, The Netherlands.
- CORTE, Confederation of Organisations in Road Transport Enforcement Aisbl, Belgium.
- Hellenic Post - ELTA Ellinika Tachydromeia SA, Greece.
- Marlo, Marlo AS, Norway.
- ZLC, Fundacion Zaragoza Logistics Center, Spain.
- K-NET, K-Net S.A, Greece.
- Conceptivity, Conceptivity SARL, Switzerland.

- Iceland Post, Islandspostur Hf, Iceland.
- UNIGE, Universita Degli Studi Di Genova, Italy.
- CBRA, Cross-Border Research Association, Switzerland.
- EOS, European Organisation for Security SCRLZ, Belgium.

For more information on the SAFEPOST Project, downloadable material and news items, please visit the project website www.safepostproject.eu.

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Automated Comparison of X-ray Images for cargo Scanning (ACXIS)

A research project funded by the European Union under the 7th Framework Programme...

The project ACXIS brings together the expertise in X-ray cargo inspection of leading research centres in Germany, France and Switzerland, the major European supplier for cargo inspection systems, a research and development organisation focusing on training of X-ray inspection officers, and Customs Administrations of the Netherlands and Switzerland. The main objectives of the project are to develop a manufacturer independent reference database for X-ray images of illegal and legitimate cargo, procedures and algorithms to uniform X-ray images of different cargo scanners, a training simulator for cargo inspection officers, and a toolbox enclosing several assisted / automated identification techniques for potentially illegal cargo. Historic images of real detections and images of illegal cargo mock-ups as well as images of legitimate cargo will be integrated into the reference database.

Improved inspection procedures

Automatic detection at border controls

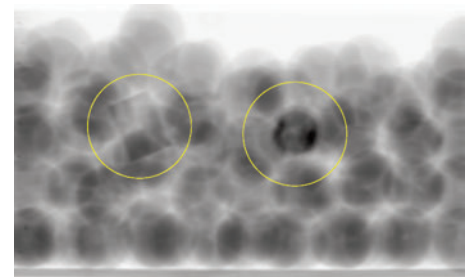


Figure 2: Example of images containing threats, plastex and hand grenade hidden between apples, photo and X-ray image

plays an important role in the vision of the Customs Administration of the Netherlands and the Federal Customs Administration of Switzerland. The increasing amounts of goods that pass their checkpoints require effective and efficient inspection procedures. ACXIS develops assisted / automated target recognition (ATR) methods to automatically detect legitimate and illegal cargo. The X-ray data is converted into a standardised format and stored along with the results of the ATRs and other annotations in a database (Fig. 1). The Customs officer has these procedures available on-demand, and he may annotate the results and share them with other agencies through a secure

cloud-based system. The standardization allows comparisons between scans from X-ray machines of different manufacturers and models. The database is filled with a large array of reference material, and new scans are continuously integrated.

Mock-up scans and database integration

Based on risk analysis conducted by the Customs Administrations, threat objects and their locations in the container were identified. Following their recommendations, a set of mock-ups was created with real threat items and simulants, combined with common goods (Fig. 2). These were scanned using laboratory systems and some with a cargo scanner chosen as reference. The main objective of these mock-up scans was to enlarge the variety of threat images. For the same purpose, simulation tools were also used in order to generate X-ray images from 3D models of various types of threat items (e.g. weapons). All the images from the database, and especially the ones containing threats, will provide a large basis for training

Figure 1: X-ray inspection procedure for border controls, with automated target recognition functions based on a centralised database

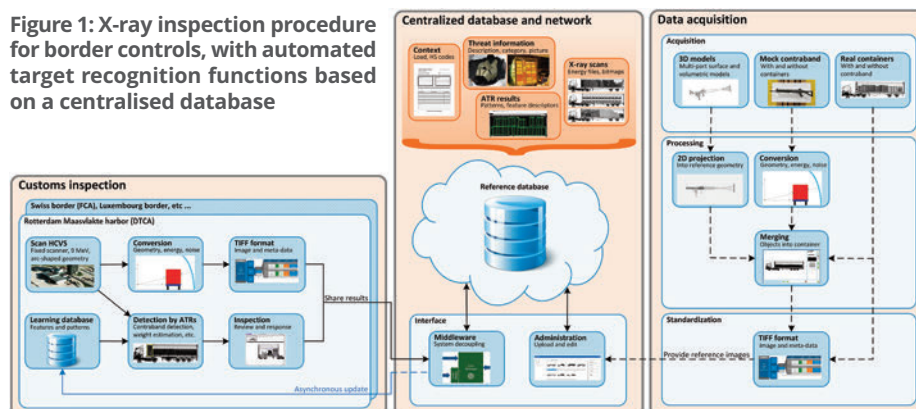




Figure 3: Example of automated detection of cigarettes

of screening officers and also for machine learning methods in automated detection algorithms.

Unifying the X-ray image standard

When analysing X-ray images, the human brain easily adapts to other different systems, regardless the possible geometric deformations, various textures and different levels of contrast or noise, which is not the case for automatic algorithms. Since a large variety of X-ray scanners are installed at border checkpoints, the analysed images need to be similar in terms of the aforementioned parameters. Standardising these images is a preparation step and is mandatory for good detection performances.

Image processing and automated detection algorithms

Physical processes involved in digital X-ray imaging were studied and accurate models were developed in order to take into account the differences between the various x-ray scanners. Geometric adaptation is perhaps the most challenging since projecting a complex load from distant view angles generates different distortions in the resulting image. However, an approach which selects the most similar ray paths and makes use of the standardised container dimensions gives satisfactory conversion results. Contrast corrections take into account the source spectra and typical phantoms are used to estimate several attenuation points which are then fitted in order to use the obtained curves for

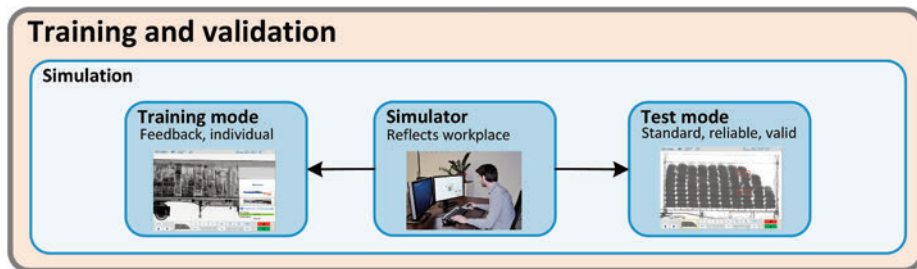


Figure 4: Educating the experts: training with the simulator

adjustments of grey level values. Several noise reduction algorithms were evaluated such that the noise level can be adapted towards the targeted system, i.e. the reference scanner.

The ultimate goal is to provide assisted/automated detection techniques of threats through dedicated algorithms. Several illicit goods detection scenarios were selected and prioritised. Several approaches of complementary assisted/automated detection techniques have been investigated according to the various envisioned scenarios, such as image comparison, load characterization, and direct target detection. For instance, methods for cigarette detection based on texture analysis are being developed and show promising results (Fig. 3).

Training the experts

A software application is being developed to provide focused training and to periodically evaluate the performance of Customs officers (Fig. 4). The user interface is carefully designed to resemble to various X-ray scanning systems and includes the most important support functions, such as zooming, image filters and enhancements.

The impact of the ATRs on the performance of Customs officers is evaluated through a validation study. A group of operators is selected for training during which they are presented with simulations of X-ray scans of shipments that are annotated with

the detection results of the ATRs. The performances of these participants are compared against a control group.

The training module includes three different levels of systematically adjusted difficulties. Supervised learning is guaranteed by providing the user with feedback after each image. The test modules are standardised packages that enable reliable and valid means to carry out initial and recurrent evaluation of the detection performance of Customs officers. These methodologies are rooted in behavioural psychology and have been applied to airport security personnel for many years with great success.

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The European Union Internet Referral Unit at Europol

Corporate Communications at Europol outline how the internet has become a powerful tool for terrorists and how they aim to combat this problem...

Terrorists' use of the internet and social media has increased significantly in recent years. Via the internet, terrorists can now reach millions of people with a single click. This gives them a powerful tool to reach their audience. The number of internet users worldwide is estimated at more than 3 billion people, according to the United Nations specialised agency for information and communication technologies (ITU).

Jihadist groups in particular have demonstrated a sophisticated understanding of how social networks operate. They have launched well-organised concerted social media campaigns to recruit followers and to promote or glorify acts of terrorism or violent extremism. In doing this, they have been empowered by the use of the internet in unprecedented ways.

To tackle this phenomenon, European Union (EU) Member States (MS) have decided to implement a coherent and coordinated European prevention approach. On 12 March 2015, the Justice and Home Affairs Council of the European Union mandated Europol to establish a dedicated unit aimed at reducing the level and impact of terrorist and violent extremist propaganda on the internet. Europol's European Union Internet Referral Unit will identify and refer relevant online content towards concerned internet service providers and support Member States with operational and strategic analysis.

On 1 July 2015 Europol launched the European Union Internet Referral Unit (EU IRU) to combat terrorist propaganda and related violent extremist activities on the internet. This new capability draws upon existing trusted relationships with law enforcement authorities across the EU and beyond, the private sector and the on-site Europol Liaison Officers' network. It relies on



available secure communication channels and databases, as well as Europol's unique robust data protection and confidentiality arrangements.

Currently, the EU IRU team comprises 13 Europol officials and experts from national authorities in the EU. This dedicated team will grow in numbers and capabilities over the next year, reaching full maturity by July 2016. The full impact of the EU IRU, however, will be delivered by leveraging the combined resources of social media partners and national expert contact points due to be established shortly in all Member States, working as a concerted community through the EU IRU at Europol.

As per the mandate given by the Justice and Home Affairs Council of 12 March 2015 (see Council of the European Union Concept Note on the EU Internet Referral Unit of 16 March 2015), the EU IRU main tasks are to:

- Coordinate and share the identification tasks (flagging) of terrorist and violent extremist online content with relevant partners;
- Carry out and support referrals quickly, efficiently and effectively, in close cooperation with the industry;



- Support competent authorities by providing strategic and operational analysis;
- Act as a European Centre for Excellence for the above mentioned tasks.

These tasks are carried out by receiving requests from the Member States or through the research for content online and are performed in accordance with the data processing rules outlined in the Europol Council Decision.

The content identified as extremist or terrorist is referred to the social media platforms which act according to their own Terms of Reference in removing such content. It is important to note that a referral activity (meaning the reporting of terrorist and extremist online content to the concerned online service provider) does not constitute an enforceable act. Thus, the decision and removal of referred/identified terrorist and extremist online content is taken by the concerned service provider under own responsibility and accountability (in reference to the terms and conditions).

“On 12 March 2015, the Justice and Home Affairs Council of the European Union mandated Europol to establish a dedicated unit aimed at reducing the level and impact of terrorist and violent extremist propaganda on the internet.”

The EU IRU, is still in its operational phase and focuses on the main terrorist propaganda players. From the EU IRU inception in July to mid-December 2015, over 1700 decisions for referral have been made. In more than 90% of the cases, the content has been deleted by the relevant online media platform. ■

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Using biometrics to fight crime

INTERPOL highlights how biometrics can be used globally to investigate crime and tackle terrorism...

As the world's largest international police organisation INTERPOL is ideally, and uniquely, placed to both develop and share global expertise in biometrics to assist law enforcement in combating and investigating crime and terrorism.

Among the capabilities developed by INTERPOL are targeted datasets for fingerprints and DNA, with ongoing work in developing a facial recognition system.

Fingerprints are of course one of the oldest policing 'tools' in existence and even today remain one of the foremost and successful means of identifying an individual.

What has evolved in terms of fingerprint technology is the manner and speed at which marks can be taken and checked. Any information shared with INTERPOL by each of its 190 member countries remains under their ownership, and they also decide which other countries will have access. However, clearly the more information is shared, the greater the chance of a match even from the most unlikely of places.

One example was in Mali, where an INTERPOL team had been deployed to help identify high-value prisoners suspected of terrorism. Following training on biometric devices provided by INTERPOL, Mali's Gendarmerie fingerprinted, photographed and iris-scanned the inmates. Checks against INTERPOL's fingerprint database revealed a match to an individual wanted by Algeria for terrorism, but who had been arrested under a different identity.

INTERPOL is currently working in partnership with the Greek authorities, Frontex and Europol to deliver enhanced biometric border screening capabilities through the use of fingerprint identification at the

migrant screening centres established on the island of Lesbos, amongst others.

In 2013 INTERPOL put in place the AFIS gateway which allows member countries to make fingerprint searches on the INTERPOL database, and this year INTERPOL will be piloting a project with 2 member countries to enable direct searching from national databases.

As with fingerprints, INTERPOL's DNA gateway is also evolving. It is important to point out that INTERPOL does not keep any nominal data in the DNA database linking a profile to an individual.

Checks via INTERPOL have enabled countries to establish links between cases and identify perpetrators far from where they committed their crime. A DNA check via INTERPOL linked multiple unsolved rapes in the US to a sex offender in Austria. Following his eventual identification, a 32-year-old Afghan national was arrested and extradited to the US where he is now serving a 60 year custodial sentence.

Cooperation via INTERPOL also led to the identification and arrest of an international hitman through combining the use of DNA evidence and CCTV images. In 2012, two unrelated attempted assassinations took place in 2 countries and DNA evidence from both crime scenes were matched by the INTERPOL DNA database.

Although the identity behind the DNA profile was not known in either country, CCTV images of the suspect at the first shooting were shared with the police from the country in the second. Here, the officers recognised the individual and an INTERPOL Red Notice, or international wanted persons alert, was issued for the suspect.



With assistance from the INTERPOL Fugitives unit, the suspect was soon identified and arrested in a third country from where he was extradited. A direct DNA comparison confirmed the match with the samples taken from both shootings and the suspect is currently facing judicial proceedings.

This is why we encourage our member countries to upload the complete biometric package recovered from a crime scene. By sharing all known and available biometric data, combined with INTERPOL's global Notices system, the chances of identifying, locating and arresting the offender are significantly increased.

Facial recognition is the latest INTERPOL capability which will go live in 2016. Developed in partnership with Safran/Morpho, member countries will be able to access this centralised matching system for facial images with a dedicated team at the General Secretariat to conduct comparison work.

Whilst still in the early stages, this new system provides exciting opportunities to offer biometric matching for crimes where no DNA or fingerprints are available, such as ATM fraud or rioting.

In addition to the centralised database we will be looking at the live capture of faces for comparison against a watch list of wanted people, clearly a major asset in identifying individuals in key places such as border control points.

An essential component of developing our biometrics and forensics abilities is the provision of training complemented through our working groups to identify member country needs. It is vital that we understand and provide the resources they need and share expertise developed across our 190 member countries.

As we further develop these services we will see increased data sharing by our member countries which will result in more identifications and fugitives brought to justice around the world. ■

For more information about INTERPOL's forensic and biometric capabilities, please visit our website <http://www.interpol.int/INTERPOL-expertise/Forensics>.

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 INTERPOL
 www.interpol.int

Municipality issued passports in the middle of a shopping centre

The municipality of Frederiksberg (Denmark) serviced citizens in the preferred time and place of families with children. It was made possible by a high-tech suitcase from Biometric Solutions ApS.

“We were present in the Frederiksberg Centre Saturday June 5th from 10 am to 5 pm. Our event was an effort to accommodate citizens’ wishes to be able to have passports made on a Saturday. At the same time it was a chance to be open for service an extra day during a period when many people needed passports issued,” says Sara Mia Petersen, Civil Service Chief at the municipality of Frederiksberg.

The municipality had advertised the event in advance, and local media had also mentioned it. Citizens could complete the application online from home and have the application approved Saturday at the Frederiksberg Centre, a major shopping centre in the middle of Frederiksberg in Copenhagen, Denmark.

“We saw a lot of interest from citizens both inside and outside the municipality of Frederiksberg. We had positive feedback from citizens who met us at the centre, as well as on the municipality’s Facebook page. There is a clear desire for this kind of event close to the citizens and outside normal working hours,” Sara Mia Petersen says.

At the municipality’s mobile stand, citizens had their passport applications approved, they had their passport



photos taken, fingerprints registered and their signatures scanned. All in a regular “suitcase” with a built-in computer, camera, scanners for fingerprints and signature as well as a 4G mobile data connection (LTE). The suitcase has been developed by Biometric Solutions and adapted to the requirements of the municipality of Frederiksberg.

High resolution fingerprints were a challenge

Not everything went smoothly. When the shopping centre was full of customers with smartphones in their pockets, the cellular network was so overloaded, that the large image files with fingerprints and passport photos were not transferred quickly enough.

“Many times our service took much longer than we would encounter in our daily routines at City Hall. That is why we did not issue as many

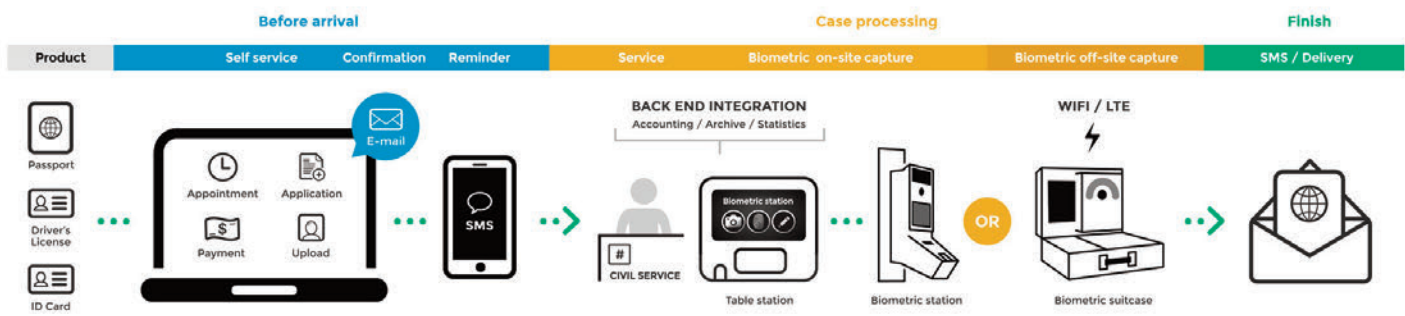
passports as we could have,” says Sara Mia Petersen.

Since the event, Biometric Solutions have successfully reduced the required bandwidth needed to make an application, facilitating a faster process even at poor network conditions.

The passport suitcase may be used for other purposes too

The passport suitcase may be utilised for a wide range of services for the citizens, as it contains a computer with a data connection to the municipal network. It provides new opportunities for the municipality of Frederiksberg:

“There will be a number of communal matters internally at Town Hall, where it may come into play. We will be able to serve citizens without the actual civil service office being open,” said Sara Mia Petersen.



“There is great potential in cooperating with the library or local associations like Ældre Sagen (a senior citizen organisation). Both the library and Ældre Sagen have target groups not always provided for by our opening hours.”

“With the passport suitcase, the municipality can serve citizens anywhere in the city and run extra passport stations in the high season.”

People before technology

The passport suitcase is provided by Danish Biometric Solutions ApS, specialists in user-friendly solutions for issuing identity documents.

“When a municipality serves the citizens on location, the process of issuing identity papers is made more

personal and much less mysterious. For the citizens it is a positive change, because they can do most of the work from home and make an appointment online. It provides the citizen with a pleasant feeling of control over the process,” says Alex Ramskov Johannsen, CEO of Biometric Solutions ApS.

The passport suitcase is only one part of the solution, which also consists of permanently installed biometrics stations at the municipality’s civil service office, as well as an online self-service, where citizens can fill out their applications in advance for passports, driver’s licenses or ID cards and make an appointment, so the physical expedition at the municipality’s office only takes five minutes.

“The technology for the recording of biometrics is currently at a high level,

and whether it is hardware from Dermalog, Crossmatch or some other supplier, we integrate it into the solution our client wants,” Alex Ramskov Johannsen explains and continues:

“Our mission is to give people the maximum benefit of the technology: We create coherent physical frameworks and IT systems that provide a quality experience and save time for both the citizens and employees of the municipality. And, at the same time, we ensure high quality and security in the production of identity papers.”

More about the passport suitcase

<http://biometricsolutions.dk/en/biometric-suitcase/>

Try it: Order a new Danish passport at the municipality of Frederiksberg

<https://selvbetjening.mitpas.dk/?key=A147&SOP=PAS>

(NB: in Danish)



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Access control and what the future looks like

With a stream of deadly terror attacks affecting nations around the globe in recent months, never has there been a more important time for both public and private sector organisations to ensure that their security measures are as effective as possible. James Kelly, Chief Executive of the BSIA discusses access control and what the future looks like...

Although sounding very technical, access control is one of the simplest forms of security a company can employ. When a credential is presented to a reader, the reader sends the credential's information, usually a number, to a control panel, a highly reliable processor. The control panel compares the credential's number to an access control list, grants or denies the presented request, and sends a transaction log to a database. The terror attack on the Charlie Hebdo office in Paris in January – where terrorists entered an office building – has highlighted the importance of access control and how vital it is as first barrier in protecting your staff.

Biometrics

Biometrics is the science and technology of measuring and analysing biological data. In information technology, biometrics refers to technologies that measure and analyse human body characteristics, such as DNA, fingerprints, eye retinas and irises, voice patterns, facial patterns and hand measurements.

The use of biometrics has wide repercussions, as with mobile devices, experience shows that consumer adoption helps to facilitate business use. The popularity of biometrics is set to grow in the coming years. The quality and accuracy of biometrics have rapidly improved in recent years, moving on from fingerprint readers and now readily incorporating facial recognition (which is very well suited to 'clean' areas) and moving towards previously niche and more complicated systems such as palm vein and heartbeat recognition readers.

Security Integration

The momentum of security integration is unlikely to



slow- in fact it will continue to be a key market driver moving forward. The benefits are unquestionable, with the drive for efficiency savings being the core proposition. It enhances security reaction times – for instance if a door is forced the combined system will sound an alarm, lock-down key areas and direct the security team to the location of the potential incursion. Integration makes installation and upgrades easier and more cost-effective and it makes full use of legacy and existing systems. There is a massive growth in the use of BACnet protocols, which are protocols that allow communication of building automation and control systems. These are adding a new level of software integration which is helping users to move away from

the remaining proprietary software that was once commonplace in the security industry.

There has been some debate within the security industry lately about the effectiveness and convenience of using passwords (both for physical to premises and logical access to IT systems). Integrated security systems allow authorised users to minimise the security details they have to memorise and are likely to gain further interest this year because of this advantage. The ability of integrated systems to intelligently provide access also means that workforce management is much easier using integrated security. From managing working hours to activating buildings services only when they are needed (and thus saving energy and resources), integration is providing intelligent solutions that will save users money.

Near Field Communications (NFC)

A technology that has been promising to do big things for some time is Near Field Communications (NFC). Whilst the technology for it has been available for some time, NFC’s success will be determined by the tipping point from the number of enabled mobile devices and the public’s willingness to use them to gain secure access to secure doorways. However the use of NFC has also been spurred on by a number of new compatible stand-alone locks which are especially well suited to access control using a smart device.

The technology is well suited to access control systems and has seen an appetite for these solutions in a number of different sectors.

Certainly the use of smartphones as an identifier is going to be hugely beneficial in the hotel industry. Most of the major hotel chains operating in the UK have shown an appetite for using mobile technology in this way and there are a number of pilot sites around the country.

Hotels have shown an interest in using customers’ smartphones as the key for bedrooms which has a number of really unique benefits. Customers can make a booking online, download an app – which links into a hotel’s loyalty scheme – automatically check in and then lock and unlock their room over the duration of their stay with just their smartphone. The ease of use and the ability to link an app to a



James Kelly
Chief Executive

hotel’s loyalty scheme will yield an impressive return on investment. Typically, the sites trialling access control systems that utilise smartphones are making use of Bluetooth Low Energy (BLE) as it is more readily available in a wide range of smartphones.

Cloud-based Security

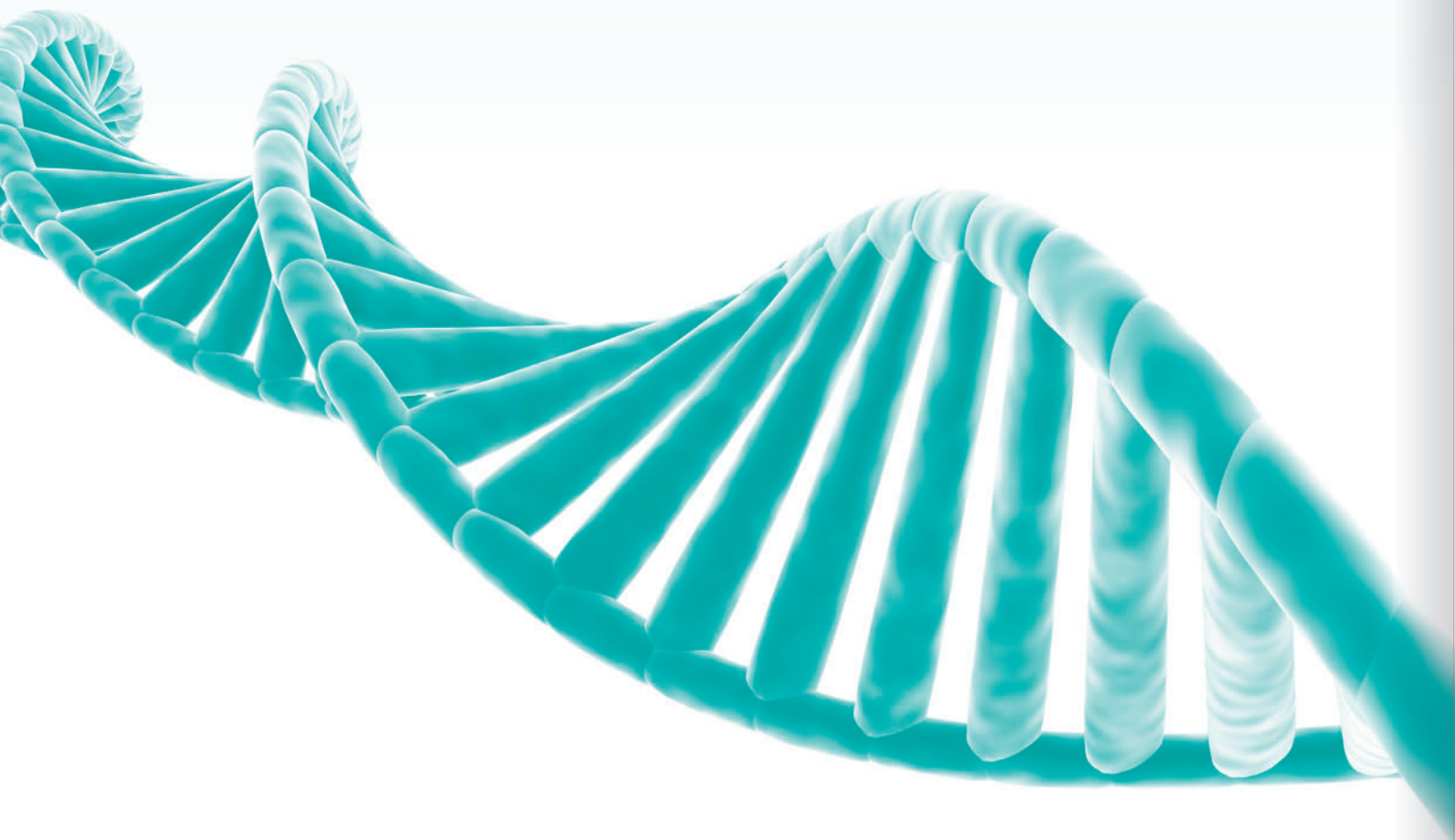
The adoption of cloud-based security is another area that has gained enormous ground in recent years and looks set to continue vehemently in future. It’s fair to say there were concerns over the security of using the cloud voiced by some commentators and potential users when cloud-based access control was first mooted.

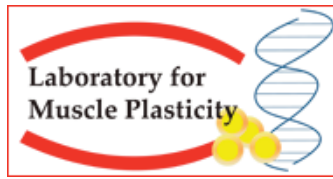
However, these were largely quashed by a wider acceptance of online use of services such as banking or retail, which have demonstrated that using IP needn’t compromise vital security. As well as ease of use and installation, cloud-based services also rapidly roll out updates (which is particularly useful in an emergency situation) and there is no need to store large servers onsite (which could be attacked or hacked directly) – freeing space and resources.

Members of the BSIA’s Access and Asset Protection section are experts in Access Control solutions and can offer advice on the different types of products available and the environments they are best suited to. ■

.....
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A Quest into Muscle Plasticity





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Reinventing the City Building on Creativity

Creativity, innovation and a strong focus on social and cultural aspects of sustainability are at the very heart of developing the City of Varberg to become the Swedish West Coast's Creative Hot Spot by 2025.

In our vision for the future, the City of Varberg has unique opportunities. Our goal is clear, and we are acting on it. We are building a community converging around means of public transportation in a rapidly expanding region. The railroad, which has long created a barrier between the seaside and the city centre, will now be relocated into a tunnel underneath the city. To expand on this opportunity we are moving the harbour in order to further free up land for letting the city reclaim its position as a seaside town. In total, the project will result in more than 500,000m² of land for development of our future city front. For people living, working or visiting the city of Varberg, the change will dramatically increase the freedom to experience the coastline. Places of residency, places for eating and meeting, places to shop and work, etc. – comes as a bonus.

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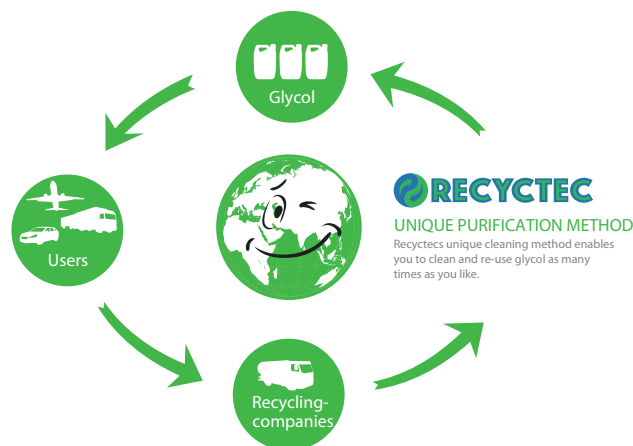
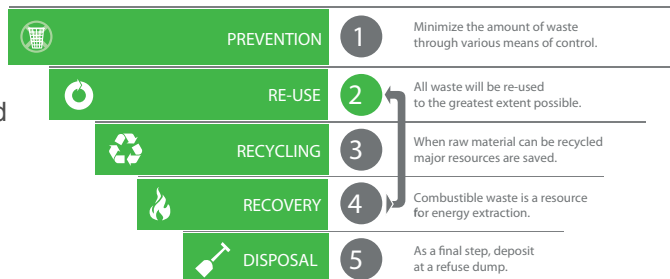
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