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FOREWORD

Michael Matlosz
President
Science Europe

Debates concerning the value of science and scientific research for society should not miss the point. For true and lasting impact for our societies and their citizens, science policy cannot be effective without clear focus on what makes science work: free-thinking, curiosity-driven exploration, discovery and comprehension! Unfortunately, one can encounter quite a few confusing narratives around this topic and, given its importance, it is therefore crucial that Europe reaffirms its focus on science in its science policy.

Surprisingly, the essential role and value of scientific research in a knowledge-based society is often forgotten. Debates about public policies for research seem to

imply that value for money and direct economic impact are the primary justifications for investing in research. This reasoning is much too restrictive, since scientific research has intrinsic value in and of itself, resulting directly from what research produces: knowledge and discovery. Sensible public policies for science are those that help ensure a steady and long-term supply of the most essential public good any policy maker can aim to provide: a robust knowledge ecosystem that allows societies to produce and employ a wide variety of knowledge leading to all sorts of and often unexpected, impact.

We need to sort out the confusion about the value of science for society.

Another source of confusion that seems to creep regularly into policy debates about science is the blurred distinction between research and innovation. In a knowledge-based society – and that includes a knowledge-based economy – innovation is the result of knowledge put to new use. Research contributes to innovation in the presence of an innovative culture capable of creative use of the rich variety of new knowledge and discovery. Research and innovation are nevertheless two very distinct concepts, and whilst they are cross-fertilising, they need to be addressed and supported by equally distinct public-policy approaches.

Publicly funded research is an activity that produces knowledge and skills that no other activity can or will develop. Innovation is a culture that allows new solutions to emerge when the right kind of knowledge and skills meet. Both need to be developed without competing against each other for the same public support.

We need to sort out the confusion between research and innovation.

Much like education, the research system is a basic knowledge infrastructure that underpins a society's ability to meet its own goals. European society has ambitious goals and it needs to meet important challenges. It therefore needs to focus its science policy on true scientific research for long-term societal benefit.

It is time to make science the top priority in our policies and in our research funding programmes. ■



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WELCOME

The coming months could prove to be very important for the UK. In June voters will be heading to the polls to decide whether they want the country to remain as part of the European Union. If the result is a Brexit, this could prove tricky for a number of areas, including science and research. A great deal of funding for UK research comes through the European Commission's Horizon 2020 programme.

In the May edition of Adjacent Government we look at both sides of the argument. Standing on opposite ends of the debate, MEPs Vicky Ford and Andrew Lewer put across their thoughts on the Referendum and how they feel people should vote.

Elsewhere in the publication we shine the light on Canada. In a special focus, we highlight science and healthcare in the country with a number of editorial pieces. A feature by Yves Joannette at the Canadian Institutes of Health Research – Institute of Aging focuses on brain health and the differences between men and women. We also highlight key priorities from the Minister for Health, Jane Philpott, and Kirsty Duncan, Minister of Science.

The environment section sheds further light on the circular economy and what more Europe can be doing to make this a reality. Karmenu Vella opens the section detailing why Europe needs a positive vision for economic development – in short, a circular economy.

Other articles that highlight this include a piece by the European Environment Agency, and MEP Sirpa Pietikäinen.

We also feature impressive articles from German Federal Minister for the Environment Barbara Hendricks; Norwegian Minister for Fisheries Per Sanberg, and Norwegian Minister for Climate and the Environment Vidar Helgesen. Each minister details environmental and climate policy for their respective countries.

As always the health section has an array of features, including a piece from Richard Bergstrom, Director General at the European Federation of Pharmaceutical Industries Association, on the importance of collaborative efforts to tackle the global problem of antimicrobial resistance (AMR).

Other areas of focus in this edition include: cancer prevention; the Zika virus; STEM investment in Ireland; education exchange programmes; and The Norwegian Climate and Forest Initiative.


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

.....
Laura Evans
Editor

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MEPs outline opposite sides of the EU Referendum debate

Adjacent Government highlights two sides of the argument with regards the EU Referendum from MEP's at the European Parliament...

On 23rd June UK voters will head to the polls and decide whether they think, as a country, we are better on our own or as part of the EU. Voters will have a very important decision to make regarding our status in Britain and Northern Ireland. The campaign has already been swamped with controversy, and as we get closer things are just beginning to hot up.

According to the latest ORB poll, as it stands at the moment the Remain campaign are ahead with 52% of the votes, and Leave stand at just 43%. This has changed somewhat from March 15, when an ORB poll revealed that the Leave campaign was ahead with 52% and the Remain on 45%.

A higher proportion of people, however, are now undecided about which way they would rather vote. Without sufficient information, people feel a decision is hard to make faced with uncertainty over the future if Brexit should happen.

The government were highly criticised for their Remain information booklet, with the Leave campaign suggesting it was 'biased' and highlighting the fact it cost £9m to print and distribute. However, the government have defended their choice by saying that the leaflet was a "moderate" response to people wanting information about the referendum.

Labour MP and Leave campaigner Graham Stringer said while the public did want information, the leaflets were "very biased" and broke the government's pledge to have facts independently verified. The official budget for the campaign is £7m for each camp, which includes £600k of public money.



“Voters will have a very important decision to make regarding our status in Britain and Northern Ireland. The campaign has already been swamped with controversy, and as we get closer things are just beginning to hot up.”

There are still many unanswered questions with regards to Britain's future in or out of the EU. What will it mean for jobs and trade? A number of people are particular concerned with how it will affect our borders. With immigration on people's minds at the moment, this is something that could sway the votes. The pressure is on, as UK voters have an integral decision to make which could change the country enormously.

Here, Adjacent Government highlights two views from MEP's on whether they think the UK would be better off in or out of the EU. Andrew Lewer and Vicky Ford highlight how they will be voting, and why they feel the UK will be better off in or out of the European Union...

Why I will be voting to remain in European Union:

Ever since I became an MEP I have said that the status quo could not continue. Europe needs to change and our relationship with it needs to change.

In just 7 years the Eurozone has gone from a Monetary Union to a Fiscal Union and Banking Union – now they are discussing “Social Union” too. This is a massive fundamental change to the governance of the economies of countries in the euro. We, outside the Eurozone, could not keep muddling along without change. The Prime Minister’s negotiation keeps the UK out of the euro, safeguards our economic independence, cements the independence of the Bank of England, and protects the pound. It takes us out of the “ever-closer union” and importantly prevents those within the euro from forming a cartel and discriminating against those outside. This has always been a red line for me in the renegotiation. It has been achieved.

On migration, the removal of job-seeker’s allowances and limits on benefits for new arrivals will reduce some of the pressures we have seen. Proper border control means being able to take action against those who present a danger to our communities. Sharing of cross-border criminal records will help us in the fight against crime and terror.

As an MEP I have fought against unwarranted red-tape and unnecessary laws. This negotiation sets up an annual review of all EU law and establishes sector by sector targets for removing unnecessary costs, returning decision-making to national parliaments where international EU rules are not warranted. There is of course more I would like to see.

The single market does help us to trade across Europe’s 500 million consumers. But the devil in the detail of EU law can affect every sector of our economy. This is why I have rolled up my sleeves to negotiate trade terms on cars, pharmaceuticals, banking, telecommunications, digital, offshore oil and gas, package travel, science and research, and many more areas. Other countries such as Norway have to accept

these business laws without having a say on the underlying terms. For an economy as diverse as the UK, indeed as the East of England, we cannot afford to be in a position like that of Norway.

There is of course more I would like to see, not least a less profligate attitude to the spending of tax payers’ money, an end to the wasteful Strasbourg circus, and a closer eye being given to warnings from the court of auditors, but these are battles we can and will continue to fight.

To get to this stage has been a mammoth negotiation which has needed all 28 countries to agree, each of which have their own internal political debates and many of whom are facing deep uncertainty in their own economies and national security.

If vote “Leave” we will need to secure a new trade deal, which would again need unanimous consent of 28 countries, plus the European Parliament. Much as I would like to be able to walk away quietly from the bureaucracy of the EU institutions, all my instincts tell me that leaving would lead to a very expensive and drawn out divorce.

Across the world economies, security and natural resources are under pressure. We are not immune; our own economic recovery is still fragile. Everyone will need to think very hard about their own decision. To me, this does not feel like the right time to be walking away from allies or taking unquantifiable risks. This deal is not perfect, but it is a step in the right direction and better than a leap into the unknown. ■



Vicky Ford
MEP

European Parliament

Why the UK should leave the EU

I believe we need fundamental reform of the European Union to drive out waste, unnecessary interference and red tape. Unfortunately, that is not what is on offer when the British public vote in the June referendum.

Our deal with the EU should not have been simply about keeping Britain happy. It was the opportunity for the EU to start delivering real benefits and changes for all its member states. It was our best chance to rein in the EU and hand back powers to national parliaments. If we are to stay in the EU, it needs to become a modern, effective force across Europe. In its current shape, it is not.

There are very real and difficult issues facing Europe today – such as the refugee and Euro crises. So far, the EU has failed to provide the necessary leadership to properly tackle these issues. Yet it seems determined to press ahead and create an ever-closer union, claiming even more powers for itself.

The UK does not need this creeping interference in national government affairs – neither do many other member states. But the response to the UK's modest set of reform proposals, suggests there is no appetite among our partners for doing things truly differently.

We did not ask for much – not nearly enough in my opinion. And what we have asked for has been badly watered down. Not only that, the deal could be further diluted by the European Parliament or thrown out by the European Court of Justice after we have had our UK remain or leave referendum. We will not know until after we have voted.

If – and it is a big if – we are to remain, we need to tackle the EU's significant drawbacks including:

- Over-regulation and interference;
- Loss of sovereignty;
- The huge transfer payments we make – £350m a week;

- The continuing aim for an ever-closer union;
- The lack of control over our borders and over migration.

Unfortunately, I do not believe the EU is willing or capable of delivering what is needed. Taken together, I believe these outweigh the benefits of staying in. And I believe – on balance – we will be better off economically and democratically outside the EU.

Neither do I subscribe to the belief that the UK is safer inside the EU – it is not borne out by recent history. The EU has just thrown billions at an autocratic Turkish regime for a bizarre migrant swapping scheme. It also means free access to the EU for a further 77 million people.

None of us has a crystal ball to predict the future. However, the leave camp is expected to have more answers. The idea that a future inside the EU is a model of calm and safe status quo is not borne out by recent history. Over the last decade it has lurched from unpredictable crisis to unpredictable crisis.

In an uncertain world is it not safer to have the ability to react, adapt and change? Or would we rather be tied to 27 other countries' agendas and problems?

The EU does have its good points and leaving would have negative as well as positive consequences. On balance, I believe, we would be better off leaving. The choice, will be made by the British people and not by politicians. And we have David Cameron and a Conservative government to thank for that – whatever the result. ■



.....
Andrew Lewer MBE
MEP
European Parliament



EU referendum: should we stay or should we go?

Digital Editor Amy Caddick gives a perspective on the confusion surrounding whether to remain or leave the EU..

As part of the generation that has only ever known the UK in the EU, the whole idea of a referendum into whether to stay or leave is somewhat bemusing.

For years, Europe has been at the forefront of British politics, driving legislation, promoting science, and allowing the free movement of people into the country. The thought of no longer being tethered to our European cousins is, frankly, a little surreal.

As of yet I am not sure which camp I fall into: in or out. Neither arguments have swayed me sufficiently to choose a side. It is hard to pick when both campaigns

seem to have descended into scaremongering and name calling.

There has been plenty of discussion over what the downsides of leaving would be, but minimal answers to why staying would be tantamount to political suicide for the UK. Businesses have weighed in, MPs have weighed in, even celebrities. Everyone seems to have an opinion on what we should do, but no one seems to be able to say why we should do it.

Sure, businesses are lamenting the loss of trade deals, the banks are talking of the total annihilation of the economy, while the Leave campaign is stirring rallying

cries about sovereignty and independence. It is easy to get swept up in flying the banner of freedom, but no one has actually explained what freedom looks like.

Conversely, staying in a political arrangement simply because it is easier than dealing with the fallout of leaving is a dangerous path to take. To stay or go must be a decision based in facts and understanding of the ramifications. Staying will keep us tied to the union. Even with the reforms secured by PM David Cameron is this what is best for our country in the long term? On the other side of the coin, would distancing ourselves from Europe be in our best interest in a society that increasingly globalised?

In all honesty, I do not have the answers to any of these questions. What the best course of action will be does not have an easy answer. Staying could be risky; leaving could be just as dicey.

What I have discovered during my exploration for knowledge on the referendum is no one really seems to know what an exit would entail. It might bring down the entire structure of society, decimating trade and the economy and liberty and a whole host of other terrible calamities. On the other hand, it probably won't do any of those things. The problem is there is no precedence for this type of action. The EU is a club most nations want to join, not leave. It is that uncertainty that is leading to an amount of dithering on the issue. Better the devil you know than taking a plunge into the unknown.

What is clear is the Remain campaign seems to be heading for the shock and awe tactic of worst case scenarios, while the Leave campaign has done little to inspire faith in what the UK would look like without the EU. There are agendas driving both sides of the debate, making it next to impossible to know which side to listen to. It is little wonder voters are confused.

As of yet neither side has put forward definitive arguments for why we should jump ship and go solo or stay best friends with the union. The arguments for

Remain or Leave have done little to inspire thoughts either way.

To hear the stay campaign talk, leaving the EU would rain down Armageddon, complete with economic collapse and the death of freedom as we know it. Our Scottish neighbours would push for another vote for independence and we would be overrun by terrorists within a week.

“What I have discovered during my exploration for knowledge on the referendum is no one really seems to know what an exit would entail. It might bring down the entire structure of society, decimating trade and the economy and liberty and a whole host of other terrible calamities.”

On the other hand the Leave campaign does not seem to know what will happen, but they maintain it will be a fist-bump for democracy. At this stage I would settle for knowing what kind of exit strategy we are looking at.

All this posturing and backbiting is tiresome. Wading through the political gesturing is becoming more of a slog as June moves closer. The time has undoubtedly come for both sides to set out their stalls and deliver the facts. Whether we are better or worse in the EU I'm still not sure, and I'm sure I am not alone in my indecision.

At Adjacent Government we would like to hear your thoughts on the Referendum – complete our [online survey](#). ■

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Why the UK and EU work better together

Adjacent Government's Sean Heath outlines why community is more important than sovereignty and why the UK should remain in the European Union...

Being in my late forties now, the first time I remember being aware of the European Community and that it was a contentious matter as to whether in fact we should be a member was in 1988. This was only 13 years after we had joined and Margaret Thatcher gave the famous "Bruges speech" giving her vision for the future of Europe. Being 21 at the time, it caught my eye being a prominent news story and it seemed to begin a period where Europe was the battleground for Conservative Party infighting spilling over into the mainstream news. After that we had the 'No. No. No.' speech in the Commons, Thatcher's fall, the ERM, Maastricht, the Single European Act and John Major's cabinet bastards to name just a few seemingly Tory melodramas that they got excited about but didn't really have a lot to do with the rest of us as we went around our daily lives.

Europe, and our role in it always appeared to be something that perturbed the retired Major's and WI members in Middle England for whom Jerusalem was, and is the surrogate National Anthem, and Johnny Foreigner is an anathema. In other words, your stereotypical Conservative voter/backbencher.

"We cannot fight the threat of international terrorism on our own either – together we are smarter and stronger."

Somehow, after all these years of it being a Tory Party issue, we have arrived at the point where suddenly we are being asked whether we still want to be European. For most people, I get the impression this is a bit of a shock and many family, friends and colleagues that I speak to say they are unprepared and don't have

enough information. I for one had been feeling as though I was European as well as British / English for some time now, and to think that part of my wider identity might now be taken away is disturbing.

I like being part of a larger community. What's the phrase? 'Strength in Numbers'? France, Germany, Holland, Spain etc are not strange overseas lands filled with undesirables, I like the ease of the Euro, I like the tunnel and passport control. To me, being part of Europe feels natural. Who knew we'd like tapas so much. More importantly it feels good to have a wide range of nationalities that essentially want to work together to build a safer, stronger, more prosperous and harmonious region.

We know where we stand with our current position being part of the wider European community. We know there are problems to resolve with the migration crisis. We know there is resentment brewing through the Schengen Agreement on open borders. There are irritations with our NET contribution to the EU budget and there is rising ill feeling because of the perceived lack of accountability of EU law makers and the imposition of unnecessary bureaucracy.

However, these points are seized upon by the 'out' campaign associated media like the Express and Mail and fed to us on a daily basis to distort our view and give us the impression we are somehow different from the rest of Europe and therefore should be separate. They make us feel we are under daily threat of being pillaged by a modern day equivalent of the Viking hordes except this time they are economic migrants and refugees who want to come to Britain because our benefits system is so great. Unfortunately there is a large and growing proportion of the population being influenced by this propaganda and sadly believe it.

Immigration is undoubtedly a troubling topic for many people up and down the country, but it should be our aim to solve it, not allow it to become something that turns us into a nationalistic, Nigel Farage-inspired UK version of Nazi Germany. When we see children dying on Greek beaches on the news and our own colleagues come back from the camps in Calais with stories and photographs of unimaginable living conditions for mainly innocent people, we have to be part of a European union that sets about sorting this out rather than leaving it to other nations.

The fact is we know what our problems are being part of the EU. We don't know what our problems will be being out on our own – it is guesswork at best and blind faith at worst.

Hindsight is a valuable tool, and with it comes the knowledge that the Scots made a great decision to vote 'NO' in their referendum. Despite the fact that they are according to the Kevin Bridges joke, "the only country in history to vote against their own independence", the whole 'YES' campaign was built around being self-sustainable underpinned by the price of a barrel of oil which is now worth less than half of what it was at that time. The newly formed Scottish economy would have been decimated. I don't remember anyone predicting that in advance.

The world is smaller; technology is eroding old traditional boundaries of trade and communication. Better transport links are making it easier and quicker to get to pretty much wherever we want. Turning insular and away from our continental neighbours somehow seems to be at odds with this concept.

Without being overly dramatic, future conflict in Europe must be avoided at all costs and for that reason alone we must make sure that all the people of Europe feel part of a collective that can celebrate their differences but rejoice in being part of something bigger, stronger and diverse that can show the rest of the world the way forward. We cannot fight the threat of international terrorism on our own either – together we are smarter and stronger.

Conflict drains prosperity, resources, energy and takes attention away from other problems and issues many of which Europe faces today. It is our responsibility for the sake of future generations that we grasp the nettle and focus on the task of resolving problems. We might live on an island, but we also all live on the same planet and just because we are surrounded by water, it doesn't mean we should pull up the drawbridge, ramp up our border security and disengage. ■

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Tackling the risks associated with diabetes

In a speech on World Health Day, EU Commissioner for Health and Food Safety, Vytenis Andriukaitis shares his thoughts at the Portuguese Parliament in Lisbon on how Europe can tackle chronic diseases such as diabetes...

I am very pleased to join you in Lisbon to mark World Health Day 2016. I am honoured to be here with all of you who have worked so hard to improve health in Portugal. I congratulate in advance those of who will get the awards, but also those who will not. Your work can not be defined by award only and your efforts are priceless for those who received your help and care.

This year's theme – “Beat Diabetes” is indeed of special importance here in Portugal, where so many women and men, and increasingly a big number of children, are affected and suffer.

Currently in the EU, over 32 million people are living with diabetes. It is not just a number. On average it represents at least one of your neighbours, one of your children's school friends or someone who you see on the bus to work every day suffering from the consequences of this disease.

The good news is that some of this challenge – diabetes type 2 (which accounts to almost 80% of all diabetes cases) – is fully preventable!

As a medical doctor, I know the suffering that diseases such as diabetes cause. As the European Health Commissioner and former Health Minister of Lithuania, I also know the price that our citizens pay not only in suffering for themselves or their beloved ones but also for the care that is needed.

My message is simple: the time has come to shift our focus, to promoting good health and preventing diseases.

The challenge is to start seriously tackling the risk factors – not only obesity, poor nutrition, lack of exercise, tobacco, alcohol misuse and stress, but also wider

social inequalities that amplify the risks for our most vulnerable citizens.

Believe me, it is not possible to reduce the number of people suffering, nor the burden on our healthcare systems if these risk factors are not tackled.

Let me give you one example – tobacco. Tobacco kills prematurely 700,000 Europeans every year. EU countries spend over €25bn a year to treat their citizens for diseases caused by tobacco. And most smokers start early – in school, by age 17.

The case for acting on tobacco is clear. Just think of all the human suffering and economic costs we could avoid if people stopped smoking!

This is why the European Union adopted an ambitious law on tobacco products. This law stipulates that, as from 20 May onwards, all new tobacco products sold here in Portugal – and throughout the EU – will have large photo and text warnings informing people of what smoking does to their health. So that people can make informed choices.

And I am pleased that Portugal already last summer adopted the relevant national legislation.

Another example: obesity is on the rise in Europe. More than 1 in 5 schoolchildren are overweight or obese; and are at risk of getting diabetes and other diseases later in life.

The costs related to obesity are, naturally, also on the rise: in Portugal they already spend over 3% of your health budget on obesity.

We cannot watch and do nothing while our children



grow into a lifetime of smoking, obesity and – may I add – alcohol. Portugal increased the legal age to drink alcohol from 16 to 18. This is good. But we need to do more.

I believe we need to deploy all the tools and policies at our disposal to promote good health. Some of these do not cost any money and are effective.

I am thinking for example on national laws to reduce young people's access to tobacco or alcohol, and to limit children's exposure to unhealthy food. Or even increase taxes on selected products. I very much encourage you to consider such measures.

EU countries share many similar health challenges. If we want to meet these challenges, we need strong, resilient, accessible and effective health systems.

And on health systems, let me pay tribute to Dr António Arnaut – the founder of the Portuguese National Health Service back in 1978.

Portugal's health system has come a long way since then; it has helped raise life expectancy and people's well-being, and it has greatly improved access to care. And confronted with the economic crisis, the Portuguese healthcare has proven its resilience, despite all the hardship.

Health and well-being are amongst the top concerns of our citizens. People's health can determine whether

or not people can fulfil their lives, study, work, contribute to society.

I am glad to see in the eurobarometer that almost three-quarters of people aged 25 to 64 in the EU feel healthy. This is positive!

On World Health Day, let us make a wish that next year this number increases even more. Let us work together on this. ■

This is an edited version of a speech at the World Health Day event at the Portuguese Parliament in Lisbon on 7th April. The full speech is available here http://ec.europa.eu/commission/2014-2019/andriukaitis/announcements/world-health-day-event-portuguese-parliament-lisbon-portugal-7-april-2016_en

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Vytenis Andriukaitis

Commissioner for Health and Food Safety

European Commission

http://ec.europa.eu/commission/2014-2019/andriukaitis_en

www.twitter.com/V_Andriukaitis

Reclassifying neurodegenerative diseases to enable drug development and help patients

Neurodegenerative diseases are a growing global challenge as medical advances ensures more individuals live longer. By 2020 there will be more than 40 million individuals in the world with Alzheimer's disease and by 2040, without the development of truly disease modifying drugs this will be more than 80 million. Similar trends are also seen for Parkinson's disease. The annual treatment and social care of individuals with Neurodegenerative diseases is estimated to be more than \$1 trillion by 2050, making it one of the most important socioeconomic challenges of this century. Discovering and developing disease modifying drugs i.e. those that prevent progression of the disease, has been very challenging with many programs failing. One of the reasons why the biopharmaceutical industry is having challenges in converting the emerging science in these diseases is the way we classify them. This is referred to as the disease taxonomy.

Disease taxonomy

The medical disease taxonomy is actually based on the work of William Farr in the 19th century. It has been refined since then as medical science has advanced, but it is still based on the signs and symptoms of the disease that the patients have when they see their doctor. This "phenotypic" based system has served us well for many decades but as it does not reflect the causes of the disease itself it is failing

when used to develop treatments directed at the molecular causes of disease. The current phenotypic classification means that we cluster together individuals with the same symptoms even if the underlying cause of the disease is different and we separate individuals with the same underlying cause of their disease if the symptoms look different. This is resulting in patients getting treated with therapies where they have little or no potential to respond and similarly patients being denied treatments they would benefit from.

An indication as to the importance of this classification can be seen in 2 therapeutic areas where a more disease aetiological (causative) approach has been used. These are in antibiotics and cancer therapies. With regard to infection a movement from broad organ based classification e.g. pneumonia, UTI etc, to a pathogen based system e.g. Streptococcus, Klebsiella in the early and middle part of last century led to the development of treatments which could be based on treating the pathogens regardless of the organ that was affected. Similarly in oncology at present the latest personalised medicines which are transforming patients' lives are based on the molecular cause of the disease rather than the organ or tissue the cancer is in.

The lack of detailed understanding of the causes of neurodegenerative

diseases in individual patients and a corresponding classification system is significantly impacting the discovery and development of true disease modifying therapies.

Aetionomy

Aetionomy is an Innovative Medicine Initiative (IMI) funded consortium established to develop an initial mechanistic based classification of neurodegenerative diseases focusing on Alzheimer's and Parkinson's disease. This public-private partnership is co-led by Duncan McHale from UCB and Martin Hofman-Apitius from SCAI Fraunhofer. The premise behind the project is that although large sums have been invested in research in neurodegeneration and a lot of data generated the co-ordination and integration of this data across the community has been less well addressed. The consortium has brought together experts in informatics, computing, engineering, and mathematical modelling of disease, neuroscience and clinical neurology from leading academic centres, as well as, neuroscience, informatics and neurology drug development experts from the EFPIA Industry partners.

The project therefore is not focusing on generating more data but on bringing together all accessible data, curating it to ensure consistency and putting it into a knowledgebase which can be mined and used for disease modelling. Once finalised the knowledgebase will



be available for both researchers to access, as well as being a curated and harmonised repository for the storage of future research datasets.

The Aetionomy researchers will use this database to identify sub-groups of patients with different molecular causes and will use this to develop a new taxonomy of disease.

The need to truly share data

The biomedical community has already spent over €10 billion in research into the causes and treatments for neurodegenerative diseases. This has led to a high quality evidence base but a lack of real progress for patients. One contributing factor is the fact that these projects often focus on individual technologies e.g. genetics or hypotheses e.g. the amyloid hypothesis in Alzheimer's disease. Aetionomy therefore decided that rather than generate another set of data it would look to

create a framework where the currently available data could be brought together harmonised and stored so that researchers could look across 100s of millions of euros of research and develop new hypotheses.

The knowledgebase is now built and based in Germany and Luxembourg. It is currently being populated using data from

publically available datasets, partner data sets including EFPIA company clinical trial datasets and datasets from collaborators. We are now reaching out to the whole neurodegeneration research community and asking for them to share their data so that we can integrate together all of the high quality science that has already been performed and enable drug discovery and developments for the millions of current and future sufferers of this disease. This call to share data is being driven at the highest levels and was a key recommendation of the OECD meetings on meeting the Alzheimer's disease challenge, and was christened "unleashing the power of Big Data for Alzheimer's Disease and Dementia Research". A failure to share data will result in duplicating research or wasting resources on areas that have not been validated and delaying getting treatments to patients.

"By 2020 there will be more than 40 million individuals in the world with Alzheimer's disease and by 2040, without the development of truly disease modifying drugs this will be more than 80 million."

The Future

The future will include a new way to classify neurodegenerative diseases based on the causes of the disease in each individual. We will have screening programs to identify patients at risk of developing neurodegenerative diseases and we will start treatment before symptoms occur. However before we get to this nirvana we must come together and share the data that is being generated across large numbers of publically and privately funded research programs to deliver on our common goal of discovering and developing treatments for neurodegenerative conditions.

AETIO NIO MY

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PATHway leading the way: ERS paving the way



PATHway vision

Cardiovascular disease (CVD) is the leading cause of premature death (30% of all deaths) and disability in Europe and worldwide (WHO), costing the EU economy almost EUR 196 billion a year. With changing demographics and deteriorating lifestyle this situation will worsen considerably, which is neither economically or socially sustainable. Effective cardiac rehabilitation (CR) can significantly improve mortality and morbidity rates, leading to longer independent living and a reduced use of health care resources. However, uptake of traditional community-based long-term (phase III) CR is very low across member states (approx. 11%), and is further diminished by low subsequent adherence rates. Key reasons for this include: severe lack of programmes, travel time, scheduling issues, lack of peer mentoring, and low self-efficacy associated with poor exercise technique and perceived poor 'body image' (not wanting to exercise with large groups of 'strangers').

In summary, PATHway constitutes a home-based lifestyle behavioural change program that will adapt to a patient's progress through the CR program, as well as, providing feedback on this progress to both the patient and the clinician. Realising the PATHway vision offers a unique opportunity to put in place a novel approach to CR that has the potential to address key limitations associated with the currently unsustainable provision of healthcare for CVD.



Patient screen with Avatar for exercises instruction and self-monitoring



Dashboard for monitoring overall progress

Furthermore, the overall concept and system is easily transferrable to address other diseases/conditions including diabetes, osteoporosis, breast/colon cancers, and obesity providing market opportunities for the commercialisation of PATHway beyond CVD. The technical tools required to implement PATHway will leverage and extend the state of art in a number of different areas, including motion capture, exercise

evaluation, physiological and lifestyle monitoring, exergaming/exerclass, home-based human-computer interfaces, multi-parametric data modeling and decision support systems, ensuring the creation of valuable Intellectual Property (IP) that can be leveraged within a considered and strategically sound exploitation plan as the basis for successful commercialization of the PATHway concept.

PATHway project

The PATHway project (www.pathway2health.eu/) is an EU H2020 project lead by Dublin City University (DCU), Ireland's University of Enterprise.

PATHway will provide individualised cardiac rehabilitation (CR) programs that use regular and socially inclusive exercise sessions. These are used to support a personalised comprehensive lifestyle intervention program. This encompasses patient's exercise/physical activity, smoking, diet, stress management, alcohol use and medication compliance. Patients are enabled to better understand and deal with their own condition and to lead a healthier lifestyle in general. An internet-enabled sensor-based home exercise platform allows remote participation in CR exercise programs at any time from the comfort of their own living room.

PATHway will perform research to proof the additional value of such personal home based cardiac rehabilitation training.

ERS – EHR-system

ERS is a Dutch SME (www.e-recordservices.eu) and partner in the PATHway project. ERS provides the Health Data management System (HDMS) to process all clinical, administrative and research related data such as data from devices at home and data from clinical decision support services. The PATHway HDMS supports open data for clinical and population research. The HDMS uses highly structured data and is fully model driven. HDMS includes a configurable rules editor and rules engine to create 'intelligent' screens and provide clinical decision support services.



PATHway project members

In an automated way, using these structured data specifications, data entry screens, the data base schema and application program interfaces (API's) are generated. This results in a very flexible EHR-system that can be configured in a controlled and standardised way to support users. It can be adapted for all Clinical Pathway's. The EHR-system adheres to all EU and local rules and regulations with respect to data privacy.

Benefits

Potential benefits of the PATHway HDMS are:

- a cost-effective, flexible, Electronic Health Record system;
- supporting generic continuity of care and clinical pathways with capabilities for Clinical and Population research using Electronic Data Research Capture Forms to re-use Clinical Data from HDMS;
- integration with commercial sensors, devices, games, and;
- intelligent Decision Support Systems with access to normalised patient data all supporting (self-) treatment of patients at home in a monitored manner by the care giver.

ERS HDMS can be used for:

- p-Health, because it supports tailor-made and adaptive treatment of

patients at home;

- m-Health, because mobile sensing devices are integrated, and;
- e-Health, because of the integration with EHR-system(s) and supporting research.

PATHway partners

DCU, Ireland
 KU Leuven, Belgium
 CERTH, Greece
 ERS, the Netherlands
 Nurogames, Germany
 Engineering, Italy
 University of Glasgow, Scotland
 University of Ulster, North Ireland

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ERS

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Facility Management in healthcare Institutions

Why the non-medical processes are well worth a closer look

Facility Management – a broad concept

According to the European Committee for Standardisation Facility Management (FM) is defined as, 'the integration of processes within an organisation to maintain and develop the agreed services which support and improve the effectiveness of its primary activities'. Simply put, FM supports the core business of any organisation and therefore the nature of FM is very broad and compliant. This is how the Institute of Facility Management at Zurich University of Applied Sciences looks at the concept of FM. Within the healthcare context, FM refers to the variety of non-medical support services and their corresponding processes in hospitals and other healthcare institutions, such as nursing homes.

For the past ten years, one of the institute's research main focus has been on FM in healthcare, mainly on the Swiss situation. From that experience

it can be stated that even though FM is emerging as a recognised management discipline, there is still much potential to align and improve the effective coordination of services through proper management of the buildings, spaces, people and infrastructure available to an organisation, in order to reveal financial savings as FM amounts for around one-third of healthcare institutions total costs.

An aspect that was hindering this process is that FM has not been seen as holistically as it should due to lacking definitions. To tackle this issue, the institute recently developed a catalogue of the non-medical support services that healthcare institutions require in order to run efficiently, available in German, French and English. This document clarifies what FM in the healthcare industry includes and also takes into account that the practices of individual organisations vary.

Current challenges require evidence-based data

National healthcare services are increasingly forced to operate with fewer resources and under greater pressure than they have done in the past. Switzerland, for example, drives one of the world's most expensive national health services and due to difficult economic times and the demographic change, cost reductions are mandatory. Thereby FM is commonly seen as the preferred area to cut costs. In order to argue for and against such measures, facility managers need to be equipped with evidence-based data to advocate for their tasks and services. This includes cost-transparency within the FM area, agreed on service-levels and sets of different options for actions respectively clear indications what cost cuts mean in terms of service levels or opposite elaborated argumentation for the leverage effects investments in FM can have on customer satisfaction





Part of Prof. Dr. Susanne Hofer's teams, passionately advocating for FM in Healthcare are Senior Research Associates Nicole Gerber and Franziska Honegger and Research Associate Gabriela Züger (picture from left to right).

and the organisations overall image. So far this is still a field with a lot of research potential. For example, the needed cost transparency is by far not yet achieved, at the time being accounting structures are revealed and put in place to enable this crucial demand within and also across healthcare institutions.

Based on afore issues, it is that FM's value is not yet thoroughly recognised and accepted at the strategic level of an organisation. The constant advocacy of the efforts done by institute members is paying off as healthcare institutions increasingly place Chief Facility Manager Officer (CFMO) in their executive boards.

This aligned advocacy for the benefit of FM in healthcare would not be possible without the close relationship between researchers and practitioners the institute has developed over time. Evidence-based data and applicable tools are developed with and for practitioners, according to the purpose of a university of applied sciences. To focus on applied research and development, as well as, on consultancy in FM in healthcare the developed and existing trusting relationship the institute shares with the industry is essential.

Importance of international perspectives

Even though the institute focuses on healthcare institutions within the Swiss context, applied research and development cannot be done without looking beyond one's own borders. FM in healthcare happens everywhere, aligned with cultural customs and available resources. Keeping up with ongoing process developments is crucial as innovation does not only happen in Switzerland. Picking up alternative or improved processes to deliver effective and efficient FM in healthcare and to align them to Swiss requirements is one of the key deliverables the institute offers to practise.

Passion for FM in Healthcare

The passion for FM in healthcare emerges from the diversity of the field, especially requiring the skill to communicate and work with FM in healthcare stakeholders across organisational and hierarchical levels as well as different disciplines. This high complexity makes the research area highly fascinating. And as an educational institution the applied R&D activities are constantly into the curriculum to equip students to take part in decisive strategic discussions, as well as giving them a broad understanding of tacti-

cal and operational FM knowledge. That pays off as more and more former students are placed in strategic FM positions within healthcare institutions, continuingly advocating for FM's potential.



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- 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
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eHealth is for citizens

Terje Peetso, MD, Policy Officer for DG CONNECT at the European Commission discusses how online healthcare can be beneficial to patients...

Citizens' participation in managing their own healthcare has consistently increased over the last decades and digital tools certainly play an important role in this. The process consists of a number of elements: access to personal health data and information; use of technological tools for monitoring and getting professional guidance; the creation of personal health records; active participation in all steps of healthcare path – from prevention to rehabilitation with making necessary inputs and accepting the need for changes.

Today, the internet is most often used as a source of health related information and according to the Eurobarometer on digital health literacy of 2014,¹ over three-quarters of respondents (77%) agree that the internet is a good tool for improving their knowledge of health-related topics. Another valuable characteristic of the internet is that it allows people to access their health records outside of healthcare settings. Both of these aspects need to be carefully addressed.

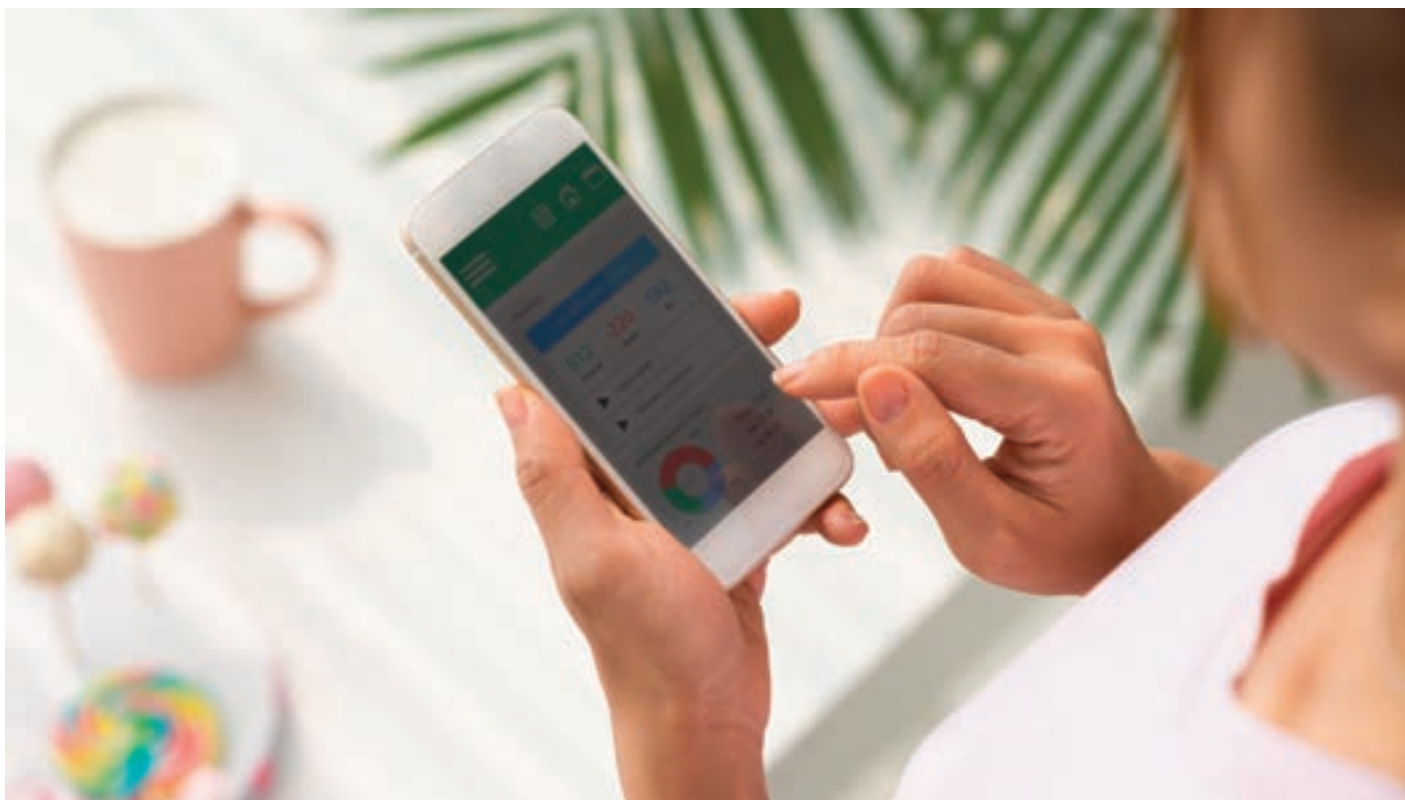
Some websites can significantly improve people's health literacy and help them to better understand their medical condition. At the same time it is important that information comes from a trustworthy source. As most of us use search engines for finding an answer to our health questions, a certain level of health knowledge is required, not only for understanding information provided on a website, but also for assessing its credibility. Horizon 2020 is going to fund projects that aim at improving digital health literacy using online courses with open access to all citizens, including children and the elderly and high-risk patient groups.²

With regards to how citizens' access their electronic health records (EHR), there is still a lot to be done. According to the "overview of the national laws on electronic health records in the EU"³, only 14 Member

States grant patients full access to their EHRs. Among the countries which do not allow patients to access all the content, the typical reason is that access could cause harm to the patient. However, the Competitiveness and Innovation Framework Programme (CIP) project SUSTAINS evaluated in many Member States, the impact of eHealth tools to patient empowerment⁴ which demonstrated that patients are expecting to have full access, and do not find any kind of information about their own medical condition being harmful. On the contrary, for example the Swedish patient associations strongly argued for patient choice regarding a respite of 14 days before a health record entry is visible to the patient. During the implementation of the SUSTAINS project resistance among physicians gradually decreased and healthcare professionals saw more opportunities and advantages with the e-services compared to the beginning of the project. My health data is about me and my health and I would like to know everything about this as soon as possible. It is much easier to handle difficult information together with friends and family and then go to see a doctor with prepared questions and avoid emotional reactions that would prevent meaningful discussion about treatment options.

The importance of this issue is highlighted in the Patients' Charter on Patient Empowerment – "Patients have the right to receive information they need and want, in the right amount and format and at the right time, in simple enough language to enable them to make choices according to their wishes".⁵

The use of mobile health and wellbeing apps is becoming more and more popular and new apps and innovative solutions are coming out every day. While today health and fitness apps are one of the fastest growing categories, a lot is also happening in the area of medical apps, many of which aim at helping people to overcome



acute diseases, as well as effectively cope with chronic diseases. Of course, the use of both types of apps requires a good level of health literacy and it adds valuable information to our health record. For example, a simple measurement of steps can first of all remind us about the importance of physical activity, but at the same time it can provide valuable information about the status of our health with different medical conditions e.g. with mental diseases, where a decrease in physical activity may be one of the early symptoms and may provide useful information for healthcare professionals. As validity and reliability of the data that health apps collect and process is essential, the Commission has set up a working group to develop guidelines for assessing the issue. Twenty members from civil society, research and industry organisations plus Member States' government representatives participate in the working group⁶. The guidelines are expected to be published by the end of this year.

How eHealth can support patients in health and care management will be thoroughly discussed at the eHealth Week 2016 in Amsterdam on 8-10 June organised by the Dutch Ministry of Health as part of the Dutch Presidency of the Council of the European Union, the European Commission and HIMSS Europe⁷. ■

Disclaimer: This paper expresses the personal views of the author and in no way constitutes a formal/official position of the European Commission.

- 1 http://ec.europa.eu/public_opinion/flash/fl_404_en.pdf
- 2 <http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/2439-sc1-hco-12-2016.html>
- 3 http://ec.europa.eu/health/ehealth/docs/laws_report_recommendations_en.pdf
- 4 <http://www.sustainsproject.eu/>
- 5 http://www.eu-patient.eu/globalassets/campaign-patient-empowerment/charter/epf_pe_charter_110316.pdf
- 6 <https://ec.europa.eu/digital-single-market/en/news/new-eu-working-group-aims-draft-guidelines-improve-mhealth-apps-data-quality>
- 7 <http://www.ehealthweek.org/ehome/index.php?eventid=128630&>

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BRIDGE Health: working towards an EU health information system

Petronille Bogaert, Jean-Marie Robine, Herman Van Oyen for BRIDGE Health

BRIDGE Health is a European project under the third European Union (EU) Health Programme. The acronym stands for Bridging Information and Data Generation for Evidence-based health policy and research. One of its major tasks is to prepare a comprehensive, integrated and sustainable EU health information system which will incorporate know-how and technical tools to coordinate and harmonise research and surveillance for Member States in key EU health policy areas.

Why do we need an EU health information system?

European countries are struggling with common challenges, such as providing care to ageing populations with rising occurrences of chronic diseases and multi-morbidity that are largely, but not exclusively, associated with unhealthy lifestyles. At the same time, each country has to maintain excellent health care systems. Health care costs are generally rising, partly because of demographic pressures, but also due to costly innovations in healthcare. Moreover, resources available to Member States' health systems are diminishing due to the current economic situation. Scientific evidence from sound data and information, and relevant research are needed to address these common challenges through evidence-based policy making. Only a system operating at European level will be able to deliver comparable information on health and disease

patterns, health service use and outcomes, and trends across Europe. An EU health information system is therefore a prerequisite to tackle these common challenges effectively.

What are the benefits of an EU health information system?

Working with an EU-wide health information system supports sharing comparable information on population health and health systems across Europe. This would allow Member States to have a precise picture of the situation in their country and compare their outcomes to other Member States. At EU level, a unified general picture of the public health situation in Europe can be generated.

Before comparison and benchmarking can be possible, data needs to be harmonised and a single methodological approach to data collection needs to be developed and supported for better data quality. An EU health information system can provide the framework for that and involve key stakeholders at Member States and EU level, such as public health institutes. It can facilitate the exchange of data and ensure the sustainability of data collection and availability of data for evidence-based policy making.

Fostering EU-wide cooperation also allows for an exchange of expertise and capacity building, through strong health information networks Member States can learn from each other.

Simultaneously, such an approach can address health information inequalities in Member States and the EU. Having the appropriate tools and knowledge allows policymakers to respond effectively to population health and health systems' challenges and to evaluate policy measures.

But most importantly, what the EU needs today is a coherent health information strategy which would guide and coordinate EU action in public health and across policy areas in the coming decades. Currently, a variety of EU institutions perform activities in health information. It is not clear which institutions are involved in which activities and how those activities are distributed. A holistic approach is lacking. An overarching EU health information system can coordinate activities and provide a link between institutions and projects. It can centralise discussions and overcome silo mentalities which the current European Commission (EC) is trying to overcome.

What is the political context?

Discussions on the creation of a health information system at EU level have a long history. Some Member States have called for a new agency to be created or to extend the mandate of the European Centre for Disease Prevention and Control (ECDC) to include health information. The Council of the EU conclusions of December 2013 invited the EC and Member



Second General Assembly of BRIDGE Health on 22nd April 2016

States “to cooperate with a view to establishing a sustainable and integrated EU health information system [...] built on what has already been achieved through different groups and projects [...] exploring in particular the potential of a comprehensive health information research infrastructure consortium (ERIC) as a tool”. However, the EU and its Member States still fail at putting it into place. Nonetheless, investments have been made in the past 20 years through EU projects of the health programme. Although the project-driven approach is fragmented, it has led to success stories in the development of common, harmonised EU instruments such as health indicators, and health interview and examination tools.

What is BRIDGE Health doing?

BRIDGE Health is working towards an EU health information system. It coordinates and converges the best of EU projects in domains of population and health system monitoring, indicator development, health examination surveys, environment and health, population injury and disease registries, clinical and administrative health data collection systems and methods of health systems monitoring and evaluation. It builds on existing knowledge and expertise to work

through horizontal activities with the following objectives:

- Enhance the transferability of health information and data for policy and improve the utility and use of data and indicators for stakeholders in policy making, public health surveillance and health care;
- Reduce health information inequality within the EU and within Member States;
- Develop a blueprint for a sustainable and integrated EU Health information system by developing common methods for :
 - Standardisation of health information gathering and exchange between population health and health systems information within and between Member States;
 - Standardisation of data quality assurance systems;
 - Health information priority settings; and
 - Harmonisation of ethical-legal issues.

The horizontal activities will provide the building blocks for the EU health

information system. In May 2016 BRIDGE Health will present a policy paper which can serve as a draft agreement between Member States, candidate and EEA/EFTA countries and international organisations for the construction of an EU health information system. The policy paper will include the scope, tasks, activities and governance structure of a future EU health information system. It will present the strengths and limitations of a set of possible structural and institutional options to allow an informed decision by the stakeholders.



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Vesalius Health 4.0

Tomorrow's breakthrough innovation in healthcare

Last year I attended an exhibition entitled '500 years Vesalius'. Andreas Vesalius (1514-1564) was a Belgian physician who played a pivotal role in the discovery of human anatomy (The Fabric of the Human Body).

The element of the exhibition that struck me the most was the dissection theatre in which the whole anatomy of the human body was examined and explained. It was extremely simple, an open theatre where a number of physicians opened a human corpse and explained to all attendees their understanding of the anatomy and physiology. This led to the most important documentation on anatomy and medical science in that era and we still use the knowledge acquired by Vesalius today.

This article is not about Vesalius, it's about innovation through and acceleration of digital health, ideally implying the following good practices:

- Using the full potential of the increasingly available data while respecting the owner's privacy;
- Turning data into information, information into knowledge, knowledge into actionable insights;
- Sharing and disseminating data, knowledge and insights amongst professionals that are into the same subject;



- Pre-competitive interaction and collaboration amongst potential competitors;
- Creating a platform where professionals can meet, test, experiment and share lessons learned, based on a vast amount of available real-life data.

It goes without saying that the computational powers of the 21st Century offer both enormous opportunities and risks in taking healthcare to the next level. Obviously this double-edged sword creates dilemmas between personal privacy and data sharing for collaborative purposes. Risk

mitigation and transparency on the ownership, sharing and use of data are all key for guaranteeing the personal rights of every citizen.

From my professional point of view on digital health innovation and health industry incubation and acceleration, I started reasoning:

- Imagine that there would be a neutral shared IT space that allows companies to test their software/hardware equipment against a 'known set of real-life health data records';
- Imagine that such a platform would facilitate message brokerage between

applications and could check interoperability standards (both syntactic and semantic);

- Imagine that the comparison and incremental 'wisdom' of its mechanism was able to 'validate' applications in comparison to other (previously accepted/validated) applications;
- And imagine that the users (both citizens and care-providers) could visit and monitor in a transparent way the results of these experiments, tests and validations.

At iMinds Health (Belgium) we help great academic research grow into start-ups and accelerate into successful companies. In that position, we are well placed for getting a good feel of the as yet unmet needs in Flanders' Digital Health innovation ecosystem. Triggered by these learnings, we are in the process of implementing an Interoperability, Test and Validation Lab (ITV lab), seeking to create the opportunity lined out above. The target audience of the ITV lab are, start-ups and SME's that are developing health applications. We focus on helping them understand the complexities of the health and care market, its current opportunities and challenges. We enable experiments in silico in a protected environment, i.e. without having to enter the 'real' health market without this prior testing.

The lab works with anonymised or self-generated data. It currently serves three purposes:

- It promotes and showcases future health innovations;
- It serves to promote government initiated eHealth applications

(+ standards) towards commercial software vendors;

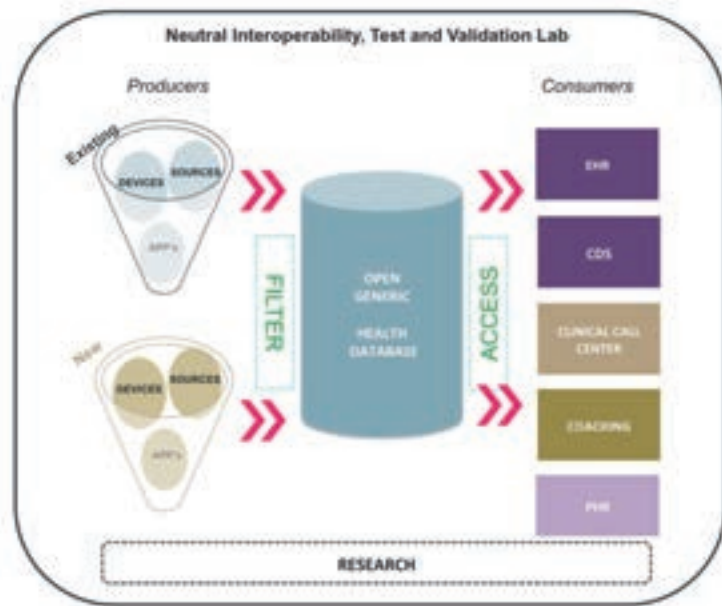
- It offers a low-cost playing field to suppliers of health applications of any size where they can test, integrate and partially validate their applications.

Partially similar initiatives exist in other domains and have proven their value:

- FabLabs where startups can use shared facilities and 3D-print their prototypes on a pay for use basis;
- Biobanks of well-documented human tissues accessible to researchers (with strict guidelines).

Provided privacy and transparency are guaranteed by the competitive ecosystem of applications handling the data, big data is not equal to big brother.

I believe that having a Vesalius Health 4.0 open Health Innovation Lab has the potential to significantly accelerate the use, acceptance and validation of healthcare applications. That kind of initiatives across the world will boost



innovation and integration of health, increase competition in a faster growing market and build bridges between the consumer, the healthcare professional, his suppliers and government authorities. With iMinds Interoperability, Test and Validation Lab, we are fully committed to doing our share.



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Our daily digital health – is everyone ready?

Marc Lange, Secretary-General and Diane Whitehouse, Member of the Secretariat at the European Health Telematics Association (EHTEL) explain how digital technologies are helping to transform health service delivery...

Our daily life is becoming increasingly digital, and people are considering this move as the way to go for more and more activities. Digital health is really happening now too. Technology-enabled care and health is on the agenda of people, patients, health services, and researchers. Mobile devices in particular are accelerating the use of health apps, and are easing people's access to health data based on their own electronic healthcare records.

In EHTEL, this is exactly what we are seeing. EHTEL (the European Health Telematics Association) has been active on digital health since its launch in Brussels in 1999. EHTEL supports more than 60 corporate members – who come from all over the European scene – in expanding the use of digital health services.

As a result, the association is a leader in sharing lessons learned on the latest developments in digital health: telehealth use is growing, with and through the association's members.

Transforming health delivery and its impact

As in many other sectors, digital health is having a transformational impact on the way health is delivered. Digitalisation is expected to have a positive impact on the efficiency, hence sustainability, of healthcare systems. It is also expected to have a positive impact on the integration of health and social care to the benefit of all the actors in the field.

The fact is well known: today chronic diseases represent a potential major burden to our healthcare systems

and to patients' quality of life. Any efficiency gains in managing and treating patients with chronic diseases is therefore likely to be beneficial.

Currently, in routine care, patients with a chronic disease – with no complications – are self-managing their conditions through regular follow-up visits, every 3 or 6 months, to their general practitioners. They are given guidance to improve their self-management and of course, if necessary, referred to a specialist or a hospital.

Working with telehealth centres

With telehealth, patients' health can be followed every single day by a telehealth centre. Patients can use a variety of digital solutions that collect and send their physiological measurements to a centre (for example, in the case of patients with chronic heart failure or diabetes type 2, a blood pressure or blood glucose meter, a pulse oximeter and intelligent weight scales). The role of the telehealth centre is to assess whether the measurements are in or out of the patient's range, according to a predefined and personalised set of parameters. If the readings are out of range, an alert is generated that follows the clinical protocol. The centre can also be in charge of distance coaching for patients, so as to reinforce self-management, provide further guidance, or adapt their plans.

Learning from the results of United4Health

Earlier in 2016, the transformational impact of telehealth was analysed by the [United4Health](#) project. The project successfully implemented and assessed the impact of telehealth services for patients with chronic conditions. Its initiatives are underway in Scotland, Wales, Slovenia and 11 other regions on the continent. The results of this analysis were publicly communicated for the first time on the occasion of the project's [final conference](#), organised jointly with EHTEL.

Several key messages were delivered at the conference:

- “Helping you live your life your way”: patients can indeed manage their chronic conditions more efficiently, hence better prevent the worsening of their health;
- “Clinicians are now able to make important sensible decisions” by analysing patient data collected on a daily basis;

- “Telehealth can reduce unnecessary visits to clinicians”: it enables healthcare systems to use the resources they have more efficiently.

Tangible benefits of the efficiency gains

While there is enough evidence about telehealth benefits when it is used to transform healthcare, it is still not so easy to assess its economic impact. Evidence is only now emerging.

Economic analysis is often about analysing a moving target. It is common sense that the cost of telehealth depends strongly on factors like the size of the market – at present, small although growing. Yet a shared ICT infrastructure is still lacking. If the infrastructure were to exist, it would enable pooling of some of the costs over several services.

It is important to bear in mind that savings are likely not to be directly ‘cashable’ (they might be absorbed by another part of a healthcare system) and that they may easily be side tracked from the direct aim of offering increased capacity in healthcare systems.

United4Health's own positive experiences demonstrate that transforming care delivery processes through telehealth often need several cycles to optimise the organisational and financial benefits. ■



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mHEALTH: Challenges, hopes and doubts

There are many hopes and at the same time, doubts related to the mHealth development.
Here MEP Michal Boni explains the reasons why...

Firstly, mHealth development is part of the digital revolution. It means that all aspects of the functions of the healthcare systems can be changed under the conditions related to the digital tools. On the one hand, the new opportunities in the area of genetic research and the possibilities to use the molecular insights into health and diseases – open the new ways for diagnosis. On the other, many new devices, wearables, applications can give us the possibility to monitor the real state of health in the real time. It is the background for adequate, fast intervention. Both: better and deeper diagnosis and faster interventions create the framework for the shift paradigm in the healthcare area. This is the transit from the model of reaction on the diseases to the model of avoiding of the diseases. One of the important parts of this shift paradigm is oriented on changing the minds of patients – to build the possibility for taking the self-responsibility for their own health via knowledge accessible by apps. It is easy for some groups, but difficult for many people. So, there are hopes and doubts.

“Better understanding of mHealth as a game changer for the whole healthcare system and the strong involvement of partners can lead to the success.”

Secondly, what is the key factor of this healthcare shift paradigm? All diagnostic efforts are focused on the individual dimensions of the state of health of the individual person. It establishes the personalisation of the service. This is the special added value to the healthcare system, which can give us the cost savings (better organisation of the work, proper therapies based on the real evidence etc.) and the stronger patients' satisfaction. A whole range of mHealth devices and applications are user friendly. Of course, for the effective functioning they require better infra-



structure: fast internet, future 5G for transferring data and information in the milliseconds, and proper High Performance Computing Centers. In addition, they require standardisation of solutions and certified high quality of measures. It is the hope for the future, but it is also the threat: if the technology and infrastructure is or in the short time, will be really ready?

Thirdly, the new model of healthcare is focused on patients' expectations and future, possible benefits of personalised medicine. So it needs framework for the new model of relations between the patients and doctors. There is no possibility to make this shift paradigm in the medical area without doctors. There is no danger for keeping and improving the human dimension of the relations between patients and physicians. The human factor is fundamental: for interpretation of the same phenomena and the results of the state of health monitoring. It is also important for building the personal climate between two sides of the process for cooperation during the time of sickness and the time of taking the self-responsibility by some patients. Of course, all those – require the trust and the digital and medical literacy. The education and promotion are very much needed, as the only way to avoid weaknesses and doubts – and develop mHealth solutions.



Fourthly, this new model of the healthcare system is based on the Big Data, on the possibilities to process the data, collect, transfer and share those data. At last, it requires the privacy protection and the security – as a basis for the trust. The rules need to be clear, transparent at that area. It is important, if we want to avoid many doubts. The problem of the privacy protection and the security at the area of healthcare is important because of the sensitiveness of those data. Anonimisation and pseudonimisation of the data, together with full encryption from the starting point to the end of the transferring of the data – are the guarantees of the safe development of the new mHealth solutions.

Finally, the shift paradigm is needed for the better future, which during implementation processes requires the cooperation between all stakeholders. Why it is so important? Better understanding of the mHealth as a game changer for the whole healthcare system and the strong involvement of partners can lead to success. In Europe the healthcare area belongs to the Member States competences. This shift paradigm

in the health system depends on common efforts of all European countries. And depends on the cooperation of all partners: patients, physicians, managers, decision and policy makers, researchers, business. If so, some kind of the action plan for stakeholders is required. We need to develop opportunities and hopes, than to create still new doubts. ■

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Epigenetics: The missing link at the frontier of health and disease

The implantation of genomic medicine is one of the major challenges of health science for this century, in order to be able to predict disease risk many years before the onset of a particular illness, implementing effective disease prevention, and personalising pharmacological treatment. However, it is likely that many current expectations will become frustrating realities based on delusional fantasies emerging from unrealistic perspectives. We are at the beginning of a very exciting opportunity, just crossing the border that separates conventional (reparative) medicine from future (predictive) medicine. There remains a few conundrums surrounding the novelties of genomics, transcriptomics, proteomics and metabolomics. Genomics cannot explain in full many different aspects of the enigmatic world of disease, especially the impact that environmental factors may exert on people with a vulnerable genomic background prone to the development of specific diseases. Epigenetics seems to be a superb interpreter of the symphony of our genome.

Epigenetics is the molecular phenomenon by which phenotypic changes are transmitted from one generation to another, with no apparent alterations in structural DNA. Classical epigenetic mechanisms, including DNA methylation, histone modifications, and microRNA (miRNA) regulation, are among the major regulatory elements that control metabolic pathways at the molecular level. These epigenetic modifications regulate gene expression

transcriptionally, and miRNAs suppress gene expression post-transcriptionally.

Vertebrate genomes undergo epigenetic reprogramming during development and disease. Stable transmission of DNA methylation, transcriptomes and phenotypes from parent to clonal offspring are demonstrated in various asexual species, and clonal genotypes from natural populations show habitat-specific DNA methylation. Methylation varies spatially across the genome, with a majority of the methylated sites mapping to intra-genic regions. Not only nuclear DNA, but also mitochondrial DNA may be subjected to epigenetic modifications related to disease development, environmental exposure, drug treatment and aging. Distinctly methylated genes identified in different human populations suggest an influence of DNA methylation on phenotype differences, such as, susceptibility to certain diseases and pathogens, and a response to drugs and xenobiotic agents.

Epigenetics has emerged in recent years as one of the most important biological mechanisms linking exposures during the course of life to long-term health. Epigenetic status is influenced by a range of environmental exposures, including diet and nutrition, social status, chemical and emotional environment, pregnancy conditions, infertility, contraception, and different modalities of pharmacological intervention. Epigenetic status is also influenced by genotype, and genetic variation in genes encoding a

plethora of enzymes and proteins. Furthermore, DNA methylation contributes to natural human variation.

Epigenomic modifications are involved in a great variety of physiological and pathological conditions; of major importance are those associated with age-related processes and with major problems of health such as cardiovascular disorders, obesity, cancer, inflammatory processes, asthma and allergy, and brain disorders. Multiple epigenetic changes have been reported in different tissues with aging. Epigenetic factors influence life span in several species. Major problems of health, such as cardiovascular disorders, cancer and neurodegeneration are age-dependent processes in which epigenetic alterations also play a pathogenic role. Most of these complex disorders are the result of multiple defects distributed across the human genome together with the interaction of environmental factors and epigenetic phenomena. Some of these medical conditions are susceptible to epigenetic intervention with epigenetic drugs. Interventions targeting epigenetic regulation might be effective in treating a range of age-related neurodegenerative disorders.

Pharmaceuticals, pesticides, air pollutants, industrial chemicals, heavy metals, hormones, nutrition, and behavior can change gene expression through a broad array of gene regulatory mechanisms. Mechanisms include regulation of gene translocation, histone modifications, DNA methylation, DNA repair, transcription,

RNA stability, alternative RNA splicing, protein degradation, gene copy number, and transposon activation. Genetic variation associated with different diseases interferes with miRNA-mediated regulation by creating, destroying, or modifying miRNA binding sites. miRNA-target variability is a ubiquitous phenomenon in the adult human brain, which may influence gene expression in physiological and pathological conditions.

A good paradigm of the influence of epigenetic factors on human pathology is the oncogenic process in some types of cancer. For instance, myelodysplastic syndromes (MDS) are clonal diseases of the elderly, characterised by chronic cytopenias, dysplasia, and a variable risk of progression to acute myeloid leukemia (AML). Aberrant methylation of tumor suppressor gene promoters has been established, suggesting that these alterations are drivers of MDS pathogenesis. Recurrent somatic mutations in genes encoding proteins involved in DNA methylation and demethylation, and in covalent histone modifications, have been reported in myeloid malignancies, including MDS. Some clinical trials have established hypomethylating agents as the mainstay of therapy in the advanced forms of the disease.

Epigenetic modifications are reversible and can potentially be targeted by pharmacological and dietary interventions. A series of epigenetic drugs have been developed, and some of these compounds have been approved by the FDA for the treatment of neoplastic processes. Examples of epigenetic drugs include the following: (i) DNA methyltransferase inhibitors (nucleoside analogs: decitabine, azacitidine; small molecules; natural

products: curcumin derivatives, psammaplins, tea polyphenols, catechins, bioflavonoids); (ii) histone deacetylase (HDAC) inhibitors (short-chain fatty acids: sodium butyrate, valproic acid, pivanex; hydroxamic acids: vorinostat, oxamflatin, pyroxamide, trichostatin A, derivatives of the marine sponge *Psammoplysilla purpurea*, panobinostat, givinostat, belinostat; cyclic peptides: romidepsin, apicidin, trapoxin, chlamydocin; benzamides: entinostat, mocetinostat; ketones; sirtuin modulators (inhibitors and activators); (iii) histone acetyltransferase modulators; (iv) histone methyltransferase inhibitors (lysine/arginine methyltransferase inhibitors); (v) histone demethylase inhibitors; (vi) histone methyltransferase inhibitors; (vii) histone demethylase inhibitors; (viii) chromodomain inhibitors; (ix) bromodomain inhibitors; and (x) miRNAs.

Epigenetic modifications are associated with drug resistance. Chemotherapy resistance remains an important problem in cancer. The acquisition of drug resistance is tightly regulated by post-transcriptional regulators such as RNA-binding proteins and miRNAs, which change the stability and translation of mRNA-encoding factors involved in cell survival, proliferation, epithelial-mesenchymal transition, and drug metabolism. Alterations mediated by epigenetic mechanisms are important factors in cancer progression and in response to treatment in different types of cancer.

Epigenetic intervention may modify brain transcriptome, potentially reversing age-related cognitive dysfunction. Consequently, epigenetics is of considerable translational significance to the field of neuroprotection. In addition,

the efficacy and safety of both epigenetic drugs and other medications are closely associated with the efficiency of the pharmacogenetic process in which the gene clusters involved in the pharmacogenetic network (pathogenic, mechanistic, metabolic, transporter, pleiotropic genes) are also under the influence of epigenetic changes; therefore, the pharmacoeigenetic machinery may determine the therapeutic outcome (drug efficacy and safety). The redundancy and promiscuity of this complex system regulating drug effects and toxicity will be a scientific challenge of paramount importance for the pharmaceutical industry and the medical community in the coming years.



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The cost of dementia

Julia Stuart of the Alzheimer's Society sheds lights on the true cost of dementia on the UK's finances and resources and what it means for care received...

The Health Secretary's ambitious aim to make the UK the most dementia-friendly society in the world by 2020 will fail without a dramatic increase in social care resources.

In March Jeremy Hunt announced a series of commitments to boost diagnosis rates, raise awareness and encourage research.

But the Alzheimer's Society estimates that the amount spent by government on social care for people with dementia will need to more than double, from £3.7bn in 2015, to £8.5bn by 2030 just to keep pace with demand and care inflation.

"The NHS could be the best at looking after people with dementia, but that will be irrelevant if something isn't done about social care," said Laurie Thraves, senior policy officer for the charity. "And doing something about social care is about the money, essentially. Unless the money is there, I don't think we can ever be the best in the world."

Around 70% of people in care homes have memory problems or a dementia diagnosis. Social care is also critical for those with dementia living at home, as many need help washing and dressing. "Some people with dementia who live alone won't be able to perform these basic tasks, or they'll do them badly," said Thraves. "If someone is being cared for, these needs put additional pressure on the carer. Caring is a full-time job and people need as much help as they can get. It's particularly tricky when you have 2 frail elderly people, one of whom has dementia, and you're essentially asking the other frail person to do a lot of heavy lifting."

Carer burnout is one of the most common reasons why someone with dementia is admitted to a care home or a nursing home.

When people with dementia are unable to get care in the community they often reach a crisis point more quickly and end up in hospital, where they spend a lot longer than other older people. Many become less mobile, their muscles waste, and they find the environment more distressing and confusing than their peers do. A significant proportion will then be admitted to a care home rather than return to their own home.

"In 2 years the global cost of dementia is estimated to reach \$1 trillion, according to the World Alzheimer Report 2015. The report, commissioned by Alzheimer's Disease International, also found that the costs of dementia in Europe increased by 25% to \$300bn last year."

"The vast majority of NHS spend goes on the final years of our lives. We know that at the very end of life people with dementia are often admitted to hospital for expensive acute care when they could be cared for in a care home if they had access to specialist palliative services which people with other long-term conditions such as cancer are more likely to be able to access," he said.

There are currently 850,000 people with dementia in the UK. This is predicted to rise to 1 million within 10 years, and reach 2 million by 2050. A third of people with dementia are already living in care homes. Numbers are expected to increase from 313,000 to just under half a million by 2030. This would require the creation of an estimated additional 175,000 care home places for people with dementia alone.

Since 2010, £4.6bn has already been taken from the adult social care budget, resulting in an estimated 500,000 older and disabled people being denied access to care. The government has promised around £1.5bn



through the Better Care Fund, which tries to integrate spend between health and social care, but the money won't materialise until between 2019 and 2020.

The total cost of dementia to society in the UK already stands at £26.3bn, which is enough to pay the energy bill for the entire country. Of that £4.3 bn is spent on healthcare costs and £10.3bn on social care, met partly by local councils and partly by people with dementia themselves. A further £11.6bn is contributed by the work of unpaid carers, many of whom have had to give up their jobs to look after someone with dementia, which can have a devastating effect on their own finances and career.

In 2 years the global cost of dementia is estimated to reach \$1 trillion, according to the World Alzheimer Report 2015. The report, commissioned by Alzheimer's Disease International, also found that the costs of dementia in Europe increased by 25% to \$300bn last year.

"The best case scenario is that the government realises that failing to invest in the right support in people's homes, care homes and residential homes is creating additional costs for the NHS, and it's also destroying the lives of vulnerable older people," said Thraves.

"We certainly welcome Jeremy Hunt's commitment to making the NHS better for people with dementia, but that's only half of the solution. We won't be the best in the world until we have a social care system that is adequately resourced and on a sustainable financial footing." ■

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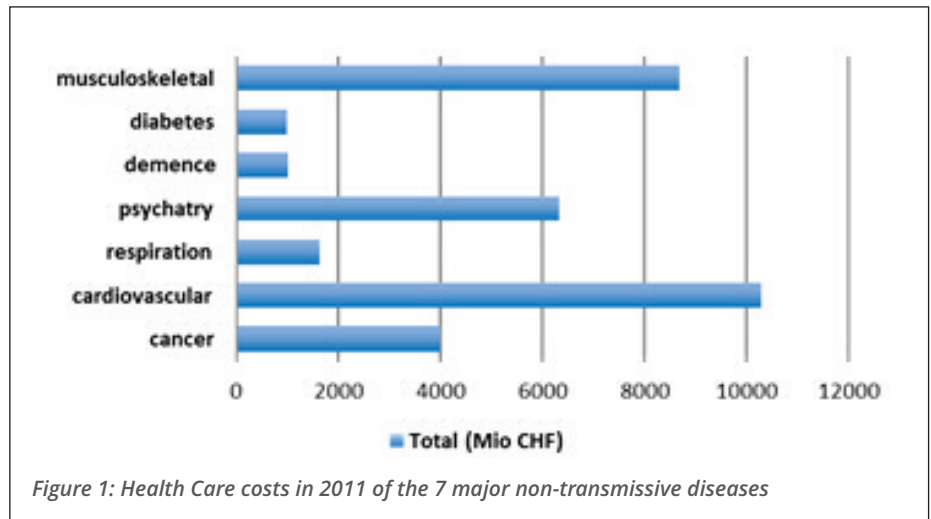
Therapies for weak muscles

It is estimated that 10% of the costs of health care in Switzerland (or an equivalent of €500 billion 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 shed light on 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 the 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 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.

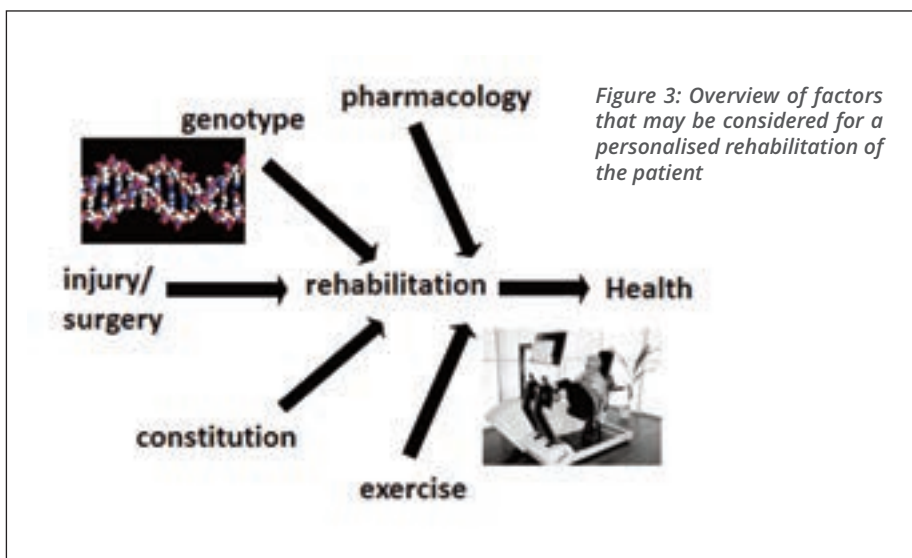
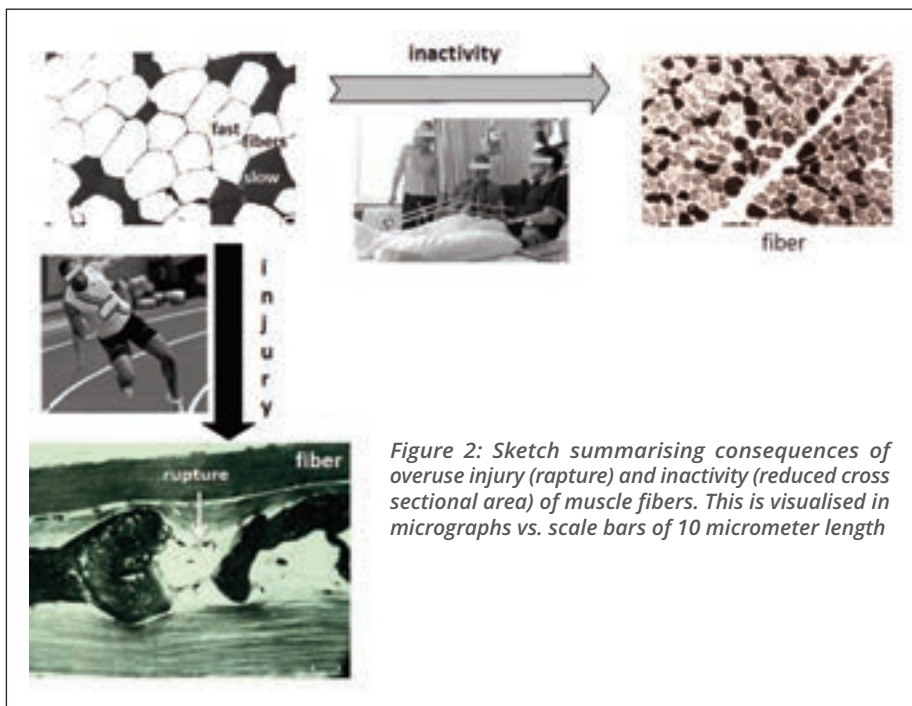
On the opposite muscle's functional capacity is reduced in the absence of a physiological stimulus by a reduction in the size of muscle fibers and their content in mitochondria (Fig. 2).

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 activities ³. 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: Since the beginning of 2016, the laboratory has been expanding its activities with the move into brand new research facilities at the Balgrist Campus (<http://www.balgristcampus.ch/en/>). A key ingredient of this research facility is an open-

space landscape where research and development into musculoskeletal medicine is integrated under one roof between clinicians, biologist, engineers, and industry. The facility is situated 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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Dementia to become trillion dollar disease by 2018

Marc Wortmann, Executive Director of Alzheimer's Disease International (ADI), outlines the major impact dementia has worldwide and the urgent need for governments to help provide a better quality of life for people with the condition...

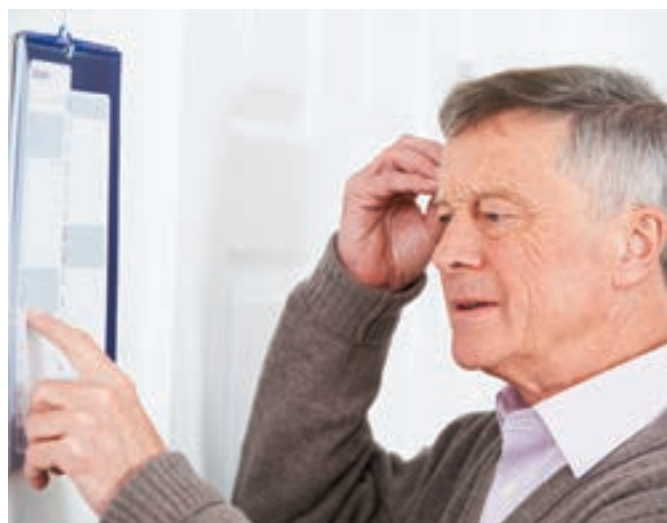
The World Alzheimer Report 2015 estimates that someone in the world develops dementia every 3 seconds. There are currently around 47 million people living with dementia globally, with numbers projected to nearly double every 20 years.

In the report, 'World Alzheimer Report 2015: An analysis of prevalence, incidence, cost and trends' we highlight the global impact of dementia and its social and economic cost – currently estimated at \$818bn. By 2018, dementia is set to become a trillion dollar disease. By 2050, it will affect over 131 million people. If global dementia care were a country, it would be the 18th largest economy in the world, exceeding the market values of companies like Apple and Google.

“ADI believes that the key to winning the fight against dementia lies in a unique combination of global solutions and local knowledge. As such, it works locally, by empowering Alzheimer associations to promote and offer care and support for people with dementia and their carers, while working globally to focus attention on dementia and campaign for policy change from governments.”

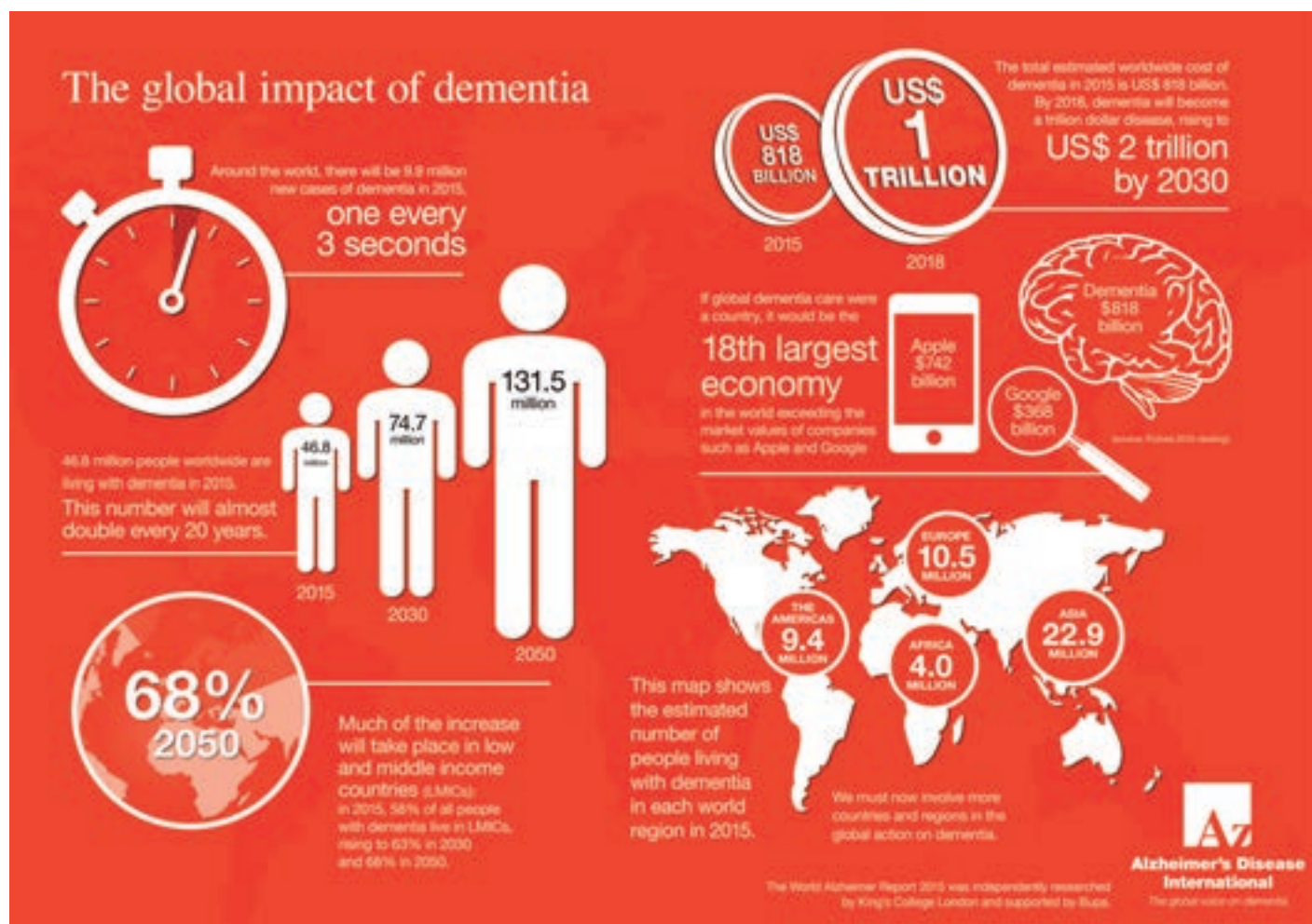
The report further illustrates the geographic prevalence and impact of a growing dementia crisis, showing that 58% of all people living with dementia today reside in low and middle income countries. As the unique challenges of dementia continue to pose a serious challenge to healthcare systems worldwide, it is these regions where dementia awareness and research is critical, and where the stigma attached to illnesses such as dementia poses a greater challenge.

The 10/66 Dementia Research Group, made of over



100 active researchers from more than 30 developing countries and supported by ADI, is a key part of effort to redress this balance. When the group was founded less than 10% of all population based research into dementia was directed towards the 66% of all people with dementia who will live in developing countries. As the only global federation, ADI works closely with Alzheimer associations worldwide, fostering twinning relationships, running Alzheimer University training events and supporting dementia care projects.

ADI is continuing to urge policy makers around the world to approach the issue with a broader agenda and a wider representation of countries and regions, particularly those in the G20 group of nations. A key call in the report is for a significant upscaling of research investment into care, treatment, prevention and cure, as well as to build on the success of dementia friendly community initiatives worldwide. These initiatives provide a key framework for integrating a better awareness of dementia needs in the community, removing barriers to the involvement of people with dementia in everyday life.



The report findings demonstrate the urgent need for governments to implement policies and legislation to provide a better quality of life for people living with dementia, both now and in the future.

You can read the full report on the ADI website at: www.alz.co.uk/worldreport2015

About Alzheimer's Disease International

ADI is the international federation of 83 Alzheimer associations around the world, in official relations with the World Health Organization. ADI's vision is an improved quality of life for people with dementia and their families throughout the world. ADI believes that the key to winning the fight against dementia lies in a unique combination of global solutions and local knowledge. As such, it works locally, by empowering Alzheimer associations to promote and offer care and support for people with dementia and their carers, while working globally to focus attention on dementia

and campaign for policy change from governments. For more information, visit www.alz.co.uk . ■

The World Alzheimer Report 2015 was independently researched by King's College London and Karolinska Institute, Stockholm and was supported by Bupa.

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The Ocular Lens as a tool for developing antioxidant therapies

Since the initial hypothesis by Denham Harman that free radicals are linked to aging, 60 years of research have focused on unravelling the relationship between reactive oxygen species (ROS) and biological function(s). This has led to the field of redox biology, where the physiological roles of ROS in cell signalling that regulate biological and physiological processes and in the generation of energy through oxidative phosphorylation are being defined. Many types of ROS are physiologically present in tissues with the superoxide, hydrogen peroxide, and nitric oxide species being the most prominent. A number of endogenous antioxidant and enzyme systems are present in cells to regulate ROS levels and a breakdown of these protective antioxidant systems results in an elevated generation of ROS. When combined with the presence of free transition metals such as iron, increased superoxide and hydrogen peroxide radicals can generate hydroxyl radicals. In addition, superoxide can also react with nitric oxide to generate peroxynitrite radical. Both the hydroxyl and peroxynitrite radicals are very toxic radicals, although very short lived, for which no endogenous detoxification systems exist. Elevated ROS, referred to as oxidative stress, can damage lipids, proteins and DNA. Most importantly, increased ROS has been detected in almost all cancers, and in age related diseases linked to neurodegeneration, inflammation, diabetes, and vision/sensory loss. Mitochondria generate the majority of ROS, and this has also

led to a focus on the role of mitochondrial dysfunction in ROS-associated pathology.

The complexity of most tissues and organs makes elucidating the role(s) of oxidative stress/redox dysregulation and mitochondrial dysfunction in the development of disease or aging difficult. However, this process can be simplified by using the transparent mammalian lens of the eye as a model. It is composed of an anterior monolayer of cuboidal epithelial cells and specifically aligned fiber cells that are all enclosed in a collagenous capsule to form the largest avascular tissue in the body. The anterior epithelial cells contain mitochondria and other organelles, large amounts of cytoskeletal proteins such as microtubules and actin, and structural proteins called crystallines. At the germinative zone located in the lens periphery, epithelial cells divide and move to the equator where they differentiate and elongate into lens fibers to form highly ordered concentric shells. In these new mature fiber cells, the mitochondria and nuclei are lost and new and different crystalline proteins are produced. This process occurs throughout life, so that the fiber cells increase in age the closer one goes to the lens centre, and at the nucleus the fiber cells contain proteins that were synthesised at the foetal stage. The fiber cells and their structural proteins are highly ordered and this order must be maintained for lens clarity. The unique structure and biochemical differences between the

epithelial and fiber cells result in significant differences in redox biology. This difference makes the lens highly susceptible to oxidative stress, causing irreversible protein and membrane changes that eventually results in loss of transparency, i.e., cataract formation. In the lens, one can clearly investigate the role of oxidative changes associated with mitochondrial dysfunction, endoplasmic reticulum stress, the reduction of detoxification systems with age, and the role of environmental factors which include exposure to light and other radiation effects that can generate radicals.

Because of the link between oxidative stress and age-related diseases, programs designed to encourage one to acquire a healthy lifestyle which includes a diet rich in antioxidants have been initiated. This has also spawned a nutraceutical industry that provides the consumer with natural antioxidants with little or no demonstrated evidence for their product efficacy. In fact, a number of large clinical trials, some sponsored by the National Institutes of Health (NIH), have failed to show significant efficacy. For example, 7 randomised, double-masked, placebo-controlled cataract trials with trial populations ranging from 1,000 to nearly 40,000 participants orally receiving select antioxidants or vitamin formulations have failed to reduce age-related cataract formation despite oxidative stress being established to be linked to cataract formation. This failure may be due to the inability of select antioxidants to achieve ade-



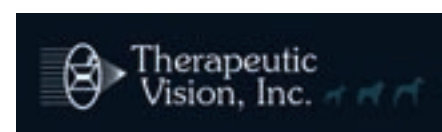
Therapeutic Vision, Inc. is a small company that is focused on the development of pharmaceuticals primarily for the companion animal market and eventually their owners. We are developing age-related and diabetic therapies for the preservation of vision and the prevention of neurodegeneration.

quate therapeutic levels after oral administration. This hypothesis is supported by results from the AREDS trials where retinal but not lens efficacy was observed. Based on their antioxidant effects in the eye, we have developed and patented a nutraceutical formulation containing EGCG, astaxanthin, resveratrol, and ethyl pyruvate that when topically applied to animal models delay the progression of lens changes associated with diabetes-induced ER stress and UV light. In addition, the formulation also preserves tear flow in scopolamine-induced dry eye and neural retinal oxidation in dark-adapted light exposed rats, a model for dry AMD. The formulation is currently licensed for veterinary use under the name Optixcare Eye Health, and is anticipated to be available soon for the human market.

Since natural antioxidants may also not have adequate potency, we have developed multifunctional antioxidants that not only can scavenge free radicals but also sequester and redistribute

free transition metals that can participate in the generation of toxic hydroxyl radicals. The compounds contain a 2-amino-5-hydroxy-pyrimidine group that has 100-fold greater scavenging activity than vitamin E. These orally active compounds have been shown to achieve therapeutic levels in the lens and retina as well as the brain. In animal studies, these compounds have been shown to reduce cataract formation induced by whole-head gamma irradiation, as well as diabetic ER stress and UV light. They also protect both the neural retina and photoreceptor layer against retinal degeneration induced by light in dark-adapted rats, as well as reduce amyloid beta plaque formation in the brain, lens and retina of Alzheimer's transgenic mice. Recent studies also suggest that these compounds protect rats from noise-induced neurodegenerative damage and may protect against blast-induced retinal neurodegenerative damage. In vitro, the compounds also appear to protect mitochondrial function. These studies, combined

with the low apparent toxicity of the compounds, suggest that these multifunctional antioxidants (MFAOs) are promising therapeutic agents for neuroprotection of the eye and brain, and prevention of age-related ocular diseases that merit clinical investigation.



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How future-proof are the NHS new 'Healthy Towns'?

Dr David Usher of human factors consultancy InterAction of Bath, discusses the issue of enabling independent living later in life and asks will the NHS new Healthy Towns be designed to accommodate societal changes already upon us?...

When NHS England Chief Executive Simon Stevens announced the plans for 10 new 'Healthy Towns' in February 2016 he said, "The much-needed push to kick start affordable housing across England creates a golden opportunity for the NHS to help promote health and keep people independent. We want to see neighbourhoods and adaptable home designs that make it easier for older people to continue to live independently wherever possible."

"We are a rapidly ageing society. The Organisation for Economic Co-operation and Development (OECD) warned in 2015 that within the next 15 years the UK will become 'super-aged', having more than 21% of the population aged 65 or older."

While exact details of the proposed 10 new towns are yet to be revealed, there are a couple of obvious questions regarding the eventual form they will take, and especially regarding the issue of keeping people independent as they grow older.

The worry is; that from the scant details so far revealed, aged living appears to be viewed only through the lens of elderly care. For example, within the proposed new developments at Whitehill and Bordon in Hampshire, 3,350 new homes will be built that include 'care-ready homes' designed to be 'adaptable to the needs of people with long-term conditions with a nurse-led treatment centre, a pharmacy and integrated care hub'. This more modern approach to elderly care for those who need it is to be admired, especially when you consider the funding crisis currently weighing down on the elderly care sector. However, there appears to be a shortfall in thinking



about the stages of life leading up to the point where care is needed – that grey area where people are becoming aged, but where they are still able to lead relatively independent lives.

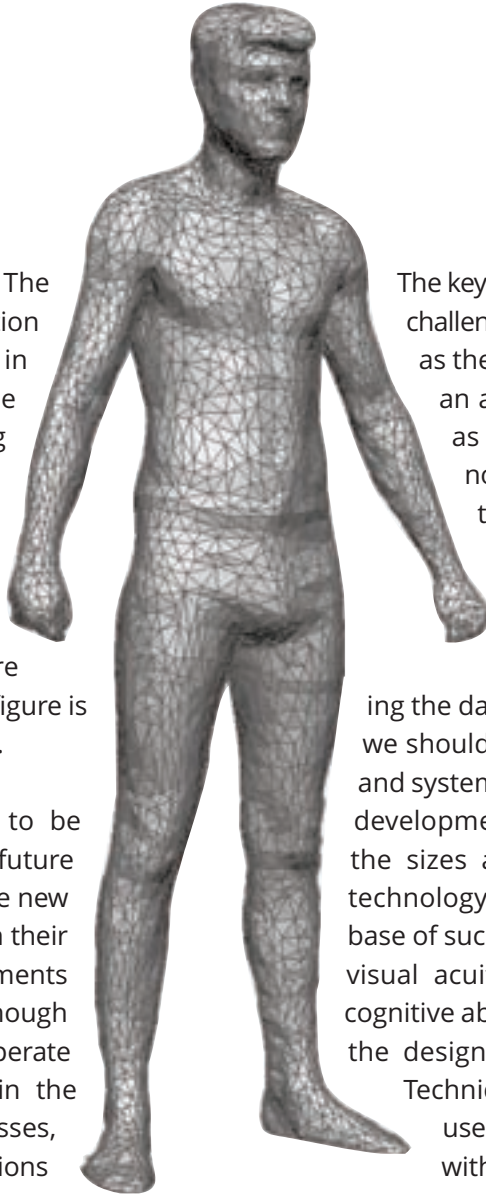
The reality is that in 10 years' time the national demographic of the UK will be markedly different from what it is today, so to plan these new towns according to our current understanding of elderly living may mean we miss the opportunity to truly design in health, wellbeing and independence.

We are a rapidly ageing society. The Organisation for Economic Co-operation and Development (OECD) warned in 2015 that within the next 15 years the UK will become 'super-aged', having more than 21% of the population aged 65 or older. At the same time, we are working later in life. According to figures from the Department of Work and Pensions, more than a million people over the age of 65 are currently in work in the UK, and that figure is set to grow steadily and substantially.

These are the changes that need to be factored in to any thinking about future urban development. In the case of the new Healthy Towns the planners will fail in their ambition to create effective environments if they do not recognise that although people are aging they still need to operate effectively and independently within the infrastructure, buildings, businesses, culture and even IT and communications systems around them.

Research is already suggesting that whilst the next generation of old people will have stronger digital skills after a lifetime of living in the digital age, their propensity to use digital technologies may well drop as cognitive ability and dexterity decline. With so much day-to-day management of our lives now taking place through technology channels, this will present a big problem for both government and business.

All elements of the new Healthy Towns need to be designed to accommodate these fundamental changes. From transport systems, to houses, retail, business and leisure, it is no longer good enough to think of society through a polarised lens which says you are either young, active and able; or old and in need of care. There is a significant stage in between.



The key to developing strategies to address this challenge is a better understanding of people as they get older. Generally speaking, this is an area of knowledge that we are lacking as a society, probably because we have not had a pressing imperative until now to gather such information, and to map the human environment against it.

As a priority we need to start measuring older people and compiling the data on older living that can inform how we should develop the buildings, infrastructure and systems around us. A first step would be the development of databases of anthropometry – the sizes and shapes of people – using new technology such as 3D scanners. A knowledge base of such data and other information (such as visual acuity, hearing, strength, dexterity and cognitive ability) would be invaluable in informing the design and planning of all environments.

Techniques such as link analysis can then be used to map out how tasks are performed within the design proposals.

It will be interesting to see the final form the new Healthy Towns take, but if they overlook the challenge of the stage of life BEFORE elderly care, they will have failed, and the cost will be counted down the line when rectification work becomes a necessity. ■

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Understanding ALS

Adjacent Government sheds light on amyotrophic lateral sclerosis (ALS) and the work of the ALS Association in raising awareness and tackling the disease...

Although amyotrophic lateral sclerosis (ALS) is something you don't hear of everyday, it does affect over 5,600 people in the US every year. The neurological disorder is commonly referred to as Lou Gehrig's disease, after a famous baseball player who was forced to retire at the age of 36 due to its effects and died 2 years later. The disease also became well known in 2014 with videos going viral on the internet of the '[ice bucket challenge](#)', intended to raise awareness and increase public support.

ALS is a progressive neurodegenerative disease which attacks nerve cells and pathways in the brain and spinal cord. There are 2 different types of ALS – sporadic and familial – sporadic being the most common with almost 90-95% of cases in the US.

According to the [National Institutes of Health](#) in America about 5 to 10% of all ALS cases are inherited, which comes under the familial form. The National Institute of Neurological Disorders and Stroke (NINDS) says:

"The familial form of ALS usually results from a pattern of inheritance that requires only one parent to carry the gene responsible for the disease. Mutations in more than a dozen genes have been found to cause familial ALS."

[The ALS Association](#) is the only non-profit organisation fighting Lou Gehrig's disease on every front. Established in 1985, the Association leads the way in research, care services, public education and policy, as well as providing help and support to those facing the disease.

The Association has committed more than \$67m to find effective treatments and a cure for ALS. Their global research has also helped to increase the number of scientists working on the disease and advanced new discoveries and treatments.

In February the ALS Association announced it was investing up to \$2.5m in the new TREAT ALS Drug Development Contract Grant Program. The programme supports preclinical assessment of therapeutics for ALS. The investment is expected to fund milestone-driven research to develop new treatments for ALS, and supports research from early target identification to preclinical research and early pilot clinical trials.

Investment such as this is key in developing new treatments, and the work of the Association is evidence of this.

According to NINDS, the onset of ALS can be subtle and differs from patient to patient. Early symptoms may include fasciculations, cramps, tight and stiff muscles, muscle weakness affecting an arm or a leg, and slurred speech. These early symptoms can sometimes be so subtle however, that they often get overlooked.

NINDS says: "The parts of the body showing early symptoms of ALS depend on which muscles in the body are affected. Many individuals first see the effects of the disease in a hand or arm as they experience difficulty with simple tasks requiring manual dexterity such as buttoning a shirt, writing, or turning a key in a lock."

In other cases, symptoms initially affect one of the legs, and people experience awkwardness when walking or running or they notice that they are tripping or stumbling more often. When symptoms begin in the arms or legs, it is referred to as "limb onset" ALS.

As well as funding and supporting much needed research for Lou Gehrig's disease, the ALS Association takes an active role in helping patients and families cope with the day to day challenges of living with the disease.



They do this by providing information, resources and referrals to many sources, including a wide variety of community services.

The cause of ALS is unknown, however in 1993 scientists supported by NINDS made an important step in answering this question. The scientists discovered that mutations in the gene that produces the SOD1 enzyme were associated with some cases of familial ALS.

“Although it is still not clear how mutations in the SOD1 gene lead to motor neuron degeneration, there is increasing evidence that mutant SOD1 protein can become toxic,” said NINDS.

“Since then, over a dozen additional genetic mutations have been identified, many through NINDS – supported research, and each of these gene discoveries has provided new insights into possible mechanisms of ALS.”

The ALS Association are working together with ALS ONE to develop and potentially fund appropriate clinical research initiatives to maximise synergies that will make a significant impact on the disease. In January the World’s leading ALS experts united for ALS ONE with a goal of finding a treatment for the disease within 4 years.

Lucie Bruin, chief scientist at the ALS Association and a member of ALS One’s Board of Directors said of the union: “Collaborations are key to expediting treatments for people living with this disease and we are pleased to see these groups coming together in Massachusetts, a key areas of the country where tremendous ALS work is happening.”

Continual research by both the ALS Association and National Institute of Neurological Disorders and Stroke (NINDS) can only further these developments and in time lead to a greater understanding and even a cure for the disease. ■

For more information regarding ALS and the work of the ALS Association visit www.ALSA.org . Or visit http://www.ninds.nih.gov/disorders/amyotrophiclateralsclerosis/detail_ALS.htm

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Helping ALS patients is not only a medical need, but also a moral obligation

By: Hande Ozdinler, PhD.

Amyotrophic Lateral Sclerosis (ALS) is one of the most complex diseases of the nervous system, and one that is very special for humankind. There exists a long-term debate about what makes us “human”. Is it really the ability to perform very skilled voluntary movements or our high-level cognitive function? Both movement and cognition sets us apart, but which one is more essential for being a “human”? ALS proves that it is our cognitive function.

ALS patients lose their ability to move their arms, legs and at times they cannot even control the muscles that help them breathe. Yet they remember the smell of their favourite flower, sense the comforting touch of a friend and will remember the names of the places you have long forgotten. But they will not be able to tell you how much they love you, nor will they be able to feed themselves or go to the bathroom alone.

ALS patients, with their ever-growing struggle to have a decent life and to retain their dignity, remind us what it really means to be a human. Some consider ALS an “orphan” disease and try to correlate the amount of research funds with a total number of patients, to make proper assessment of funds. They at times conclude that “too much is spent on ALS research already”, but miss the point that ALS is not only a disease, but an active fight of people, real people, to reclaim their lives, hopes, and dignity. Thus ALS is not just an orphan disease we can ignore, and helping ALS patients



is not only a medical need, but also a moral obligation.

ALS is a calling, which was answered by the ICE BUCKET Challenge. Millions of people worldwide joined in the largest international outcry, generating an immense momentum among scientists and foundations worldwide. Momentum is the energy we need to pave the way for an effective solution, but there are many setbacks along the way; 1) even though patients display similar pathologies, the underlying causes could be very different; 2) it is very unlikely that one drug will cure all patients, and we have to develop better inclusion criteria for clinical trials; 3) we need to develop better drug candidates by improving preclinical assessments using motor neuron viability as a readout for success, and determine the mode of action prior to clinical trials so that better groups of patients can be included in future

studies; 4) the disease progresses very quickly and the window of opportunity to include patients into clinical trials is very slim; 5) the total number of patients within a given medical center is usually very limited to perform statistically significant studies.

These limitations come with challenges, but also with an important opportunity: an opportunity for all of us humans to work together for a common goal of helping people gain their dignity and restore humanity. This is something we can achieve with global leadership and it is time we tackle this important problem. Since ALS is one of the most complex neurodegenerative diseases known, understanding ALS will help reveal the secrets of others.

Finding a cure for ALS is a collaborative effort, and it is better if that collaboration is international and

multi-institutional. The International Alliance of ALS/MND Associations and the Federation for International ALS Associations play a pivotal role in bringing ALS clinicians and researchers in many countries to the same level in terms of rules, regulations, accreditation, and inclusion criteria for clinical trials. Many different foundations and institutions recently came together to establish C4C (Collaboration for a Cure), to improve the pathway for ALS Drug Development.

Since the ICE BUCKET Challenge numerous ALS Centers have been established in the United States and in the world. They play a pivotal role in setting the right example for others and generating a framework for transparent and collaborative effort. I want to give Les Turner ALS Foundation as an example of what a few good people can achieve.



Les Turner ALS Foundation is one of the first ALS foundations in the United States, established by the friends and family members of Les Turner, who

was diagnosed with ALS at the age of 37 in 1976, at a time when very little was known about the disease. Friends and family of Les established the Les Turner ALS Foundation in 1977, and it remains one of the United States' oldest, independent ALS organizations, invested in both patient care and research. Patient care is at the heart of the Foundation's mission; in 1986 the Foundation opened the Lois Insolia ALS Clinic, one of the nation's first resources to provide multidisciplinary expertise to those with ALS. The Foundation has long had a support services team that offers continuity of care from the clinic to the home. The team provides home visits, conducts support group meetings, provides educational seminars and materials and coordinates care with the clinic health providers. Through these services, the Foundation supports nearly 90% of ALS patients in the Chicagoland area.

Joining global vision with local strength, Les Turner ALS Foundation established a pivotal collaboration with Northwestern University, Feinberg School of Medicine, where it has supported research efforts for the past 38 years. Recently, the Foundation established Les Turner ALS Research and Patient Center at Northwestern Medicine, generating a unique collaborative avenue for scientists and clinicians to work together for the common goals of building effective treatment strategies for ALS.

Les Turner ALS Foundation is part of the C4C group together with ALS ETF, ALS Finding a Cure, Answer ALS, ALS Hope Foundation, ALS Therapy Development Institute, International Alliance of ALS/MND Associations, Iron Horse Foundation, Muscular Dystrophy Association, PROJECT A.L.S., Team Gleason and the ALS Association.

I think the future is very bright for ALS patients and for all of us. There is an immense sense of urgency at local, national and international levels. The message sent by the ICE BUCKET Challenge has been globally received, and now it is time for the lawmakers and the legislators to join in the fight, and support important matters that would expedite formation of proper clinical trials, and translations from bench to bedside. ALS Survivor... Let's make it possible...



Hande Ozdinler is an Assistant Professor at the Department of Neurology, and a member of Les Turner ALS Research and Patient Center at Northwestern University, Feinberg School of Medicine. Her research focuses on the biology of upper motor neurons, and she believes in the power of transparent and collaborative approach.



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Why we need to invest in adolescent mental health care

Ophélie Martin, Communications Officer at Mental Health Europe outlines the importance of early intervention and care for young people who may develop mental health issues...

Adolescence can be a turbulent and challenging period. It is a time when young people are building their identity against a backdrop of physical and developmental changes. Educational pressure can mount, and increasingly complex social interactions and relationships need to be negotiated. It is therefore unsurprising that adolescence is a time of challenging behaviours and wide fluctuations of mood and emotion. These are, in many ways, normal reactions to various pressures and changes. However, some young people will experience more extreme distress. How can we identify what is 'unusual' distress, and how can parents, professionals and mental health services best support adolescents experiencing it?

Distress can take many forms. Anxiety, depression, body image issues (commonly known as anorexia nervosa and bulimia), violence or substance abuse are all problems that many young people will face. Studies show that one in 5 adolescents is affected by at least one psychological problem in any given year. Even more alarmingly, there is strong evidence to suggest that mental health problems developed during adolescence can continue in adulthood and in some cases become chronic and enduring.¹ Mental health problems do not only affect young people, their family and friends but they can also therefore have a longer-term impact on their social development and their adult lives. Addressing mental health problems during childhood and adolescence is therefore crucial and should form part of an integrated approach to mental health through the lifespan.

That is why researchers, organisations and health professionals are calling for appropriate prevention and care for young people², in particular adolescents. Adolescents have different care needs to adults and children as they are in a transition process and are living

with constant change. Detection and prevention are even more challenging as adolescents tend to be reluctant to share their worries or feelings with adults in their family or at school.

"We know that young people spend an increasing amount of time online on the Internet or on their smartphone. We now live in the digital era and should seize this opportunity to improve access to mental health care and information for young people. The Internet and online presence play an increasing role in the lives of millions of adolescents today."

What can we do to help without being too intrusive?

The first question is perhaps- what is 'unusual' distress? When should a parent or youth worker be worried? The answer to this is crucial: there is no right or wrong distress. Normalising emotions is a vital first step in opening up communication and building trust with a young person. But normalising does not mean minimising. Validating and acknowledging distress, whilst promoting hope, is how we can start conversations with young people around the causes of their distress, and ways in which it might be managed. This non-stigmatising approach, which is being delivered in some adolescent mental health care (AMHC) services in Europe, ensures that the young person is not 'problematised' and communication channels stay open.

In some cases, adolescents may need to access professional support. However, too many adolescents who access services are placed in child or adult services. A recent study³ has showed that many adolescents and young adults with mental health problems do not receive adequate care or get no treatment at all. It is



worrying that we have failed to address this treatment gap given what we know about prevention and the development and costs involved in chronic mental health problems. It is vital that there is adequate and widespread provision of AMHC services across Europe and that more healthcare professionals are trained in delivering age-sensitive support for adolescents.

To address this treatment gap and promote youth mental health, we need to invest in appropriate programmes in schools, where adolescents spend most of their time (5 days a week, more or less 7 hours per day across Europe). Appropriate programmes could take the form of psycho-education, coaching and counselling in school settings, which may be more effective to reach out to adolescents. Sport, music and art can also be important coping strategies and give meaning to young people's lives, and could also be used as part of an integrated support system.

“Distress can take many forms. Anxiety, depression, body image issues (commonly known as anorexia nervosa and bulimia), violence or substance abuse are all problems that many young people will face.”

The ADOCARE report⁴ presents very interesting findings and key recommendations to prevent and promote mental health in schools, which include basic trainings for teachers, classes on mental health in the curricula as well as the involvement of health professionals within a school setting. It is crucial to give teachers the right tools to detect early signs of mental distress, and to learn how to approach students in a non-intrusive way to improve communication and mutual understanding.

Mental Health First Aid for parents, teachers, youth workers and young people themselves could be

considered as a first step in acknowledging that mental health is as important as physical health. Mental Health First Aid is an educational course teaching people how to identify, understand and help a person who may be living with distress. It can help give the right tools to family and friends to detect early signs of distress and to work with the young person to help them make sense of their experiences and develop coping strategies.

“In some cases, adolescents may need to access professional support. However, too many adolescents who access services are placed in child or adult services.”

We know that young people spend an increasing amount of time online, on the internet or on their smartphone. We now live in the digital era and should seize this opportunity to improve access to mental health care and information for young people. The internet and online presence play an increasing role in the lives of millions of adolescents today.

The development of web-based interventions and mobile applications are therefore essential since they can provide appropriate help and support to young people through their screens. Mobile health (m-health) service are being developed and have proved in some cases to be very helpful. Websites and apps have enormous potential to inform adolescents about their own mental health care, access to care, but also to engage them more actively during treatment through follow-up planning and additional support. Adolescents may also look for information online before speaking up about their own experience. The sense of anonymity and community that can be found online gives room and opportunity to develop adapted support and information tools for young people.

Numerous avenues can be explored to improve the prevention and promotion of youth mental health, and this article outlines only some of them. Raising awareness is not always enough. Normalising feelings and

experiences, acknowledging distress and promoting hope, thinking creatively and collaboratively about coping strategies- these are basic but powerful ways in which parents and teachers can support a young person. Adolescent mental health services need to be appropriate, flexible and integrated. Rather than placing young people as passive recipients of services, they would meaningfully consult them in the devising and delivery of services. This would ensure that mental health care provision can respond to the real needs of young people experiencing distress. ■

¹ World Health Organization. (2005a). Child and adolescent mental health policies and plans.

² Adocare final report. (2015) Adolescent mental health care in Europe: state of the art, recommendations, and guidelines by the ADOCARE network.

³ Copeland, Shanahan L, Davis M, Burns BJ, Angold A, Costello EJ. (2015) Increase in untreated cases of psychiatric disorders during the transition to adulthood.

⁴ Adocare final report. (2015) Adolescent mental health care in Europe: state of the art, recommendations, and guidelines by the ADOCARE network.

Mental Health Europe is an umbrella organisation which represents associations, organisations and individuals active in the field of mental health and well-being in Europe, including (ex) users of mental health services, volunteers and professionals. As such, MHE bridges the gap between its 73 member organisations and the European institutions, and keeps its members informed and involved in any developments at European Union level.

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Back to the Future: Modelling the children's hospital and healthcare delivery system for the next century

Dr. Benjamin Van Voorhees from the Department of Paediatrics,
University of Illinois at Chicago College of Medicine

The Children's Hospital of the University of Illinois Hospital and Health Sciences (UIH) system in Chicago is at the forefront of the dramatic changes taking place in the provision of healthcare. The era of routine hospitalisation for the treatment of many diseases or injuries is now being replaced by extensive outpatient and same-day services, and an emphasis on ensuring the patient has a regular primary care provider.

For most of the 20th Century, the prevailing view was that medicine was responsible only for the clinical issues a patient presented, and not for the constellation of other non-medical factors that impact health. 21st Century mandates to decrease healthcare costs by reducing preventable hospitalisations and primary care sensitive emergency room visits are leading both providers and payers to a recognition that medicine must take account of the social and economic circumstances of the patient in order to facilitate successful health outcomes and minimise preventable high cost interventions. These changes in the health system are requiring both providers and hospitals to take a much broader view of their role in the patient's life.

The origin of the modern hospital has its roots in the charitable activities of those who sought to provide aid to the poor, sick, and disabled. For many children, the saving grace of hospital-

isation was the opportunity to eat regular meals and, later as germ theory advanced, live in a clean environment. The UIH system has its origins in the need to educate physicians, pharmacists, and other clinicians. In 1881 the College of Physicians and Surgeons (P&S) of Chicago was established, becoming the University of Illinois College of Medicine in 1913. In 1917, the university worked with the Illinois Department of Public Welfare to establish the Research and Educational Hospital as a teaching facility. In 1980 the current University Hospital was built and in 2011 the Children's Hospital was opened. It includes a 101-bed paediatric hospital, which provides general and paediatric subspecialty care to children from throughout the state.

Its primary catchment area includes some of the poorest communities in Chicago. The primarily African-American and Latino residents are beset with a multitude of challenges, including substandard housing, lack of jobs, low educational status, and high levels of violence and criminal activity in their neighbourhoods. These challenges interfere with a family's ability to focus on the mental and physical health of their children, leading to vulnerabilities (e.g. legal issues, racism) and adverse events (stressors such as "daily hassles"), that must be considered in treatment and prevention programs for both children and adults.

Disparities in health status result from ongoing interactions across the health care environment, health care organizations, community and provider characteristics, and person level factors throughout the course of a child's development. These complex interactions, also known as the social determinants of health, affect a child's health status, as well as his life outcomes. These ecological influences have an impact through multiple processes across time. An example might include a parent-child interaction that does not provide sufficient structure and discipline to prevent the development of oppositional behaviour. This behaviour then negatively affects the child's development and progress at the community school level. Poor educational outcomes often mean poor employment opportunities in adulthood. In short, child health models must include sufficient social force (forward moving impetus) to positively impact multiple processes of disparities development over time.

The child should be conceptualised as developing across time within an ecological framework that includes the individual, family, school/peers and community. Each individual's life course moves through a physical and social space. This space can be construed as concentric layers of family, friends/intimates (e.g. close relationships), school/work, community and wider social systems. Social support



can be derived from any one of these layers, but may be most effectively obtained from relationships that are most proximal in social space to the individual. However, the outer rings of community and systems provide many key social influences that determine behaviour and health outcomes. For example, the lack of availability of fresh foods in low income neighbourhoods may constrain healthy eating choices. Other forms of community influence include norm setting, peer pressure and peer group comparisons, all of which affect health and other behaviours.

A medical neighbourhood needs to be constructed around each child such that the balance of protective and vulnerability factors can be optimised to minimise illness and optimise development. To function in this 'optimisation role' the medical neighbourhood must:

- (1) Effectively link to social and mental health services;
- (2) Use an integrated referral and tracking data base;
- (3) Co-locate social and mental health services or make them otherwise convenient to patients;
- (4) Establish the primary care clinic as the backbone of neighbourhood-

based services and link it to services in the neighbourhood;

(5) Integrate community health workers into the health care team, building on their role of enhancing a family's ability to navigate to care and developmental and social service opportunities; and,

(6) Take advantage of technological innovations that can provide low cost behavioural health interventions and supportive patient contacts.

The concept of a children's hospital must be broadened to address the morbidity of children in adversity – mental health, oral disease, obesity, asthma, and sickle cell, consequences of prematurity, developmental disabilities – in the context of where they live and learn.

The goal of the children's hospital must be to focus on diseases and conditions that directly affect educational progress, work force participation, relationship formation and civic/moral development. We suggest a particular focus on oral disease and mental disorders because they share common risk factors with each other and other common chronic diseases, are widespread with high morbidity, commonly interfere with management of chronic diseases, and also because treatment for these conditions is often

unavailable to socially disadvantaged groups. We are developing a neighbourhood delivery model that focuses on modifying the social determinants of health in order to promote the health and well-being of both the child and the family.

In summary, in order to address the morbidities that most profoundly affect children living in adversity, we need a new model for the delivery of health care services and of the role of the children's hospital. This fully integrated model disrupts the progression of disease and adverse outcomes using a comprehensive model that includes mental, developmental, oral and physical diseases. It includes a medical neighbourhood linked with electronic data bases to track outcomes, innovative behaviour change technology, and community health workers linked through advanced data warehouses and portals that allow them to track patient contacts and predict future needs. It is a model that facilitates the successful development of the child so as to promote health and wellbeing across the life span. The Children's Hospital at the University of Illinois in Chicago is modelling these future solutions for the problems of today.



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Mental health: A communication challenge

Pfalzlinikum and the Hanover Center for Health Communication outline why mental health requires a social change...

In the field of mental health, the paradigmatic distinction between the treatment of diseases on the one hand and health promotion on the other becomes particularly evident. Although the necessity to prevent mental diseases is obvious because the cost for mental health care has risen enormously in Germany in the last few years, the major part of the resources is invested reactively, i.e. when an increased risk disposition or a disease has been diagnosed. Therefore, in terms of the pathogenetic approach it is rather a treatment of diseases than the promotion of health. Strictly speaking, even the term 'prevention', aiming at the reduction of health risks and damages and, thus, looking primarily at avoiding the occurrence or spreading of diseases, is associated rather with disease or potentially disease-causing factors. Health promotion, however, has another focus: From a salutogenetic perspective, it looks at protective factors and resources and aims at strengthening the individual skills for coping with life and at building health-promoting environmental conditions¹. A decisive point here is resilience. That is the ability to cope well with changes and the ups and downs of life and to develop oneself under the most adverse conditions². Sufficient resilience enables the individual to maintain a balance between the subjective perception of stress and one's own coping resources. Such an approach has a special potential to sustainably improve the population's mental health because in the develop-

ment process of mental disorders it starts at the earliest possible time. So it should be possible to reduce not only the incidence rates and the individuals' disease burden but also excessive treatment and follow-up cost as well as problems due to gaps in medical care. But addressing resilience only by emphasising the individual's responsibility for preserving mental health carries the risk that relevant socio-contextual factors of mental health promotion are not sufficiently taken into account. This corresponds to wide experiences of health professionals concerned and involved, who clearly state that the current conceptions of mental health and resilience have to be extended and amended. Therefore, it is important to take this systemic and socio-ecological perspective into consideration whenever efforts of mental health promotion are developed³.

From disease communication to health communication

At its core, the promotion of health is a communicative challenge – at the individual level, at the level of the social environment, as well as at the political level and at the level of the society as a whole. On every level it is necessary to initiate a 'salutogenetic change of perspective' and to first raise awareness for the value of and the need for resilience. Analogous to the way the health system is focusing on the treatment of diseases rather than on health promotion, communication efforts and public discourses are concentrating on aspects of diseases

instead of health: 'Disease communication' – which in the pathogenetic sense focuses on illness and risk factors – is dominating, while a salutogenetic perspective and, thus, mental health and conditions promoting mental health are hardly made a subject of discussion. Accordingly, mainly mental stress and its consequences are recognised as important social topics. These 'disease-accentuating discourses' are supposed to be a major cause of the lack of public awareness, understanding of and support for measures to strengthen resilience and it calls for a change of thinking and acting in all social areas. These changes of perspective can only be initiated by communication. Consequently, any effort of mental health promotion requires a 'resilience-oriented communication strategy', i.e. to emphasise the importance of mental stability, the requirements and possibilities to strengthen mental health. This should stimulate public awareness and initiate changes in social discourses which can lead to political and programmatic innovations and, finally, make change happen⁴.

Cognitive schemata and cultural models as starting points

Communicators face the challenge that frequently they do not even reach people with their messages or that messages are understood in a different way than intended. This often results from a large discrepancy between the health and communication experts' demand for high quality standards of health information on the one hand,

and the existing knowledge, problem awareness as well as the willingness and ability of information processing of lay people on the other hand. This particularly holds true for vulnerable and, thus, especially important, target groups. Therefore, the analysis of the factors influencing whether and how information reaches people is fundamental. It depends on the individual's available cognitive scheme. Schemata are structured and quite stable patterns of knowledge, attitudes, and experiences regarding issues, events, situations, and objects which form a network of associations⁵. This association network has an impact on how people select, process and respond to information. A cognitive scheme that is culturally shaped and shared in a social group, is referred to as a cultural model.⁶ Looking at the topic of resilience it is to be assumed that to date, for mental health no differentiated or only a rather biased cognitive scheme or cultural model exists; the awareness for resilience, for the importance of resilience-sensitive attitudes and for the need of promoting resilience has not been considered really relevant in the broad public.

Changing the individual and the public agenda by framing

Adequate communications strategies are capable to influence cognitive schemata or cultural models, impart knowledge and encourage an individual's self-reference and, thus, open up new roads for our thinking. By using so-called strategic framing⁷, certain aspects of reality are selected, emphasised and evaluated, while other elements are neglected. Aiming to modify attitudes and cognitive associations referring to resilience requires to emphasise health-related aspects and protective factors and to put this facet of the topic on the public and individual agenda by means of communication and public relations.

A comprehensive framing strategy considers the existing perceptions and values of individuals and groups, as well as, the socio-cultural contexts by considering people's every-day reality and living environment when developing the message. Promising means are illustrative and narrative ways of communication breaking down complex scientific information to simple and low-threshold messages customised for each target group. For instance, metaphors can concretise abstract concepts in such a way that they are easy to understand and activate emotions. As a result, it is possible to reorganise information, fill in gaps of understanding, and, therefore, reframe existing frames and cultural models⁸. This framing process should take place on all levels of communication in order to change the social debate and initiate a change in the system towards the promotion of resilience.

¹ Hurrelmann & Richter, 2013, p. 14

² Mandery & Bomke, 2015, p. 37

³ Bomke, 2015

⁴ Bomke & Kendall-Taylor, 2014, p. 179

⁵ e.g. Brosius, 1991; Scheufele, 2006

⁶ D'Andrade, 1987, p. 112

⁷ Matthes, 2007

⁸ Lindland & Kendall-Taylor, 2012, p. 49

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Danish model to reduce young people's relapse to crime after imprisonment

Esbjerg Municipality, The department for Social Services for adults with special needs and Danish Prison and Probation Service collaborate to help young people in the age between 18-30 years. The project was introduced in June 2014, and the initial results are promising...

Lately the general discussion has revolved around how we as a society can take better care of the young people who fall into a criminal pattern. Which options do we have in terms of how they serve their sentence, and how we can help them to avoid a relapse afterwards?

The Municipality of Esbjerg has expanded their cooperation with the Danish Prison and Probation Service and the consultancy MindLab in order to evaluate the existing measures, and in particular to encounter ways to improve them.

The project focuses on people age 18 – 30 years, and the primary aim is to reduce the percentage of young

people who relapse to crime after imprisonment. Some of the central collaborators are the Police, the Job Centre, the Citizen Service Centre, consultants and social workers from the municipality and the government-subsidised initiative called Kraftcentret, which exists to help people who suffer from psychosocial issues, acquired brain injury, or intellectual disability or abuse, for example.

Collaboration improves the critical transitions

The Danish Prison and Probation Service already sees benefits from the expanded collaboration and believe in the potential of committing all concerned parties during both the plea, the serving of the sentence and

after the release. It is vital to help young people, particularly during the critical transitions.

“The project focuses on people age 18-30 years, and the primary aim is to reduce the percentage of young people who relapse to crime after imprisonment.”

Hopefully this initiative will reveal more focus areas to test in order to achieve the main goal of enabling young people to continue a life without crime once they have served their sentence.

The target group includes people aged between 18 and 30, who have almost served the entire sentence or



who have been released within the last year. It is important to the research project that the experience is still at the front of their minds. Research and experience shows that this particular group is difficult to reach and motivate to avoid crime. Therefore it is important to specify a particular goal to determine what could help motivate them.

Waiting time is critical

Many of the young people in the target group indicate that they felt insecure in the period after they had received their sentence, but awaited the day they would begin serving it. For many of them the consequences of the waiting were severe. Some dropped out of school, some lost their home and others terminated their abuse treatment.

In Esbjerg Municipality, they will therefore explore the options to engage as

soon as the sentence is handed to the young person. The waiting time is often quite long, and it is vital to use it wisely, for instance prepare the practical matters. It is important to know what awaits you when you return to your ordinary life after imprisonment.

“Hopefully this initiative will reveal more focus areas to test in order to achieve the main goal of enabling young people to continue a life without crime once they have served their sentence.”

One of the significant changes in Esbjerg Municipality is that the Danish Prison and Probation Service now meet the young convict as soon as he or she receives the sentence. They plan for the future together and explore how to make the best use of the waiting time. Before the young person has to serve their sentence,

they have looked into possibilities to continue, for example, treatment or education in prison.

One of many strategic initiatives

Esbjerg Municipality draws on their experience from a former project called “The good release” and from their Homeless Strategy, and are engaged in several coherent strategic initiatives.

The overall aim is to ensure that the young person convicted experience a better transition from sentencing to commitment and finally to return to an everyday life on the other side.

To learn more about the projects and results in Esbjerg Municipality, feel free to contact Britta Martinsen mail: brmar@esbjergkommune.dk



Esbjerg
Municipality

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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 of age. Previously there had been 17 different addresses for children's services, one profession here and another there.

The house for children and adolescents, integrates social and health care and 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:

- Easy access. The help-seeker doesn't have to know what kind of help he/she needs. Contacting methods are easy (e.g. mobile, walk-in, e-contact), there is no referral needed;
- Counselling and early support. First one to five times evaluation for all new patients;
- Straight guidance to right address. Patients with certain symptoms are guided straight to the special department (such as child welfare);
- The whole family is taken into consideration, not just the one who looks for help;
- A contact person will be named for every family;
- Tailored treatment plans for those who need care from many departments at the same time (such as child welfare and psychiatry);
- 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;
- Treatment and support at homes and schools.

After the first year of activity there are several results to be seen: The customers get instant help which is convenient 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 placements from home. The knowledge and know-how of professionals has increased.

“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 of age.”

However, the development work continues and prevention has an even greater meaning than before.

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



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The lifelong impact of air pollution

Professor Jonathan Grigg, the Royal College of Paediatrics and Child Health (RCPCH)
writes about the risks air pollution poses to our country's children...

This year marks the 60th anniversary of the Clean Air Act, the first air pollution law of its kind. The Act was in response to London's 'Great Smog of '52' which the government at the time estimated had led to 4,000 deaths and 100,000 Londoners falling ill – later research would estimate the death toll was nearer 12,000. Nowadays the so called 'pea soup fog' floating over the capital is nothing but a distant memory, but that does not mean the effects of air pollution are not still perilous today. The children of the 1950's were subjected to breathing in large quantities of soot particles from coal burning and lead from petrol, leading to both respiratory and neurological problems. Now our young people are left to breathe an invisible mix of diesel soot particles and nitrogen dioxide (NO₂), a different, but similarly dangerous proposition.

"That thick smog of the past may be exactly that – a thing of the past – but just because you can't see the pollution of today doesn't mean it isn't harmful. Collectively, if we all do our bit to reduce air pollution we can all make a difference."

Our recent joint report with the RCP, Every breath we take: The lifelong impact of air pollution, found that 40,000 deaths a year in the UK can be linked in some way to air pollution, and that high exposure to toxic traffic fumes can lead to serious health problems in children with lifelong implications and could lead to detrimental effects on growth, intelligence and neurological development. As is so often the case, it is children that are more vulnerable to the effects of our environment, and they who bear the brunt of our actions. They are especially vulnerable to the effect of inhaled pollutants, indeed, at no other point is the body undergoing such rapid changes, as the brain, lung and immune system mature.



These rapid changes are at their most robust during the first months and years, with babies and toddlers often struggling with wheezing and frequent coughs as a result of air pollution. But perhaps the most significant finding of our report is that, after years of debate, there is now overwhelming evidence that air pollution is associated with reduced lung growth during childhood and increased risk of developing asthma. At a time when every 20 minutes a child is admitted to hospital because of an asthma attack, and 1 in 3 in every classroom is suffering from the disease, it is clear that we must as matter of urgency clean up our act on air pollution.

But pollution is not just something you breathe in when shopping in our busy city centres – there are also air pollutants in the home. Anything from kitchen products, to open fires through to faulty boilers can emit compounds with the potential to cause long term ill health. When we are thought to spend around 26 years of our life sleeping in our home, the risks attached to highly polluted homes are obvious.



What steps must we take to overcome this issue? The RCPCH and RCP want to see the onus put on the polluters. We want to see those who pollute most take responsibility for the negative effect they have on our health and see tougher regulations introduced in the UK to ensure reductions in emissions. We want to see better monitoring of air pollution by central and local governments to more accurately identify where most people are exposed, and then see these results effectively communicated to the public. We also want to see more research into the effects of indoor-generated air pollution. We want our paediatricians to be trained to communicate both the risks of air pollution, but also ways of reducing exposure to parents and children. But we also want individuals to take responsibility. If you are only a small commute from work, try cycling. For those travelling further afield, can you take public transport?

That thick smog of the past may be exactly that – a thing of the past – but just because you can't see the pollution of today doesn't mean it isn't harmful. Collectively, if we all do our bit to reduce air pollution we can

all make a difference. But most importantly we need Government to act to reduce emissions from roads – maybe we really do need a new Clean Air Act. ■

“As is so often the case, it is children that are more vulnerable to the effects of our environment, and they who bear the brunt of our actions. They are especially vulnerable to the effect of inhaled pollutants, indeed, at no other point is the body undergoing such rapid changes, as the brain, lung and immune system mature.”

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Professor Jonathan Grigg

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Surviving cancer in Europe

Satu Lipponen, Director of Communications and Foresight at the Cancer Society of Finland sheds light on the Joint Action Cancon and its role in guiding the way forward for quality cancer care...

What if cancer experts decided to work together and find answers to current policy problems? How to improve quality of life of cancer patients? How to secure quality care? What does survivorship mean in practice?

This has actually happened. Up to February 2017 the Cancon Joint Action will be working on these themes. The result will be the European Guide on Quality Improvement in Comprehensive Cancer Control.

The Guide is in its final phases. Special policy papers are prepared for decision makers. Europe needs effective cancer control, and this can happen only via concerted action.

Guide – why and how?

There is one Work Package in Cancon dedicated to the Guide coordination itself. The Guide is the single most important outcome of the project. The guide will be a coherent, patient-centred document, and key strategic tool for governments and policy makers.

The core chapters of the Guide are integrated cancer control, community-based post-oncological care, cancer survivorship and rehabilitation – from treatment to recovery and beyond – and population-based screening programmes.

The Guide will be in editing phase, compiled, in September 2016 and as a printed book in February 2017, when the final Joint Action conference is in Malta. It will be distributed in many channels, as digital versions, as research papers and as executive summaries, and also available online. In the last months of the Joint Action, the consortium puts much energy into getting it available in all member countries of the European Union. The Guide is directed at governments, parliamentarians, health care providers and funders and cancer care professionals at every level.

Dozens of organisations working together

The overall coordination of this EU Joint Action is in Slovenia, at the Public Health Institute in Ljubljana. There are 65 organisations involved in Cancon and 25 countries, of which 23 are EU member states.

In addition to the Guide, there will be special policy papers, which help governments to implement recommendations. Policy papers are coordinated by the Italian Ministry of Health. Altogether 5 policy papers are being prepared currently. Their topics range from cancer genomics to health inequalities, national cancer control plans, prevention and re-allocation of resources for effective management.

What do patients need?

At the centre of this action is the cancer patient. Early diagnosis is essential for getting the best treatments. Cancer Society of Finland coordinates cancer screening, and looks at population-based programmes. Their implementation varies a lot in Europe. INCA, the French National Cancer Institute is in charge of survivorship and rehabilitation. As cancer patients survive their disease, quality of life becomes more important than before – the question is not how long but how well. ■

Cancon Joint Action supports full transparency. Easiest way to follow is to register to receive a bi-monthly CanCon newsletter from www.cancercontrol.eu/news-events/newsletters/

Satu Lipponen

Director – Communications and Foresight

Cancer Society of Finland

www.cancercontrol.eu

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Obesity, fatty liver disease and liver cancer in Europe

Alterations in our way of living over the last decades, including high caloric intake (e.g. through high fructose and high fat diet) combined with a sedentary lifestyle, have augmented the incidence of overweight and metabolic syndrome, characterised by abdominal obesity, insulin resistance, hypertension and dyslipidemia. This trend is observed not only in industrialised countries such as the United States of America or Europe but also step by step in developed as well as developing countries.

Overweight and metabolic syndrome lead to diseases of several kinds, including coronary heart diseases, Type 2 diabetes, and also cancer (e.g. liver, colorectal). Epidemiological data clearly indicate that overweight and metabolic syndrome are reaching pandemic dimensions in industrialised countries. Notably, it is suggested that newly developing countries – as a consequence of industrialisation and adaptation of their lifestyle – will also experience a steep increase in overweight and metabolic syndrome-triggered diseases. In the past ten years, the rate of obesity has doubled in adults and tripled in children in the USA. A similar trend has also been observed in Europe.

The liver – which is the most important metabolic organ – is strongly affected by a chronic state of overweight and metabolic syndrome. Non-alcoholic fatty liver disease (NAFLD), the most frequent liver disease worldwide, is a clinical manifestation of



overweight and metabolic syndrome. NAFLD is a chronic disease that can last several decades, characterised by predominant macrovesicular steatosis of the liver. Although the prevalence of NAFLD is increasing globally, epidemiology and demographic characteristics of NAFLD vary worldwide. It is becoming increasingly clear that a number of pathways are involved in the pathogenesis of NAFLD and NASH and its progression to advanced stages of liver disease. These pathways may be diverse in different cohorts of patients suffering from the condition, and understanding which pathways play a role in its development will be critical before launching treatment modalities.

A significant number of NAFLD patients develop nonalcoholic steatohepatitis (NASH), fibrosis and conse-

quently hepatocellular carcinoma (HCC). In recent years, obesity, leading to metabolic syndrome, steatosis and steatohepatitis, has attracted increased attention due to an increased HCC incidence in the US and Europe. In line with this, the most common etiology for HCC in industrialised countries has recently switched from chronic viral infections (e.g. hepatitis B and hepatitis C virus) to obesity, making HCC the most rapidly increasing type of cancer in the US, with a similar trend observed in Europe. Today we lack a detailed understanding of how chronic steatosis develops into NASH and what factors control its transition from NASH to HCC. At the same time, no therapeutics exist to efficiently treat NASH, and treatment options for the therapy of late stage HCC are limited and prolong the lifespan of patients for between three to six months.

“In the past ten years, the rate of obesity has doubled in adults and tripled in children in the USA. A similar trend has also been observed in Europe.”

In laboratory mice, NASH can be induced by several different diets, such as a methionine/choline-deficient (MCD) or choline-deficient diet (CD) but not by a high-fat diet (HFD) alone. However, C57BL/6 mice fed with MCD or CD do not develop obesity or metabolic syndrome, and the diet has to be discontinued after a few months due to weight loss (up to 40%) or occasional cachexia. Hence, these approaches do not recapitulate NASH and its consequences (e.g. transition to HCC) in humans, and appropriate mouse models for genetically and mechanistically dissecting NAFLD-induced NASH and NASH-triggered HCC development have been thus far lacking.

Deficiency in the essential nutrient choline was described in NAFLD patients to exacerbate NAFLD and NASH. Moreover, humans with inadequate choline uptake were shown to have defects in hepatic lipoprotein secretion, oxidative damage caused by mitochondrial dysfunction and ER stress.

Based on the clinical observations of choline deficiency to exacerbate NAFLD and NASH patients, we have recently combined choline deficiency with a high fat diet (CD-HFD) as a chronic diet for laboratory mice, which may lead to

metabolic syndrome, steatosis, liver damage and NASH, thus delivering the ‘second hit’ that promotes dietary-induced liver carcinogenesis – similar to the human situation. This approach has enabled us to establish a chronic mouse model of NASH and metabolic syndrome, triggering subsequent HCC in a wild-type C57BL/6 mouse, in the absence of chemical carcinogens or genetic mutations predisposing to NASH or HCC development (Wolf et al., Cancer Cell, 2014). CD-HFD-treated mice display obesity, overweight, insulin resistance, liver damage and fibrosis and hepatic mitochondrial damage, dyslipidemia and NASH, as observed in human patients. HCC developed 12 months post-CD-HFD start and resembled histologically, genetically and morphologically human HCC. Interestingly, by using this novel model we could show that adaptive immune cells (e.g. cytotoxic T-cells as well as natural killer T cells) greatly contribute to the diet-induced liver pathology. Consequently, we also analyzed NASH patients and patients suffering from other liver diseases with concomitant lipid deposition diseases (e.g. chronic HCV infection) and could find the same activated immune cells in livers of NASH patients, as well as the same cytokines, which we identified to be causally linked to NASH and HCC disease development.

We thus believe that our mouse model recapitulates several pathophysiological aspects of human NASH and enables us to study its development and transition to HCC. In the

future, the link between activated T-cells in the liver and their crosstalk to hepatocytes could give us important insights into how we can generate novel therapeutics for treating NASH as well as NASH-induced HCC in industrialised countries.

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Understanding pancreatic cancer

Pancreatic cancer is a devastating disease with the poorest prognosis of all solid tumours. Dr Catherine Hogan of the European Cancer Stem Cell Research Institute explains how an innovative approach to understanding the early stages of this disease may pave the way for the development of earlier detection tools...

The European Cancer Stem Cell Research Institute at Cardiff University is the first institute of its kind to focus on cancer stem cell biology and related therapies.

Since joining the Institute in September 2013, my research has primarily focused on gaining a better understanding of the early stages of pancreatic cancer.

Pancreatic cancer is a particularly devastating disease, with a 5 year survival rate of less than 5%. This is due to the highly aggressive nature of the illness and a lack of suitable screening methods to detect at-risk individuals.

Early detection is key to improved patient prognosis, but while our knowledge of the genetics and pathology of pancreatic cancer has improved considerably in recent years, our knowledge of how this disease begins and develops at the cellular level remains insufficient.

It is this 'knowledge gap' that we are working to address.

Our focus is on understanding how cancer starts in epithelial tissues (the tissue that lines the surfaces and cavities of organs). Many human cancers start spontaneously when normal cells acquire genetic mutations and become transformed. What remains poorly understood is how transformed cells expand to form tumours within an environment of tight regulation and control.

While working as a postdoctoral researcher at University College London, I demonstrated that local cell to cell interactions with normal cells profoundly affect the fate of transformed cells. Specifically, cells expressing activating mutations in the cancer-causing gene Ras

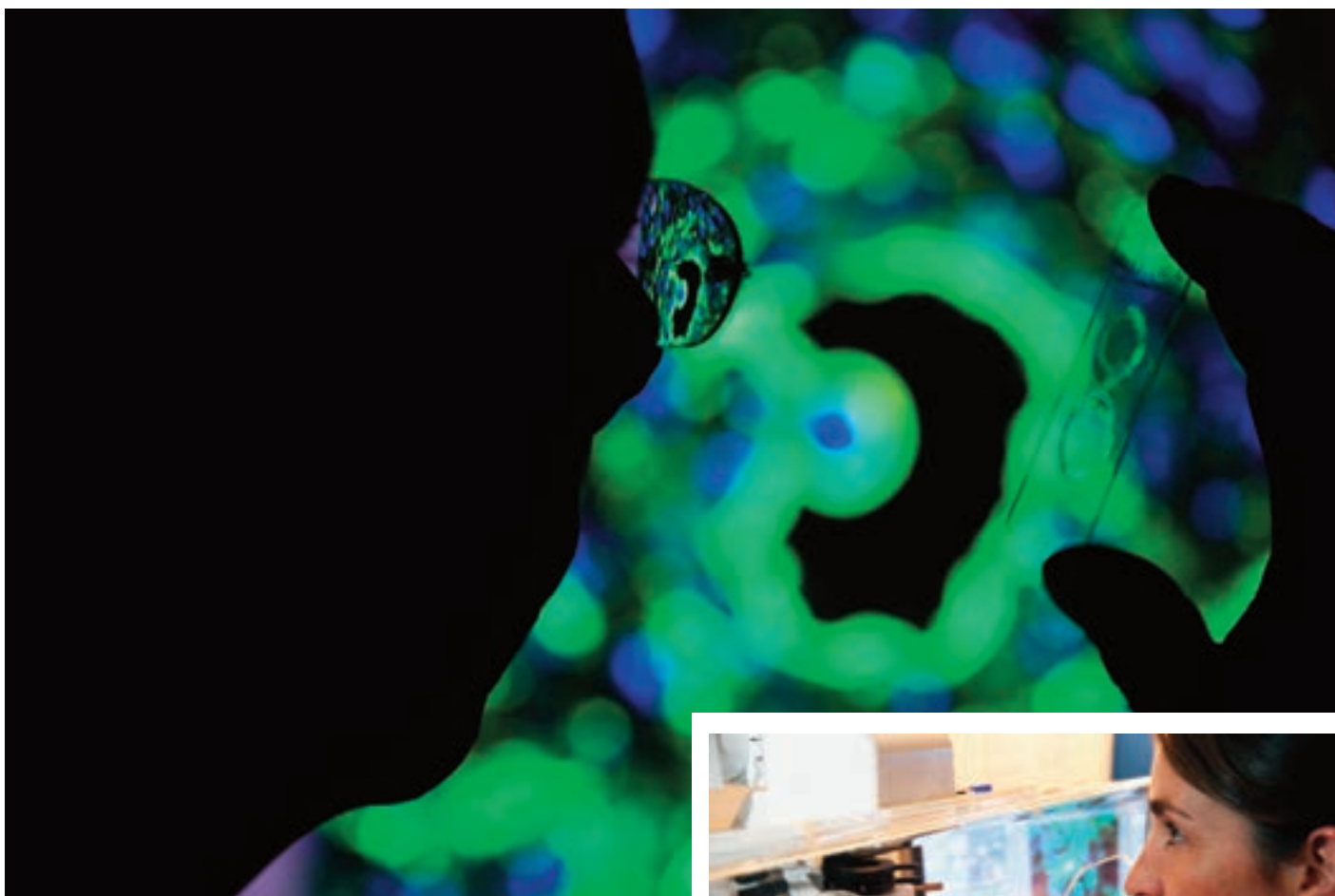
are detected by normal cells and are subsequently pushed out of epithelial tissues.

At the Institute, we have recently discovered that this elimination step is driven by signals transmitted at cell to cell interactions between the transformed and the normal cell, which instruct the transformed cell to change shape and position in the tissue. This elimination process may act as a clearing mechanism that prevents the early stages of cancer from developing, or it may promote the escape of mutant cells to metastasise even before a solid tumour has formed. In order to determine the significance of this finding, we are applying our knowledge and experimental systems to pancreatic cancer.

Pancreatic ductal adenocarcinoma (PDAC), the most common form of pancreatic cancer, arises from transformed cells in the exocrine pancreas that express activating mutations in the KRas gene. The earliest detectable stages of PDAC are the microscopic precursor lesions called pancreatic intraepithelial neoplasia (PanINs).

The cell of origin for these lesions has been a contentious issue for many years. However, it is now generally accepted that PanINs originate from a duct-like cell. We also know that acinar cells, the most abundant cell of the exocrine pancreas, reprogramme to a duct-like state preceding PanIN development.

Acinar-to-ductal reprogramming (ADR) is largely triggered by inflammation of the pancreas (e.g., pancreatitis) as well as by activating mutations in the oncogene KRas. The pancreas has an inherent ability to regenerate following inflammation and, in this situation, ADR is reversible. However, the expression of activating mutations in the oncogene KRas blocks this reversible



regenerative switch and cells stay 'fixed' in a duct like state, promoting PanIN lesion development.

In collaboration with Professor Owen Sansom's team at the Beatson Institute of Cancer Research in Glasgow, we are currently investigating whether KRas-expressing mutant cells are competing with their 'normal' neighbours for survival in the tissue, or are being kicked out of the normal tissue in a manner that is promoting disease progression.

Indeed, recent studies from labs in the USA have revealed that KRas-transformed cells can be detected in the bloodstream and can metastasise to the liver before a solid tumour has formed. It is possible that although spreading out of the pancreas at very early stages of the disease, these mutant cells, once seeded in secondary sites, become dormant or grow at a slower rate and are not detected until years later. We are also exploring whether signals communicated from neighbouring normal cells delay the reprogramming of KRas-transformed acinar cells during early PanIN development.



Dr Catherine Hogan of the European Cancer Stem Cell Research Institute

We are hopeful that our research will improve our knowledge of how pancreatic cancer starts and develops. By understanding the signals that control the early stages of the disease we may identify new biomarkers and diagnostic tools that will help contribute to more positive prognoses for pancreatic cancer patients. ■

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Understanding cancer through physics

How physics can help to develop technology to analyse images of cancer

It is an exciting time for physics. Highly advanced technologies like the Hubble Space Telescope and Laser Interferometer Gravitational-Wave Observatory (LIGO) have transformed astronomy, enabling the study of an entire spectrum of processes in the universe, including asteroids, planets, stars, black holes, galaxies, and more.

For example, scientists have used images from Hubble and other observatories to gain insight into fundamental questions of our very existence. How do planets form? How do stars evolve? How does life emerge?

Astronomers approach these questions using the laws of physics. Mass

and energy are conserved. We have used the same principles of physics to understand cancer. Just as astronomers have developed the knowledge that enables them to look at a galaxy and say whether it is an avid star producer or not, we are developing ways to analyse the images of cancer (Fig. 1).

One example of our work in this area is pancreatic cancer. Diagnostic imaging with computed tomography is a vital piece of patient care in this disease because the cancer exhibits physical properties that are different from the surrounding normal tissues. This enables physicians to see where the abnormalities are. We have recognised that there is much more information in the images than just the simple diagnostic

data. These physical properties provide insight into the fundamental nature of the cancer itself!

We demonstrated this in a recent study published in the *Journal of Clinical Investigations* (Koay et al., 2014; PMC3973100) and another study in *Physical Biology* (Koay et al., 2015; PMC4266401). We used methods to measure the enhancement characteristics of the tumors, providing a way to characterise their perfusion properties.

We also developed a mathematical model to describe these properties. The model used our multiple, systematic measurements of the density of the tissue of interest (i.e., tumor or normal pancreas) at sequential time

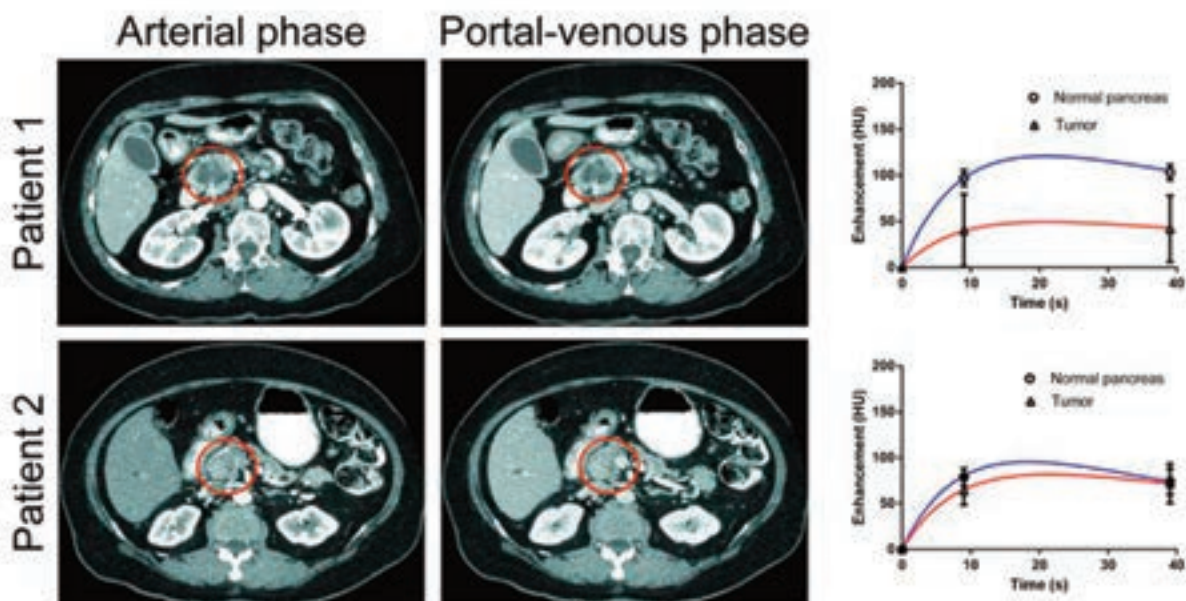


Fig. 1. Measuring enhancement profiles of pancreatic cancer during the timed phases of standard-of-care computed tomography scans. Patients 1 and 2 both had adenocarcinoma of the pancreas but different imaging characteristics and enhancement profiles in the tumor. Adapted from (Koay et al., *J Clin Invest* 2014; PMC3973100). Reprinted with permission.

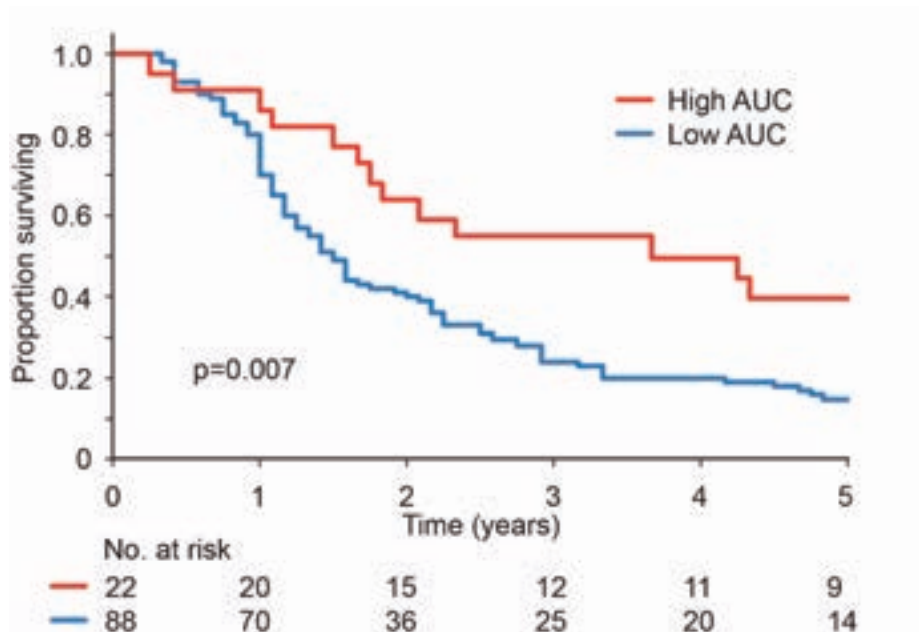


Fig. 2. Survival outcomes of patients with pancreatic cancer, stratified according to the imaging characteristic of the area under the enhancement curve (AUC). Adapted from (Koay et al., *J Clin Invest* 2014; PMC3973100). Reprinted with permission.

points during the CT scan. By using the data from the patient to fit the model, we quantified the physical properties of individual tumors.

In doing so, we found that these model parameters correlated with the amount of fibrous scar tissue in the tumors, how much chemotherapy could reach the cancer cells, the response of the cancer cells to chemotherapy and radiation, and – most importantly – the overall survival of the patients (Fig. 2). This work is the first demonstration that the physical transport properties of pancreatic cancer can be derived from CT scans and should be considered biomarkers.

It is quite remarkable that this information was in front of our eyes for years without being used. By applying principles of physics to the images of these patients, we gain significant insight into the micro-universe within pancreatic cancer and the outcomes of patients. Indeed, this is an exciting time for physics – both in astronomy

and in cancer. We are now expanding our approach in other settings for pancreatic cancer, including new and emerging therapies like immunotherapy. We are also integrating this approach into the next generation of clinical trials. One clear application of this approach in the clinic is to properly select patients for specific treatments, increasing the chances that they will have a response. In this manner, our physics-based approach aims to help patients with this deadly disease.

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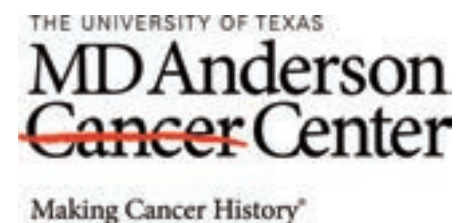
Additional resources:

<http://physics.cancer.gov/>

<http://www.internationalinnovation.com/taking-cancer-out-of-the-equation/>

<http://www.pnas.org/content/110/35/14266.long>

<http://www.ncbi.nlm.nih.gov/pubmed/26839407>



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Identifying research priorities for cancer

Pavel Poc, Vice-Chair of the Committee on Environment, Public Health and Food Safety at the European Parliament, outlines why cancer research and innovation must not be at the expense of healthcare equity...

There is no doubt cancer is one of the greatest challenges of the current society. When discussing healthcare strategies, many tend to focus intensively on cancer research and the development of innovative therapies. Despite personally considering research in general as the motor of our progress in knowledge, we must be careful when identifying our priorities in this area.

Research and new technologies are of significant importance. What is even more important however, is its application and its consequent availability throughout our healthcare systems in an equally accessible way. Issues such as lengthy certification procedures, ethical questions, reimbursement management, or simultaneous adaptation of the health care infrastructure to the influx of innovations must be resolved in order to gain a real added value.

“Effective and humane treatment and care is an imperative, but I also highlight prevention, both primary and secondary, as it should have an outstanding place in the strategy planning of our cancer research efforts.”

As a parliamentarian, when making conclusions after a day full of meetings and events related to healthcare, I must repeatedly battle 4 questions, which are essential for setting the strategy of any EU health care system or plan related, but not limited, to cancer:

1) In the EU, which one would wish to think of as the flagship of the modern civilization, we have too many people dying simply because of not having access to basic healthcare because they simply cannot afford it. Have we forgotten the true sense of healthcare? In my opinion it is not to make money profits. Or is it?



**Pavel Poc,
Vice-Chair**

2) Many Europeans do not even have access to a plain paracetamol; forget about complicated cancer treatments. Despite considering myself a pioneer or innovator in regard to progress of the human kind and crossing distant boundaries, I ask whether it is effective and useful to obstinately invest in more innovations at any cost when this happens at the expense of using the existing medicine, procedures and technologies by as many people as possible?

3) There are still considerable amounts of people, who cannot make a phone call because there isn't simply any mobile phone reception in their area or because they do not have a landline or, because they are simply too old or unable to manipulate a phone. In this case, is the so-called eHealth really the best way to a personalised medicine? Wouldn't it be much easier to restart the time-tested idea of family doctors? Is personalised medicine about being more human or about being more techno, shiny and trendy?

4) As lawmakers, we often hear it is necessary to lift obstacles and regulatory barriers of the healthcare industry. I ask, instead of disintegrating an already fragile house of cards, wouldn't it be better to make all the regulations “bomben-fest und idioten-sicher” to prevent another breast implants scandals?



I am not saying that research and innovative methods should not be explored. In fact it is quite contrary; consider the issue of pancreatic cancer for example. But it will simply not bring us any good if the results, which always come at the expense of other important items of the healthcare budgets, were at the end of the day available only to a small select group of people, who can both access and afford it. Equity must be the fundamental principle of healthcare management.

Effective and humane treatment and care is an imperative, but I also highlight prevention, both primary and secondary, as it should have an outstanding place in the strategy planning of our cancer research efforts.

Last, but not least, it is important to note that none of the above can be used to its full potential without the cooperation and interest of the public. General awareness is a fundamental key to success. Therefore any action, which contributes to making people around us more aware about the basic cancer issues, is praiseworthy. Not matter whether it is the World Cancer Day,

European Week Against Cancer, European Digestive Cancer Days or a simple chat with a friend.

Food for thought: I dare to raise one example of strange priorities in the EU decision making process related to healthcare: How much research about the cancerogenicity of glyphosate still needs to be done in order for the European Commission and the EU Member States to make an informed decision on the re-approval of this widely used, yet potentially carcinogenic, herbicide substance? ■

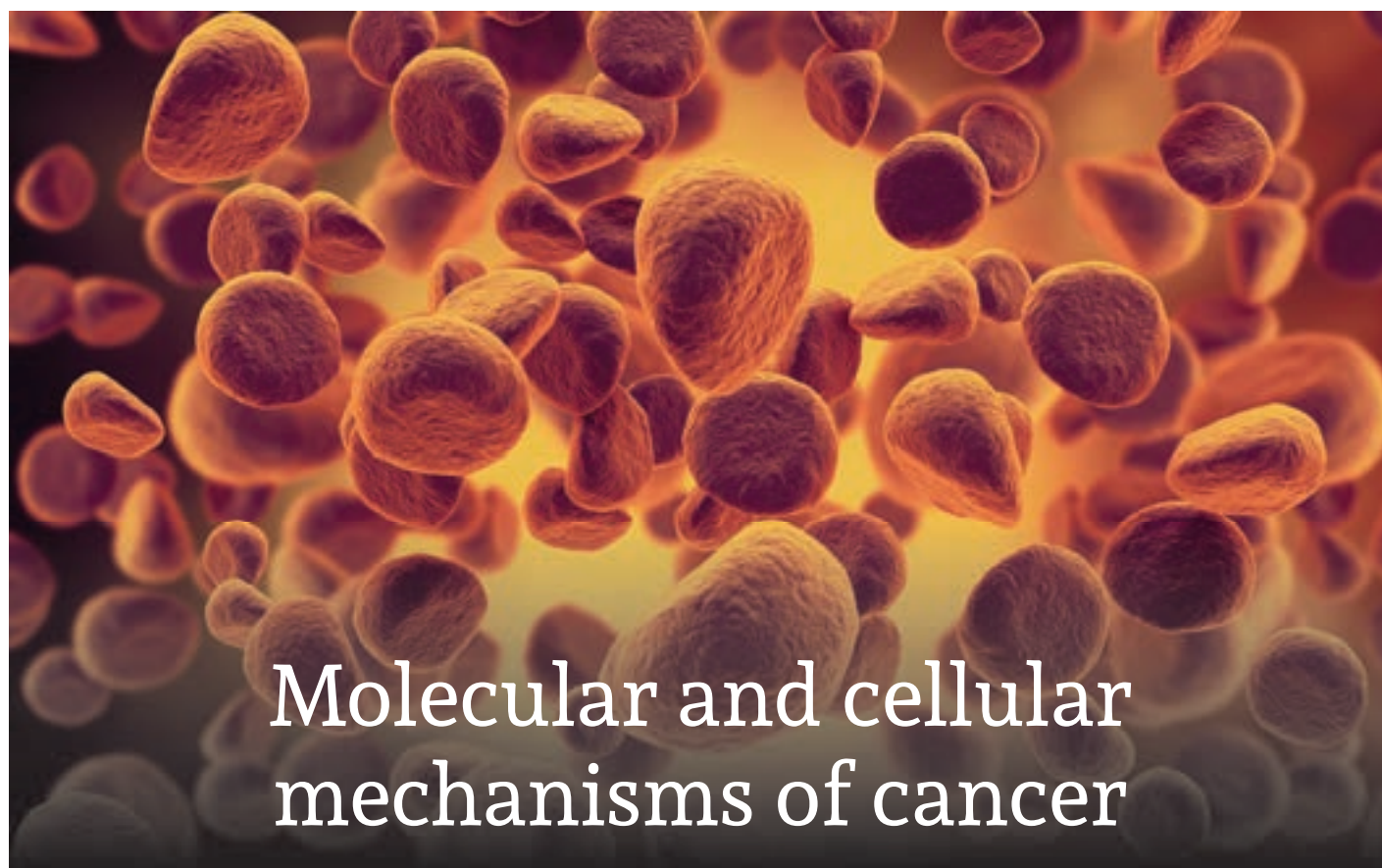
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http://www.europarl.europa.eu/meps/en/96715/PAVEL_POC_home.html



Molecular and cellular mechanisms of cancer

Professor Wen Jiang, Dr Andrew Sanders and Dr Lin Ye from the Cardiff China Medical Research Collaborative, Cardiff University School of Medicine highlight the work being done to combat cancer and develop new treatments...

Cancer presents a serious issue worldwide for healthcare systems and results in substantial morbidity and mortality for afflicted patients. In Wales alone there were 8933 reported cancer deaths in 2014, an increase of 7% compared to cases recorded in 2005¹. Dissemination of cancer cells away from the primary site to secondary locations, through metastatic spread, is tightly linked to patient outcome and treatment options. Whilst substantial progress has been made in the field of cancer research, specific anti-metastatic treatments are limited in comparison. The prevention of such metastatic spread would significantly improve cancer management and patient survival.

The metastatic cascade/mechanisms of spread

The metastatic dissemination of cancer cells from the primary tumour occurs through a sequential system of events, termed the metastatic cascade. Following carcinoma development, cancer cells can develop an invasive phenotype, invade through the basement membrane and expand into surrounding tissues. Here they will frequently secrete angiogenic or lymphangiogenic factors,

develop their own blood or lymphatic vessels and subsequently invade (intravasation) and use these vessels to spread around the body to a secondary site. Here they will arrest, invade out of the circulatory system (extravasation) and develop micro- or macrometastasis^{2,3}.

Dysregulation of key cellular events enables cancer cells to proceed through this cascade unchecked. For example, expansion of primary cancer arises through the acquisition or enhancement of pro-metastatic/tumorigenic genes or the loss of metastasis/tumour suppressor genes. Subsequently, the loss of cell-cell contact molecules, such as E-cadherin and tight junction proteins, enhanced protease activity or expression, and enhanced cellular motility occur, resulting in the cells taking on a more mesenchymal rather than epithelial state (a process known as epithelial to mesenchymal transition or EMT), enabling cancer cells to invade. Secretion of pro-angiogenic factors, such as vascular endothelial growth factor (VEGF) enables cancer cells to develop their own vasculature which not only provides

the rapidly growing tumour with essential resources but also provides close access to the vascular system. Here, factors involved in interaction, migration and invasion through endothelial cells are key. Moreover, tumour cells must also develop mechanisms to avoid immune detection/attack and survive in the circulatory system until they reach their secondary locations around the body. Finally, invasion from the vasculature into the secondary tissues occurs and the metastatic foci can either remain dormant for many years as a micrometastasis or undergo rapid expansion to form a secondary macrometastasis^{2,3}.

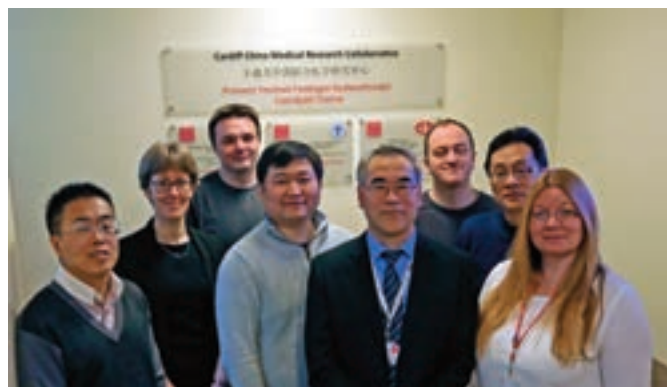
Importance of the microenvironment

Contributing to the complexity of this mechanism of cancer invasion and metastasis, the interaction between cancer cells and their surrounding environment also play key roles in the progression of cells through the cascade. Growth factors, angiogenic factors and inflammatory cytokines can all be released by surrounding immune cells, fibroblasts and fat cells or can be obtained through the degradation of extra-cellular matrices. These factors in turn function to drive processes such as angiogenesis, immune invasion and EMT and in doing so enhance the metastatic potential of the cancer cells^{2,3}.

Current and future perspectives

Over the last 25 years improvements have been made in both early diagnosis and treatment regimens with combinations of surgery, radiotherapy and chemotherapy, leading to improved survival after treatment of many primary cancers. However, there are only limited options available for the treatment of most types of metastatic cancer, which is the commonest reason for cancer related mortality. Novel anti-metastatic treatments are vital in improving overall survival rates for cancer patients worldwide. Ideally, future therapies should be able to prevent the ability of a cell to break away from the primary tumour, thus removing the opportunity for the development of metastases. However, given the complexities of the metastatic cascade and the intricate cross-talk between cells and their microenvironment, such therapies would probably need to target multiple aspects or signalling pathways to achieve this.

In addition, a major consideration is the significant and serious toxicity associated with many current treatments. Therefore research into novel therapies with lower toxicities may also be warranted. There is



Authors (from left to right) Dr Yuxin Cui, Miss Rachel Hargest, Dr Andrew Sanders, Dr Lin Ye, Professor Wen Jiang, Dr Alwyn Dart, Dr Jun Cai and Dr Tracey Martin

growing interest in the scientific community as to the potential efficacy of low toxicity, well tolerated compounds, such as those found in many phytochemicals. Such potential has recently been highlighted in an incentive bringing scientists together from around the world to explore such products across all the defined cancer hallmark traits, in addition to cancer invasion, for their efficacy in a holistic sense⁴. Such therapies, or combinations of novel and conventional therapies may hold the key to the development of anti-metastatic therapies and aid in the management of this disease. ■

¹ Welsh Cancer Intelligence and Surveillance Unit "Cancer in Wales" <http://www.wcisuwales.nhs.uk/sitesplus/documents/1111/WCISU%20Statistical%20report%2028bilingual%29%20rotated.pdf>

² Jiang et al (2015) *Semin Cancer Biol.* 35: S255-75

³ Nguyen & Massague (2007) *Nat Gen Genet.* 8:341-352

⁴ Block et al. (2015) *Semin Cancer Biol* 35:S276-304

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Fight Zika virus before it gets out of control

European Parliament MEP Annie Schreijer-Pierik (NL, EPP Group) and co-author of the resolution on Zika Virus, sheds light on what more could be done in Europe to help prevent the deadly disease...

Europe should step up efforts to fight the Zika virus. More research, more money more awareness is needed. The European Parliament stated this in a resolution, adopted with a large majority this month.

The Zika virus is seen as the cause of a trail of misery, mostly in tropical countries. The World Health Organization (WHO) considers it the prime suspect for the increasing number of babies born with too small heads (microcephaly).

Starting among monkeys in the Zika forest in Uganda, the virus has spread to humans in Africa, then Asia, the Pacific and now the Americas.

In 2014 in French Polynesia, the arrival of the virus coincided with a remarkable rise in microcephaly. Now in Brazil there are also indications of a similar rise, although not all numbers are yet confirmed. It seems the microcephaly occurs more often when the mother gets the Zika virus in the early months of the pregnancy.

In Europe, a few cases of autochthonous Zika virus transmission have been reported. A group of researchers from Slovenia presented a first case of mother-to-fetus Zika transmission. A 25 year old woman had her pregnancy terminated due to microcephaly.

In this case it was a woman who had travelled outside Europe. But the WHO warns that a certain mosquito, that could transmit the Zika virus, is also common in Southern Europe in summertime.

Some say we should wait until further evidence emerges about the link between Zika and microcephaly. However, the European Parliament does not agree. Our opinion is, better safe than sorry.



European Parliament MEP
Annie Schreijer-Pierik

We have no time to waste in protecting young mothers and their babies outside and inside the EU – only in the EU 5 million babies are born every year.

But how could we fight the Zika virus before it gets out of control? All we can do now is focus on prevention and control: trying to terminate the mosquito's from transmitting the virus, by using repellents, mosquito nets, sprays and eliminating breeding sites. The European Parliament favours free distribution of nets.

An approved vaccine is not available yet. The European Commission mobilised €10m (Just under £8m) for research on this virus. This amount is by far too small. More money should be allocated from the huge research funds of the EU, like Horizon2020.

Most EU Member States have asked pregnant women to delay travels to Zika affected areas. Our parliament resolution calls for more awareness of clinicians and travel health clinics. We also ask on EU Member States and the European Commission to enhance vigilance towards early detection of imported cases from the EU overseas countries and territories.



Cargo carriers should increase levels of disinsection of their cargo, to help keep the mosquitos out.

Despite the clear indications from WHO about the Zika virus, some politicians of Green parties in the European Parliament tried to shift the focus to pyriproxifen. The chemical that is widely used against insects, including ants and mosquito larvae. This product came into the picture because of the Argentinian press, which mentioned a report that pyriproxifen could be the cause of the rising number of microcephaly in Brazil, which resulted in a state in Brazil suspending its use in their water supply.

One could say the EU would have to ban this chemical as a safety precaution. But I don't agree, as long as there are no leading experts pleading for this. On the contrary, the Brazilian ministry criticised this state decision, the Argentine authors of the report stated they were misinterpreted and the WHO doesn't suspect this chemical. I think we should follow experts and not rumours. Most politicians are not scientists themselves.

In the debate in the European Parliament sexual prevention also became an issue. Some liberals and

left wing MEPs stress the importance of condoms and abortion, as a prevention against the Zika virus. Indeed there are rare reports about the virus being transmitted via sexual intercourse. But I think decisions about abortion are very personal and substantial, and EU politicians should neither interfere with the national values on this controversial theme.

We do understand Europe has more crises to deal with than the Zika virus alone. For example, the attacks in Brussels, the conflicts in Syria and Ukraine, the migrants entering Europe – and not to forget the financial crises. Nevertheless, our citizens count on us to prevent a crisis and not just to deal with the present ones. ■

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www.europarl.europa.eu/meps/en/125030/ANNIE_SC_HREIJER-PIERIK_home.html

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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Understanding the effects of the Zika virus

Laura Merson and Stephen Kennedy from the University of Oxford highlight a new online data-sharing platform for images of fetal and newborn heads in the context of the Zika virus outbreak...

In November 2015, the Brazilian Ministry of Health reported an unusual increase in the number of babies born with microcephaly in the north-eastern states of the country, during a Zika virus outbreak. The worst affected state was Pernambuco, where the incidence of microcephaly that year was 77 times higher than in 2010-14.

Microcephaly literally means a smaller head than expected for a baby's age and sex. It is a clinical sign, not a disease in itself. However, when the baby's head is very small, the condition is associated with brain abnormalities due to a range of possible genetic, environmental and infectious causes (including, almost certainly, Zika virus).

On 1st February 2016, WHO declared, on the advice of an Emergency Committee of the International Health Regulations, that the cluster of cases of microcephaly and other neurological disorders in Brazil, following a similar cluster in French Polynesia in 2014 associated with Zika virus, met the conditions for a Public Health Emergency of International Concern (PHEIC).

In a Lancet article published a week later, the emergency committee emphasised how little was actually known about the effects of Zika virus infection on, for example, the development of the baby's brain during pregnancy.¹ They also felt that the lack of a clear definition of microcephaly was hampering research efforts. This comment arose because, at the start of the outbreak, microcephaly was being defined on the basis of head circumference criteria alone, i.e. without taking into account the sex and gestational age of the baby at birth.

A group of Brazilian epidemiologists then demonstrated that the initial definition of microcephaly almost

certainly led to considerable over-reporting of cases through the inclusion of normal babies with small heads, including many born prematurely.² Given that over-reporting of suspected cases can lead to parental anxiety, unnecessary terminations and wastage of precious health care resources, the epidemiologists urged the international community to adopt the recently published INTERGROWTH-21st international Newborn Size Standards that are gestational age and sex specific.³

“In simple terms, we aim to determine whether the size and shape of fetal and newborn heads can be measured accurately by analysis of images alone, and whether there are any facial features (similar for example to those found in Down's Syndrome) that are characteristic of microcephaly due to infection with Zika virus, as opposed to one of the many other causes.”

In addition, the emergency committee stressed the importance of creating a confidential environment for openly sharing data with the scientific community so that maximum knowledge can be extracted from all available datasets. The recommendation is based upon the fundamental premise that every researcher generating information related to a public health emergency has a moral obligation to share the primary data. A group of international stakeholders have even declared that 'timely and transparent pre-publication sharing of data and results during public health emergencies must become the global norm – using modern fit-for-purpose pre-publication platforms'.⁴

As we jointly have extensive experience of developing data-sharing platforms in emerging infections and standards for measuring fetuses and newborn babies,

Image: © EPA/ANTONIO LACERDA



we submitted an innovative proposal to the UK Medical Research Council (MRC) and Wellcome Trust 'rapid response' funding initiative to tackle the global threat posed by the Zika virus.

In 2 weeks, we assembled a multi-disciplinary team of clinician scientists, epidemiologists, geneticists, engineers, computational biologists and radiologists from Brazil, the USA and UK.⁵ Our proposal, which was recently funded, was to build a secure, online, digital information platform for transferring, storing and analysing anonymised 2D and 3D photographic, ultrasound, CT and MR images of fetal and newborn heads (plus associated clinical data) from studies already initiated by the Brazilian Medical Genetics Society Zika Embryopathy Task Force (SBGM-ZETF) and Microcephaly Epidemic Research Group (MERG).

The rationale for the platform is to enable researchers to mine and interrogate the participant level data so as to: 1) Improve the characterisation and objective assessment of fetal and newborn heads against INTERGROWTH-21st gestational age specific standards; 2) Explore, as potential diagnostic markers, the facial characteristics of newborns and infants with suspected microcephaly, and 3) Facilitate research into the causal association between Zika virus infection in pregnancy and microcephaly.

In simple terms, we aim to determine whether the size and shape of fetal and newborn heads can be

measured accurately by analysis of images alone, and whether there are any facial features (similar for example to those found in Down's Syndrome) that are characteristic of microcephaly due to infection with Zika virus, as opposed to one of the many other causes.

Our consortium faces an interesting set of challenges. Some are unique to this project, e.g. how to anonymise photos of newborn babies; many others have been encountered by other data-sharing projects. First and foremost, however, we must establish an appropriate ethical and governance framework to protect the patients and their families. As custodians of the dataset, we also have a responsibility to ensure that the data are utilised meaningfully; that the contribution of those who generated the data is recognised in all resulting publications; that wherever possible the project enhances research capacity in the Zika-affected countries, and that relevant findings are communicated rapidly to parents to reduce the impact of the outbreak. ■

¹ Heymann DL, Hodgson A, Sall AA, et al. Zika virus and microcephaly: why is this situation a PHEIC? Lancet 2016; 387(10020): 719-21.

² Victora CG, Schuler-Faccini L, Matijasevich A, Ribeiro E, Pessoa A, Barros FC. Microcephaly in Brazil: how to interpret reported numbers? Lancet 2016; 387(10019): 621-4.

³ <https://intergrowth21.tghn.org>

⁴ http://www.who.int/medicines/ebola-treatment/blueprint_phe_data-share-results/en/

⁵ <http://www.obs-gyn.ox.ac.uk/news/uk-trebles-funding-to-tackle-zika-virus>

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Underscoring the pharmaceutical industry's commitment to combatting AMR

Richard Bergström, Director General of the European Federation of Pharmaceutical Industries and Associations (EFPIA), highlights the importance of collaborative efforts to tackle antimicrobial resistance...

Antimicrobial resistance (AMR) represents one of the most significant threats to global public health and also one against which the pharmaceutical industry is committed to fighting. In order to address this effectively, though, healthcare stakeholders need to alter former approaches to the issue and embrace new solutions.

The World Health Organization already expressed serious concerns about the rise of AMR in 2014. At that time, it warned that without urgent, coordinated action, the world was hurtling towards a post-antibiotic era, in which common infections and minor injuries could once again kill. The European Commission has also suggested that if the current trend is not altered, 300 million people worldwide are expected to die prematurely because of drug resistance over the next 35 years.

The industry's determination to rise to the challenge of AMR has therefore been outlined comprehensively in the Declaration by the Pharmaceutical, Biotechnology and Diagnostics Industries on Combating Antimicrobial Resistance, which was launched on 21 January 2016, at the World Economic Forum in Davos, Switzerland. The agreement was signed by 85 companies and 9 industry associations, representing the global pharmaceutical, diagnostics and biotechnology industries in 18 different countries.

The value given to antibiotics and diagnostics rarely reflects the investment required to develop them. There is an urgent need for investment via coordinated global routes, targeting the development of diagnostics, antibiotics, vaccines, and alternative technologies. Our declaration therefore calls on governments to work

with industry with a view to creating new and alternative market structures that provide more dependable and sustainable market models for antibiotics, and to commit the necessary funds to implement them.

By creating investment mechanisms in the antibiotics research and development sector, these ultimately will provide appropriate incentives – along with safeguards to support antibiotic conservation – for companies to do this. Increased focus on research and development (R&D) will enable them to overcome the formidable technical and scientific challenges of antibiotic discovery and development.

These include mechanisms to ensure that, where appropriate, the pricing of antibiotics can more adequately reflect the benefits they bring. In line with the European pharmaceutical industry's drive towards creating outcomes-driven health systems, we believe that health systems should only pay for success.

It is also essential to develop novel payment models that reduce the link between the profitability of an antibiotic and the volume sold, thereby decreasing the need for promotional activity by companies.

Solutions to the AMR conundrum are unlikely to be realised without the adoption of a "one health approach". This means harnessing the collaborative effort of multiple disciplines at local, national and global level, including the pharmaceutical and diagnostics industries, health technology assessment bodies, regulators and payers.

There is also an extensive network of European collaborative projects within the framework of the Innovative Medicines Initiative (IMI), the world's largest public-private partnership in the life sciences sector, which is funded jointly by EFPIA and the European Union. These projects, which address the challenges of antibiotic resistance, form the New Drugs for Bad Bugs (ND4BB) programme and focus on the following key obstacles to the discovery and development of new agents, designed to prevent and treat resistant bacterial infections.

There are in fact 7 projects launched within ND4BB that cover all the key areas of antibacterial R&D: COMBACTE; TRANSLOCATION; ENABLE; DRIVE-AB; COMBACTE-CARE; COMBACTE-MAGNET; and iABC. More information on these projects is available here:

<http://www.imi.europa.eu/content/ongoing-projects>

Finally, industry understands that creating high-quality antibiotics is simply not enough if we cannot improve access and availability to all. We support mechanisms that will ensure affordable access to new and existing antibiotics to the patients who need them, in all parts of the world and at all levels of income. Already in place are a series of international programmes that have to date enjoyed considerable success in improving global access to drugs in HIV, TB, and malaria. What we need going forward is a comparable collaborative effort to address issues of access to antibiotics.

About the Author

Richard Bergström was appointed Director General of the European Federation of Pharmaceutical Industries and Associations (EFPIA) in April 2011. Over the past 20 years, he has worked for Roche, Novartis, and with the Swedish pharmaceutical industry association (LIF). A pharmacist by training, he received his MScPharm degree from the University of Uppsala, Sweden in 1988. Since 2006, he has been an advisor to the World Health Organization on Good Governance in Medicine. ■

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The antibiotic apocalypse – can heterocyclic chemistry help?

I've spent a whole career teaching and researching in the field of heterocyclic chemistry. Heterocyclic chemistry is intrinsically interesting to scientists like me, but perhaps intimidating to the lay person. If you're in the latter class, have a look at my [e-book](#) published by Adjacent Government, which explains how heterocyclic chemistry works with reference to the field of drug discovery. However, these days, probably more important than the science itself is the context in which it works. Heterocyclic chemistry is behind many technologies most notably today in electronics and medicine.



Heterocyclic Chemistry as imagined in an embroidery by the author's mother, Margaret Suckling. The components represent organic chemistry (the tetrahedra) porphyrins (purple structures), quanta of light, DNA helices, and molecular recognition chemistry (the key, to drug discovery)

Here I want to highlight what has been referred to sensationally but perhaps justifiably as the 'Antibiotic Apocalypse'. Media features, scientific

papers, and official government sponsored reports all paint the same picture in different ways and with appropriately differing emphasis. For most of us, most of the time an Antibiotic Apocalypse is as remote as a universal apocalypse but for many people, especially those otherwise ill and with weakened immune systems, it is real and immediately life-threatening. Every time I talk to my clinical colleague, Dr Stephanie Dancer, who is a consultant clinical microbiologist at an NHS District General Hospital in central Scotland, her frustration at being unable to help patients with life-threatening infections because of the lack of effective antibiotics is both challenging and moving. When you get closer to people afflicted by incurable infections the Antibiotic Apocalypse transforms from a media feature, scientific discourse, or an official pronouncement to an imperative for action. We are all vulnerable. A world without antibiotics is a public health issue.

Don't just stand there – do something!

Having issued the order, what are we doing about it? What does heterocyclic chemistry contribute in this context? Coping with microbial resistance has many aspects. It's inevitable that sooner or later bacteria, fungi, viruses and other infective agents including parasites will become resistant to available drugs. Those infective individuals that are not killed by the drug will multiply and form a resistant population. It's an aspect of natural selection and there are many possible mechanisms that can lead to

resistance. The more extensively an antibiotic is used, the more rapidly resistance can be expected to develop. One approach, therefore, is to manage carefully the use of antibiotics, so-called antibiotic stewardship. It's something that can be tackled by health care providers – especially in the public sector, and regulators and is easier to do for human health than for animal health.

Management of the use of antibiotics is, of course, beyond the range of heterocyclic chemistry itself, although colleagues at the University of Strathclyde led by one of our pharmacists, Professor Marion Bennie, are playing a major role in this aspect in Scotland. There are two particular contributions of heterocyclic chemistry, both active topics of research and development at Strathclyde that face up to the Antibiotic Apocalypse. The first is getting the right antibiotic to the patient in the shortest possible time; in this case, the heterocyclic compounds are essential components of an advanced analytical technique to identify the infecting organism. The second is providing the clinician with new antibiotics that have been developed to have the best chance of avoiding the rapid emergence of resistance; in this case, the heterocyclic compounds make up the new antibiotic itself.



Setting up assays for new drugs

Speeding up the diagnosis of infection

Getting the right antibiotic to the patient requires knowing what the infection is. In a traditional clinical laboratory, this has to be done by microbial culturing to grow the infectious agent and identify it by microscopy and test the effects of available antibiotics on it, a process that can take days. All the while, the patient may become more and more poorly. Is it possible to get useful information in a matter of hours so that the right antibiotic can be rapidly deployed? This is something that my colleagues Professors Karen Faulds and Duncan Graham have been developing at the Centre for Molecular Nanometrology at the University of Strathclyde.

The Centre is now housed in the University's Technology and Innovation Centre about which Professor Graham writes: 'Intensive collaboration between experts in a range of fields is central to research which achieves positive, lasting results for patients. This is fundamental to the approach which is being taken at the Technology and Innovation Centre.'



<http://www.strath.ac.uk/research/technologyandinnovationcentre/>

Research at the Centre (and also elsewhere) has found that using a detection method known as Surface

Enhanced Raman Spectroscopy (SERS) it is possible to detect the presence of several different bacterial pathogens at once in a biologically relevant sample. This method relies on the exquisite intrinsic sensitivity of the SERS technique coupled with heterocyclic dye molecules suitably tailored to reveal the contents of the mixture. For example, three bacterial meningitis pathogens, from *Neisseria meningitidis*, *Streptococcus pneumoniae*, and *Haemophilus influenzae* were detected in a single sample by SERS analysis of their DNA. It is not fanciful to suggest that this sort of analysis might be developed for front line clinical use. Indeed, based upon research into SERS methods at Strathclyde, Renishaw diagnostics has launched a multiplex assay system for the qualitative detection of the DNA from the fungi of *Candida* and *Aspergillus* species. Using this technology, assay can be speeded up from days to a matter of hours, which is a major advance. Analysis at the bedside or in the clinician's office has yet to be fully developed but, with heterocyclic compounds playing their part, we can see this technology coming. When the diagnosis is clear, as these technologies promise, the doctor can prescribe the best treatment rapidly to the benefit of the patient.

New antibiotics from Strathclyde

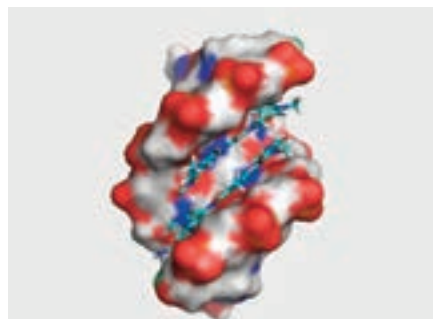
The best treatment may be an established antibiotic. On the other hand, it is likely that antimicrobial resistance may have been identified, in which case new antibiotics are needed. This is where my own team's work comes in. We're vigorously engaged in the

study of a class of compounds that bind to DNA known as minor groove binders (MGBs) and we refer to the compounds designed and synthesised at Strathclyde as S-MGBs. This study has yielded a rich harvest of anti-infective compounds that can be targeted at bacterial, viral, or parasitic diseases, all of which need new treatments because all show resistance to established drugs. We obtain our selectivity of action and avoid toxicity by taking advantage of the vast range of available structures in heterocyclic compounds. A sort of molecular mix and match allows us to find compounds with the required profile.

Working with colleagues around the world (including Australia, South Africa, India, and Switzerland) in universities and industry the S-MGB collection now has lead compounds for the treatment of Gram-positive bacterial infections in general, tuberculosis, animal African trypanosomiasis, and malaria. The front runner by some distance is a compound known as MGB-BP-3, which is licensed to a small Scottish company, MGB Biopharma. <http://www.mgb-biopharma.com/>. Excitingly, MGB-BP-3 recently completed Phase 1 clinical trials in an oral formulation for the treatment of *Clostridium difficile* infections. MGB Biopharma is now working hard to set up the Phase 2 trial for efficacy in late 2016. This development was highlighted in a BBC Scotland feature (<http://www.bbc.co.uk/news/uk-scotland-34106754>).

We will continue to work with MGB Biopharma in the discovery of other

antibacterial drugs for which we have active but un-optimised S-MGBs, notably to treat Gram-negative bacterial infections and tuberculosis. For tuberculosis, academic colleagues at the University of Cape Town, South Africa, have shown that a new class of S-MGB in which we have included an unusual heterocyclic component, contains significant leads.



Representation of S-MGBs (stick image) binding to DNA (solid image)

At Strathclyde, we're optimistic that by harnessing heterocyclic chemistry in the ways that I have described and in others, we'll be able to make a big contribution to avoiding the Antibiotic Apocalypse and thereby support the best possible quality of life for millions of people and their livestock around the world.

Image: © MGB Biopharma



Filled capsules of MGB-BP-3



Antimicrobial therapy also includes drugs to treat parasitic diseases and in our research we have found compounds of interest to treat malaria and infections caused by trypanosomes. The significant things about the antimalarial S-MGBs are that they have different structural features from the antibacterial compounds, suggesting that we can get selectivity, and that they are active against strains that are resistant to current available drugs. This encourages us to take this work forward, which we are doing in collaboration with academic partners at the University of Queensland, Australia.

It's not just human health for which there are problems with antimicrobial

resistance. Arguably, because of indiscriminate use of antibiotics, the challenges are greater in animal health, upon which the livelihood of millions of people worldwide depends. We've been working with colleagues at the University of Glasgow, the Swiss Tropical and Public Health Institute in Basel, and Galvmed, a not-for-profit company dedicated to animal health, to discover compounds to treat sleeping sickness in animals caused by parasites known as trypanosomes. Trypanosomiasis in cattle is a devastating disease not only for the animals but also for the human populations that depend upon them. We have achieved proof of concept in animal models that S-MGBs are able to treat successfully one species of infection of cattle. Moreover, as with malaria, we can treat strains resistant to existing drugs and have found that S-MGBs work by a different biological mechanism from existing drugs, all of which encourages further development. We are about to start on a three year collaborative programme to tackle this funded by the UK's Bioscience and Biotechnology Research Council led by Prof Mike Barrett at the University of Glasgow.

Image: © ILRI



A cow suffering from trypanosomiasis



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Virtual Reality based therapies

Scott Lowe, General Manager – North America at Psious explains
how Virtual Reality technology can help with health issues such as anxiety...

There may not be a “typical” anxiety patient profile, but many people suffer from anxiety who firmly believe they have no use for therapy – which could offer a cure for their ailment.

Let’s take the example of Kevin, a fast-rising executive who has a habit of confronting his fears head-on. He leads large teams and has developed a reputation as a fair but confrontational boss, capable of inciting strong performances in others through his own strong example.

In his late thirties, Kevin’s frequent duty to travel by plane caused him to experience a gradual but steady increase in anxiety and stress. Particularly when the travel was urgent and without time to plan, his fear of flying came to be the only thing in life that could make him lose control. The symptoms of panic – racing heartbeat, uncontrollable sweat, a focus on the worst possible outcome – seemed so ingrained as to be a fact of life.

Many people like Kevin, with no other anxiety symptoms, seek situational relief from anti-anxiety drugs, with a variety of side effects to monitor but more importantly, which only offer symptomatic relief. In fact, such treatment can eventually backfire, exaggerating the sense of helplessness when unavailable, as with Kevin’s short-notice trips. In the end, people like Kevin often deal with triggering situations by avoiding them, living life with the limitations of anxiety and panic.

Pharmaceuticals do not address the root cause of the problem, and in fact can attenuate the outcome of clinical therapy. Clinical therapy, on the other hand, offers a path to permanent resolution, but requires commitment and can be taxing and unpleasant.

The treatment of reference for extinguishing anxiety

related to specific fear is exposure therapy, consisting of 2 steps: imaginal and in vivo exposure. Imaginal exposure uses guided imagery to have the patient process thoughts related to their anxiety, while in vivo exposure is the gradual integration of lived experience to the treatment hierarchy. Both techniques present difficulties for both patient and therapist: therapists experience dropouts and resistance due to the inherent stress of guiding patients through the process, and patients can find the work of imaginal therapy arduous and stressful, while in vivo exposure can be costly or impossible (think of Kevin’s potential therapist accompanying him on a commercial flight). Most importantly, the kinds of specific fears that can be treated by therapy often co-occur with general anxiety, and patients can come to believe their specific fears are unfixable, instead practicing avoidance behaviours that only exacerbate their symptoms when eventually confronted.

Searching for alternatives to long-term therapy, Kevin discovers that technology offers a new way to achieve progress through the established protocol of exposure therapy. Virtual Reality-based therapies have been researched for decades, establishing their fundamental viability for exposure therapy and a now expanding suite of clinical psychology applications. While virtual reality is an emerging consumer technology, it actually refers to any system that can reliably give a sense of presence in a different place, and the means to achieve this presence go beyond the visual and auditory – in the future, it will commonly include reinforcement of smells and tactile sensations. Although complex systems will evolve, past research shows that Virtual Reality (VR) does not need realism to be clinically effective – rather, it has to replicate the physical dynamics and cues of stimuli. With increasing fidelity and quality affordably available, patients are finding recent therapy applications even more effective at stimulating anxiety



– or, if the therapist chooses, to have them practice immersive relaxation.

The reason it works is simple – Virtual Reality provokes a similar physiological response as the corresponding live experience. Since the primary mechanism for exposure therapy is to recondition the patient's response to stimuli, Virtual Reality achieves this by exposing patients to fear in digital form. Among the repeated findings of VR psychology research is that patients find it more manageable than imaginal and in vivo exposure, increasing effectiveness both by its nature and by resulting in more completed courses of therapy, compared to imaginal or in vivo exposure. The patient understands they are safe in a clinical setting, yet the symptoms of panic appearing from a virtual experience present an opportunity, a space within which the therapist can work with cognitive behavioural therapy and other protocols to retrain the patient's cognition of situational stimuli.

More powerfully, it is bringing long-suffering patients like Kevin, who did not previously consider rigorous therapy, into the clinic for the first time. By word of mouth among patients and therapists, VR therapy has made the leap from theoretical to clinical usefulness, a potent option for getting directly to the source of the problem and allowing the patient to practice – the

aspect of the therapy that appealed to Kevin. VR therapy even has the potential to allow therapists to work online with severe social phobia patients, for whom the very trip to the therapist's office may present unmanageable anxiety and cause avoidance.

Technological evolution and proliferation is sometimes maligned as adding to complexity in modern life, contributing to anxiety by giving reinforcement designed to perpetuate its use. In this case, our patient Kevin is suffering from a phobia owed partially to technology and his life's complexity, in particular an expectation of regular travel. However, with fundamental science validating technological treatments in virtual reality, coupled with leaps in low-cost computing power, best practices in anxiety are achievable right now by a growing class of therapists trained to potentiate their existing expertise with one of the few truly groundbreaking technology applications in clinical psychology: Virtual Reality . ■

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Point-of-care ultrasound for intravenous access

Patients presenting to the Emergency Department (ED) may have characteristics that impede intravenous (IV) access. Such characteristics may include hypotension, dialysis dependence, morbid obesity, or a history 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.¹ If peripheral IVs are not established, patients may need a central venous catheter placed for life saving medications to be 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.² 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.³

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 typically flanked by 2 smaller veins and the median nerve. Anatomically, these structures are medial to

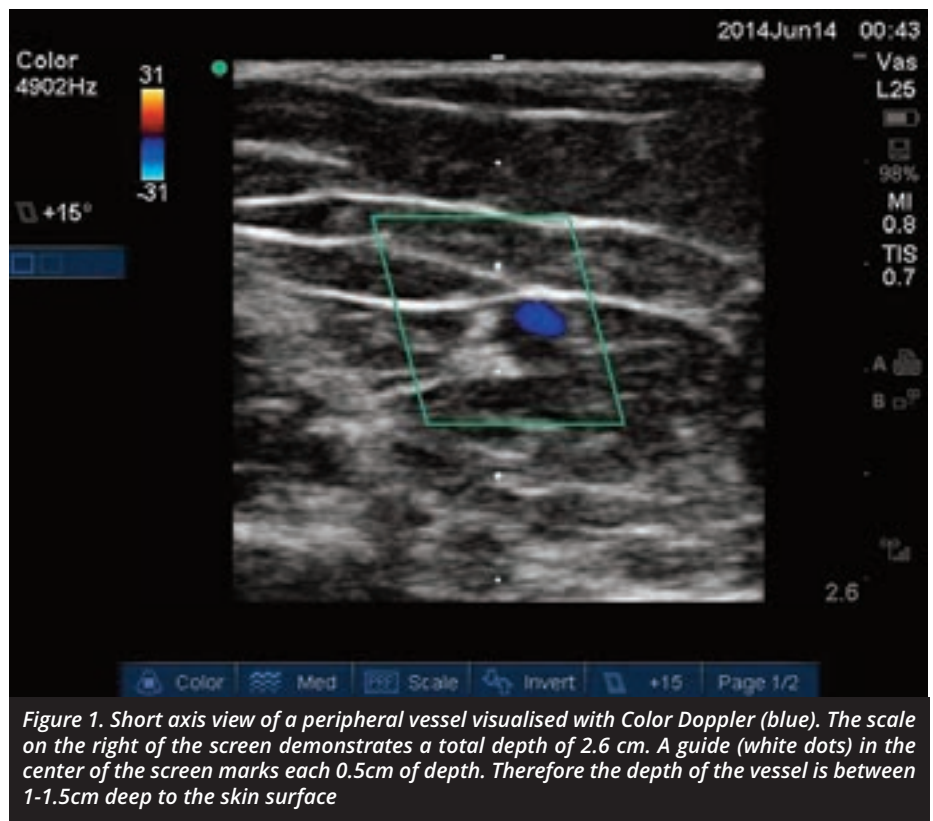


Figure 1. Short axis view of a peripheral vessel visualised with Color Doppler (blue). The scale on the right of the screen demonstrates a total depth of 2.6 cm. A guide (white dots) in the center of the screen marks each 0.5cm of depth. Therefore the depth of the vessel is between 1-1.5cm deep to the skin surface

the insertion of the medial biceps tendon. This tendon is palpable in the antecubital fossa as the patient flexes 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 bone, and longer angio-catheters may be required for cannulation.

When considering vascular access, there are 2 views, a short and long axis view. 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. Figure 1 identifies a vessel using color Doppler in the short axis view. Figure 2 demonstrates a long axis view with the needle and tip seen in the vessel. While both short and long 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

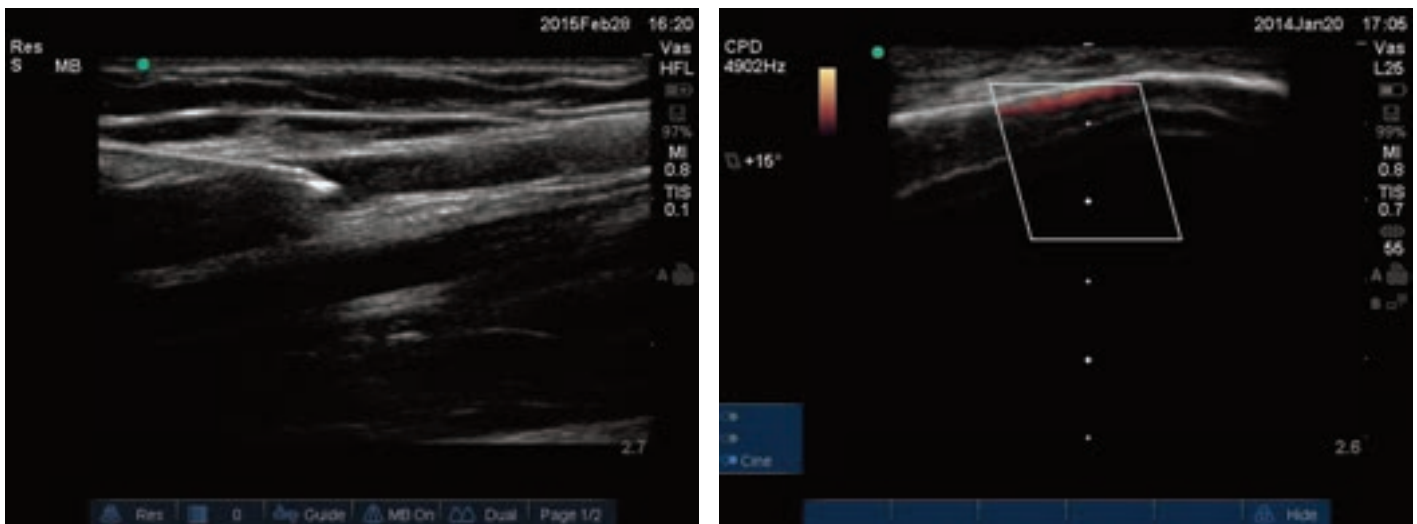


Figure 2. (Left) Long axis view of a peripheral vessel. The hyperechoic needle is visualise approaching from the top left of the screen into the vessel lumen. Figure 3. (Right) Power Doppler (orange) confirms placement of an intraosseus line within the distal tibia. The bright white line of the tibia cortex (in long axis view) is visualised at the top of the screen, with flow confirmation from a 10cc saline flush immediately distal (below) to the hyperechoic cortex

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 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 that 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 angio-catheter 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, it is recommended to first bounce 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. Figure 3 demonstrates confirmation of intraosseous (IO) lines utilise Power Doppler. A 10cc saline flush is rapidly pushed through the line, and flow is demonstrated beneath the bony cortex in this adult tibia. If the line is improperly placed, the blush of color using Doppler would appear in the soft tissues.

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

¹ Fields, J.M., Piela, N.E., Au, A.K., Ku, B.S., Risk factors associated with difficult venous access in adult ED patients. *Am J Emerg Med.* 2014 Oct; 32(10):1179-82.

² Au, A.K., Rotte, M.J., Gzybowski, R.J., Ku, B.S., Fields, J.M., Decrease in central venous catheter placement due to use of ultrasound guidance for peripheral intravenous catheters. *Am J Emerg Med.* 2012 Nov;30(9):1950-4.

³ Schoenfield, E., Shokoohi, H., Boniface, K. Ultrasound-guided peripheral intravenous access in the emergency department: patient-centered survey. *West J Emerg Med.* 2011 Nov;12(4):475-7.



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Dental diagnostics system (DDS)

Providing clear information for patient and provider...

Our medical colleagues have been capturing the causes of death for centuries using standardised diagnostic terms. The first international conference to revise the International Classification of Diseases (ICD) was convened in 1900. In 1948, the World Health Organisation (WHO) took responsibility for the now renamed International Classification of Diseases, Injuries, and Causes of Death with the sixth edition. The WHO expects to launch ICD-11 in 2020. Oral health diagnoses are classified in the early and current revisions of ICD. However, they are not granular enough and difficult to find throughout the ICD volumes. Additionally, the dental profession does not mandate documentation of a dental diagnosis as part of the billing process and consequently, diagnoses are not captured in a structured format. Hence, until recently dentistry did not capture why a tooth becomes non-vital or why it had to be extracted, much to the disadvantage of clinical dentistry, dental public health and dental quality improvement efforts.

Several attempts to address this problem have been made throughout the years, including the development of the Toronto codes in 1999 and the Systemised Nomenclature of Dentistry (SNODENT) by the American Dental Association (ADA). SNODENT, which is integrated into SNOMED, has proved largely ineffective as a chair-side terminology, not least because it is

composed of more than 7,000 terms, is not widely available and is yet to be finalised.

“The DDS aligns dentistry with medicine, in terms of establishing standard clinical practice. Enabling diagnoses to be clearly recorded after examination and providing care is important to facilitating communication between clinicians, patients, epidemiologists, researchers and students.”

To meet the need for a comprehensive yet concise set of dental diagnostic terms, a happy medium between ICD sparseness and SNODENT/SNOMED enormosity, an academic workgroup came together in 2009 to create and implement the EZCodes dental diagnostic terminology, later renamed Dental Diagnostic System (DDS). Key motivators included the dire need for the dental profession to enter a diagnosis in the patient record that is clear and can be used to inform both the provider and the patient. A standardised terminology can capture a granular diagnosis in the electronic health record (EHR) that then helps inform the providers of the specific treatment procedures appropriate for the chosen diagnoses. For the patient it will specify information why a certain procedure is being done, by providing detailed reasoning behind each procedure. From an educational perspective, it allows faculty to create a diagnostic-centered academic

approach that will facilitate students to learn.

Led by Dr. Elsbeth Kalenderian from Harvard School of Dental Medicine, an academic workgroup developed the first diagnostic interface terminology specifically applicable to the field of dentistry. The Dental Diagnostic System (DDS) – formerly known as EZCodes, contains dental diagnostic terms at the granularity level required by practicing dentists chair-side. Developing the DDS terminology was an iterative process that began with the University of California, San Francisco School of Dentistry’s Toronto Z skeleton, as it was representative of dental clinical practice. The Z Codes were based on the original Toronto codes proposed earlier, but never widely adopted. This Z skeleton was then populated with concepts from the American Academy of Periodontology, the American Board of Endodontics, UCSF own Z codes and International Classification of Disease terms to ensure adequate concept orientation. The first version of the DDS diagnostic terminology was produced following two rounds of discussion with domain experts and subsequent review by the workgroup. This produced DDS-2010 with 1,158 terms in 13 categories and 78 sub-categories. Subsequent revisions produced a robust DDS terminology with DDS-2015 consisting of 1589 terms, in 17 categories and 107 sub-categories.



Members of the workgroup include Drs. Joel White, Muhammad Walji, Oluwabunmi Tokede, Maxim Lagerweij, and Rachel Ramoni. All are united by a common goal to improve dental research, education and patient care by creating a go-to terminology for clinical and public health research. There were several considerations for the workgroup members to take into account during the process of developing a terminology that should be easy to use in the clinic and be usable for research through secondary data analysis. First and foremost, the team must ensure that clinicians use the standardised terminology consistently and accurately. Hence the DDS research team completes ongoing validation and measuring of DDS utilisation.

The DDS aligns dentistry with medicine, in terms of establishing standard clinical practice. Enabling diagnoses to be clearly recorded after examination and providing care is important to facilitating communication between clinicians, patients, epidemiologists, researchers and students. While the

standardisation of dental diagnostic terminologies is of obvious benefit to dentistry, it is important that additional consideration is given to how the terminology will be shared. Facilitating and encouraging its use is key to the DDS realising its potential. With that in mind, NIH/NIDCR is supporting the development of the DDS implementation toolkit, which will enable the terminology to be rolled out to non-academic dental institutions and general practitioners.

Eighteen dental institutions from the US, Canada and Europe use the DDS for patient care, teaching and research. Ten additional schools are slated to implement the DDS terminology within the next year. Incorporated within axiUm, Exan Corporation's dental EHR, the DDS is available to almost every dental school in the US. Two other EHR vendors are revising their EHR interface in order to effectively upload the DDS. This as a result of pressure from their users who are concerned about government mandates to document a diagnosis as part of Medicaid

reimbursement requirements. The DDS has been shown to be useful and accurate, and its terms are routinely paired with dental procedures providing a treasure trove of usable data on dental diagnosis and treatment for appropriateness of care and outcome research.

The Dental Diagnostic System (DDS) terminology has been harmonized with the ADA's SNODENT reference terminology. As such, the DDS has been renamed SNODDS.

The DDS is a crucial component of the BigMouth Dental Data Repository (which houses data from six institutions with nearly 2 million patients). Structured data entry is essential for developing effective electronic data repository systems and helping clinicians and researchers use them in a meaningful way. With the creation of the DDS, the team has made this possible.



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The impact of healthcare fraud across the NHS

Dr Martin Tunley, Senior Lecturer in Counter Fraud Studies at the University of Portsmouth's Institute of Criminal Justice Studies outlines how healthcare fraud can be detrimental to the NHS...

Healthcare fraud is a global problem, and necessitates an innovative response, because without intervention, it can easily spiral out of control. A recent review of statistically valid fraud loss measurement exercises from around the world identified that the average loss to fraud and error is 6.19%¹. What does this mean for the NHS? When the global average fraud loss rate is applied to the proposed NHS expenditure of £116.6bn for 2015/16, this suggests that £7.21bn could be lost to fraud and error. Not only are these losses significant, but they also undermine the quality and degree of patient care, which can be provided. Accordingly, healthcare fraud within the NHS is a serious problem and it must not be underestimated or undervalued.

Whilst the structure of healthcare provision is significantly different, the types of healthcare fraud committed

against the NHS are no different to those committed in other countries, such as the US for example. The following are examples of the types of fraud committed against the NHS:

- Patients falsely claiming travel expenses;
- Staff may gain employment with false documentation;
- Staff may claim pay for shifts they did not work;
- NHS staff dishonestly working in another job when they are off sick;
- NHS staff making false and inflated expenses, mileage or time sheet claims;
- NHS staff procuring goods and services for personal

gain, such as ordering IT equipment or printer cartridges then keeping for their own use, or selling on the Internet or at car boot sales;

- Job applicants failing to disclose criminal convictions or providing false documentation such as qualifications, passports and Home Office documents to gain NHS employment;
- Patients claiming free treatment and services when not entitled, such as prescriptions/glasses/dental treatment; or 'health tourists' providing false personal details to gain hospital treatment;
- Contractors may exaggerate or falsify records of NHS work. Contractors and suppliers to the NHS submitting false invoices for work they have not done or submitting duplicate invoices for payment.

A notable similarity between the NHS and US healthcare providers Medicare and Medicaid, and one that gives cause for concern, is the increased use of private contractors to deliver healthcare services. This is not without its pitfalls, as economic and political science literature suggests that any government should expect an increase in fraud when any public services, such as healthcare, are contracted out from the state to the private sector². In fact, there is already evidence of major fraud by organisations charged with delivering healthcare provision for NHS England, which offers empirical evidence to support the argument that the system can be exploited for illicit gain, and increased use of 'for profit' organisations will only exacerbate this risk. The scandal surrounding the provision of out of hours GP care by a private contractor in Cornwall being one example.

So how can the NHS address the fraud problem? I suggest a 2 pronged approach. Firstly, by being proactive and seeking to pre-empt healthcare fraud. Accordingly, fraud loss measurement is the key, because it reveals the nature and extent of the problem and allows a proportionate and specifically focussed solution to be applied. Rather than simply reacting after fraud has taken place and losses have already been incurred, the

aim is to ensure that less fraud is attempted in the first place and that less opportunity exists where it still is. Where organisations have measured their losses, even the best performing organisations have been found to detect as little as one thirtieth of the total cost – something which should point us all in the direction of pre-empting fraud rather than trying to detect it all. Losses to fraud and error – described as 'the last great uncontrolled business cost' – can now be measured, managed and minimised like any other business cost.

In conjunction with these fraud loss measurement exercises, there is also a requirement for a tactical resource charged with investigating and prosecuting major frauds identified by loss measurement exercises. This sends a strong message to would be fraudsters, and will have the desired deterrent effect.

In sum, there is a need for a powerful, well resourced counter fraud infrastructure within the NHS. Taking the fraud problem seriously, and doing something tangible to address it, will make a material difference to the lives of NHS patients across the UK. ■

¹ Gee, J. and Button, M., 2015, The Financial Cost of Healthcare Fraud 2015: What Data from Around the World Shows, available at: http://www.pkf-littlejohn.com/media/documents/protected/PKF_Littlejohns_The_financial_cost_of_healthcare_fraud.pdf (accessed 29 October 2015).

² Button, M. and Leys, C., 2013, Healthcare Fraud in the New NHS Market – A Threat to Patient Care, Centre for Health and the Public Interest, London.

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Cross border fraud in healthcare: Blind spots on the map of Europe?

A recent report from the General Secretariat of the Benelux on patient mobility between Belgium, the Netherlands, Luxembourg, France and Germany shows that in 2015 more than 168,000 patients have crossed borders to seek healthcare in one of the neighbouring countries, for planned as well as for non-planned care (EHIC).¹

A European Observatory publication on “Cross border healthcare in the European Union” from 2011 refers to an estimate of as many as 2 million patients from within the European Economic Area (EEA) having travelled in 2005 to another EEA country for healthcare, generating a financial flux between all EEA countries of approximately €1.5 billion.²

The various forms of cross-border care are legally based on different EU frameworks which also define the rules for payment of healthcare provisions and for the financial fluxes between the country of origin of the patient and the country where the healthcare has been provided.

The most important of these are Regulation (EC) No 883/2004 of 29 April 2004 on the coordination of social security systems and Directive 2011/24/EU of 9 March 2011 on the application of patients' rights in cross-border healthcare.

According to Marion Del Sol, in the 2014 publication “EU Citizenship and Free Movement”, both the Regulation and the Directive establish a judicial

framework capable of reducing the risk of erroneous payment. This should ensure that patients' information is sufficiently recorded and properly transmitted. It should also enable institutions to detect errors by exchanging information with other institutions.

Compared to these advances, fraud control issues seem almost neglected by the present legislation³. This relates to patient mobility as well as to healthcare professionals crossing borders.

Patients crossing borders

Evidence of recent abuses of the European Health Insurance Card (EHIC)⁴ by patients raise concerns about the ability of the EEA countries to tackle the issue of fraud and about their willingness to exchange information on these matters:

UK and Dutch patients (131 in total) have been found to use their EHIC card in Belgium for planned care such as hysterectomy, myectomy, and knee and hip replacements over the years 2011 to 2015. The fact that the care was obviously planned made the use of the EHIC card to be fraudulent. Additionally, patients were residing (not temporarily) at 5 addresses only and the reimbursements were executed on a small number of joint accounts.

Belgian patients have been found to regularly “shop” in Dutch pharmacies for medication worth thousands of Euros (for example 1,544 prescriptions in January 2008 for an amount of €152,109). By presenting their EHIC

card patients are exempt of paying the copayment amount they normally pay in Belgium. The Belgian health insurance service reimburses the total amount of the medication to its Dutch counterpart, often at a higher amount than the cost of the medication in Belgium.

Neither the National Contact Points created in the context of the 2011 Patient Mobility Directive, nor the Points of Contact for Fraud and Error, created by decision H5 of the European Administrative Commission⁵, have been informed by the competent authorities of these fraud cases. As a consequence other EEA countries have not been alerted to the prevalence of these kind of infringements.

Healthcare professionals crossing borders

From 18 January 2016 on, healthcare regulators across the EU have to warn all other member states when a health professional is banned or their practice is restricted. According to article 56 of the Directive 2005/36/EC on the recognition of professional qualifications, “the competent authorities of the home and the host Member States shall exchange information regarding disciplinary action or criminal sanctions taken [...] For these purposes the competent authorities shall use the Internal Market Information System (‘IMI’).”⁶

However, in practice this alert mechanism remains restricted to information about “a professional whose pursuit on the territory of that Member State

of the following professional activities in their entirety or parts thereof has been restricted or prohibited, even temporarily, by national authorities or courts". Any other [administrative] sanction related to fraudulent activities but with no consequences for the healthcare professionals' license to practice is not subject to information sharing between competent authorities.

This is the reason why recently a French practitioner could move to Belgium and set up a new practice even though he had been sanctioned for defrauding the French healthcare system without disciplinary consequences. In this particular case the French competent authority did not alert the Belgian authority. This case is particularly remarkable because a bilateral agreement on information sharing between both countries had been concluded in May 2014.

For the same reason a Belgian orthopedic surgeon, after practicing in the UK, could start over again in Belgium although he had been sanctioned for defrauding a private health insurer in the UK, as there was no information exchange in this particular case between the Belgian and British competent authorities.

More and better use of the European information systems in place is therefore paramount in the effective control of fraud risks related to patient and healthcare professional mobility in Europe.

According to Gabriella Berki in her doctorate on cross border patient mobility⁷, it is essential, in order to prevent fraudulent and abusive behaviour of patients, providers and healthcare funds, that the competent institutions in the various Member States are in direct contact and support each other.

ABOUT EHFCN

EHFCN was formally established in 2005 as a not for profit international association under 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 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 sharing of good practice, joint work, bilateral agreements and the development of common working standards.

She agrees with Marion Del Sol on the idea that the key to effectively fight fraud and abuse in the field of healthcare is efficient inter-institutional cooperation. Moreover, a central coordinating institution would, according to Gabriella Berki, hugely contribute to the common work of both European and national institutions in that respect.

In the end this would help eliminating the blind spots of cross border fraud on the map of Europe.

1 Patiënten zonder grenzen, Grensoverschrijdende patiëntenstromen in de Benelux, January 2016

2 Cross border healthcare in the European Union, European observatory on Health Systems and Policies, 2011 – The data collected are incomplete for a number of countries.

3 Taking Measures Against European Healthcare Fraud, Marion Del Sol, Ch. 27, Eu Citizenship and Free Movement of Patients, 2014.

4 The EHIC Card entitles travelers to care in emergencies and for pre-existing conditions to be reimbursed by their healthcare funder.

5 Decision No H5 of 18 March 2010 concerning cooperation on combating fraud and error within the framework of Council Regulation (EC) No 883/2004 and Regulation (EC) No 987/2009 of the European parliament and of the Council on the coordination of social security systems.

6 The Internal Market Information System ('IMI') is a software application accessible via the internet, developed by the Commission in cooperation with the Member States, in order to assist Member States with the practical implementation of information exchange requirements laid down in Union acts by providing a centralised communication mechanism to facilitate cross-border exchange of information and mutual assistance – Regulation No 1024/2012 of 25 October 2012 on administrative cooperation through the Internal Market Information System and repealing Commission Decision 2008/49/EC ('the IMI Regulation')

7 Gabriella Berki: Cross border patient mobility: The legal framework of obtaining healthcare abroad within the European Union – a patients' perspective, 2015



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The tale of two ministers

Adjacent Government outlines how Canada is investing in science and research in order to make further advances in the arena...

In one of his first acts as the new Prime Minister of Canada, Justin Trudeau created a new post of Science Minister. Differing from the government before him, Trudeau appointed 2 ministers to posts committed to furthering science, research and innovation in the country.

The new post of Science Minister was taken up by Kirsty Duncan, who has a vast amount of experience in science herself. Trudeau also appointed Navdeep Bains as Minister of Innovation, Science and Economic Development.

As a potential leader in science and research, Canada is making great advances. And, in order to gain further ground, the 2016 Budget aims to support scientists in Canada to expand research excellence.

As part of [the Budget](#), the government are introducing new ways to support research which, includes investing €2bn to improve research and innovation infrastructure, and €95m to the granting councils to support research.

Last month, during a keynote address at the Canada Excellence Research Chairs (CERC) Summit, the Honourable Kirsty Duncan, highlighted the recent budget announcement of €95m to support discovery research – underpinning the Canadian government's commitment to all sciences.

This includes natural health sciences, social sciences and humanities, and this is the highest amount of new annual funding for this purpose in over 10 years.

"The government of Canada is proud to invest in the federal granting councils, which play a central role in supporting researchers, who in turn generate the

evidence needed to make sound policy decisions. Granting council funding programs, including the prestigious Canada Excellence Research Chairs (CERCs) programme, are cultivating the research talent we need to build an innovative and clean economy," said Duncan.

The Minister also highlighted how the government's investments in post-secondary research are integral for the country to keep on track for a sustainable future. Through federal funding from 3 granting agencies – The Natural Sciences and Engineering Research Council, the Social Sciences and Engineering Research Council, and the Canadian Institutes of Health Research – scientists are able to develop new technologies and approaches that are key to an innovative economy.

As well as the €95m highlighted above, the government have also committed an additional €20m to 2 new CERCs in fields related to clean and sustainable technology.

Ted Hewitt, President of the Social Sciences and Humanities research Council of Canada and Chair of the CERC Steering Committee also commented on the investments.

He said: "The government of Canada's commitment to social sciences and humanities research will support the country's innovation agenda, which relies not only on technology, but also on human creativity and understanding.

"Our researchers provide insight into the complex individual, social, cultural and economic issues surrounding technology, so that Canadians can embrace it and become early adopters."



Image: © Courtesy of the Embassy of Canada in Washington DC

STEM is an integral part of science and research and any country's economy. In Canada in particular, STEM and its workforce are vital to the creation of a prosperous knowledge economy.

In order to ensure this happens, the Canadian government wants to encourage young people to have a solid STEM foundation. The government believes that this is the way to ensure they are able to go forward and take on the knowledge based jobs of the future.

In January, [Duncan revealed in a speech](#) that, "she wants to help build a more vibrant science culture in Canada".

The Minister also outlined how she wants to encourage more female scientists to come to the forefront. She said: "I cannot tell you what it means to me to be part of a government that feels the same passion for young people and for getting them engaged in science.

"I was honoured to be named Minister of Science – the second female federal minister in Canada's history to have the word "science" in her official title. The other

was the incomparable Jeanne Sauvé. She was named Minister of State for Science and Technology in 1974, by the other Prime Minister Trudeau.

"I think this really highlights the importance our government puts on science and on women in science. It saddens me to say that only 22% of Canadians working in STEM fields are women. In 1987, it was 20%. That's an increase of 2% in nearly 30 years.

"I am not happy with this number, and it proves that we must do better and that we have a lot of work to do." ■

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Situated and Augmented 3D Cities

Worldbuilding is the construction of 3D worlds, for whatever purpose, that have realistic statics (i.e. the description of both the geometry (e.g. shapes) and semantics (e.g. names and purposes)) and dynamics (i.e. the description and efficient modelling of both the physical behaviour of the described and how that world's statics can be modified). Seen in this way, worldbuilding of a modern city would result in a model of use to gamers wishing to build a new game, to urban planners and engineers carrying out planning, and perhaps to geographers interested in demographics. Ideally, a single model would serve all of these purposes.

Even if significant research is still necessary for this to be realised, already few technologies are embracing this concept of a digital 3D city model capturing the complex spatial and temporal implications of urban life. The recent framework of smart cities has fostered the design of these solutions, where modeling and simulation tools are indispensable in responding to the challenges of an ever-increasing urban population. Smart 3D models of cities are required by city planners in order to optimise urban sustainability. They could provide analytical and exploratory functionalities in a decision-support context. However, they would need an increased level of detail compared to that of current virtual 3D city models. For instance, representations including geometric description of doors and windows rather than facades will improve simulation models dedicated

to estimating building energy efficiency. There is a need for data collection systems capable of providing such a level of detail and precision to large scale 3D city models.

The past few years have seen remarkable development in mobile laser scanning (MLS) to accommodate the need for large area and high-resolution 3D data acquisition involved in building a smart city model. The advantages of MLS data for high resolution 3D city models are obvious: MLS provides fast, efficient, and cost-effective data collection, accurate to a few centimetres out to hundreds of metres from the sensor. In addition, MLS data is a key enabler of outdoor augmented reality (AR) applications in urban contexts. Augmented reality overlays computer-mediated information on the real world in real time. This ability enriches environments for action and learning and offers the potential for new kinds of shared experiences.

Augmented reality deployed in the city is already foreseen as a disruptive technology. Indeed, this is a transversal technology with major improvement and innovation potential in various application fields (e.g. cultural, entertainment, urban planning sectors). AR can become a strong vector of economic activities. Some countries, like France, have already developed a national augmented reality plan and roadmap in order for the technology to boost competitiveness and profitability. The concept of the "Augmented City" has emerged from such initiatives. It stands for city space

enriched with information. The content, which can include historic information, personal stories, and commercial information, when added to space changes the experience of users with their urban environment, which becomes intrinsic. Users can interact with the world in a more meaningful and tangible way.

"...smart 3D city models are indispensable simulation and modeling tools to optimise urban management. From the acquisition standpoint, mobile laser scanning can bring a strong contribution to the efficient building of a smart 3D city model."

AR and Augmented City can have a significant impact on several sectors related to urban management and sustainability. One of them is that of utility locating technologies. Understanding underground assets remains vital for utilities and construction contractors. AR solutions offer the ability to make visible items in the environment that are not accessible to the naked eye. Such technology allows engineers to perform field tasks with the awareness of both the physical world (e.g. the ground and underground) and the synthetic world (e.g. 3D models of cables and pipelines aligned and blended with their real background). Other sectors in construction, architecture or engineering could benefit from such AR visualisation in order to monitor progress during a project construction phase, underline discrepancies between as-built and as-planned project, detect



defective infrastructure, and assist inspection of architectural structure, to name a few.

AR technology still has key challenges to overcome in outdoor and urban contexts: mobility, ergonomics, power limitations, adverse weather conditions, difficulties in term of spatial alignment of real and virtual entities (due to inaccurate positioning in urban context) and visual illusion of real and virtual world coexistence (due to moving obstacle and occlusion). Alternate mixed reality solutions exist. Situated simulation is among them. Its principles involve a 3D virtual model of the user location and environment displayed on a mobile platform. The view and the position in the virtual world follow dynamically, in real time, the user's movements. Thus, the viewpoint on the virtual model always matches the viewpoint on the physical world.

Situated simulation is less immersive than a true mobile augmented reality approach but offers more detailed 3D visualisation and rich interaction capabilities. Situated simulation is also less sensitive to phenomena

related to the external environment (occlusions, illumination changes). Situated simulation takes fully advantage of smart 3D models of cities. It provides a unique point of view on phenomena on a large scale.

As an example, we designed such a solution for a large urban planning project in Rennes, France, involving an entire district of the city. The high level of detail of the 3D models, the capability to see the environment from various perspectives, the user mobility, and displacement contributed to increase the user's sense of immersion and provided a better awareness of the impacts of this project on the urban landscape. Such technology can bridge the gap between citizens, urban developers and decision-makers in the context of consultations on future construction planning.

To summarise, smart 3D city models are indispensable simulation and modeling tools to optimise urban management. From the acquisition standpoint, mobile laser scanning can bring a strong contribution to the efficient building of a smart 3D city model. It is far more efficient than any

other known approach for building centimetre-scale models of large domains. As such, MLS offer great advantages for building the 'where' in situated and augmented urban applications. And situated simulation and Augmented Cities have the potential to revolutionise people's personal and professional lives by providing new and improved services at the city scale.



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http://www.crg.ulaval.ca/?page_id=851&id-Fonction=96

Looking beyond the Rhetoric of ‘Refugee Crisis’

What are the long-term impacts and transgenerational effects of violence?

After ten years of conducting interviews and field research with Punjabi diaspora communities in Frankfurt and Toronto, Professor Michael Nijhawan highlights the vulnerability, resilience and agency of young migrants as important change-makers in our contemporary world.

At a moment when the European Union seals its morally convoluted refugee relocation deal with Turkey and as we see how in North America the debate about admitting more refugees is triggering new moral panics around Muslims as potential terrorists, it is worthwhile to pause and take a deep look into how state policies of immigration affect the displaced and vulnerable even further.

This issue has been the focus of a Social Sciences and Humanities Research Council (SSHRC)-funded research project led by Michael Nijhawan of York University Toronto in conjunction with a similarly themed and funded conference on youth migrations in collaboration with Sociologist Ratiba Hadj-Moussa.

Selecting Frankfurt and Toronto as two global and interconnected cities that have been recognised for their progressive multiculturalist policies and vibrant migrant communities, Nijhawan situates migrant lives as they strive for legal and cultural citizenship. Working with Sikhs and

Ahmadis as religious minorities, he shows the multidimensionality by which violence affects migrant precarity.

Whereas the public sphere is often exclusively focused on how well migrants integrate, Nijhawan uses a different optic and demonstrates how it is not so much the lack of a “will” to integrate, but instead the forces of law, state and public discourse that causes profound problems. His main findings concern the role of refugee determination procedures, the public image of religious minorities that don’t fit common frameworks of recognition and the everyday exclusion and violence faced by those pushed to the social margin. Nijhawan’s work further considers the new and important role of next generations: young people in both communities who break with common stereotypes and emerge as visible social actors pushing for the recognition of injustices past and present and social change.

Impact 1

With the gradual erosion of asylum law and the imperative to deport those who don’t qualify current admission policies, how are those not typically eligible affected? While much of the current refugee determination procedures in Europe are in flux, Nijhawan shows how in the recent past, the German asylum courts have assumed a pivotal role in affecting migrant lives very differently. This is

especially true for Sikhs and Ahmadis, who were offered dramatically different results in legalisation. Examining the relationship between the legal field and religion is particularly telling in this context. Considering the discourses of judges in the administrative court, lawyers and asylum claimants’ testimonies, as well as recent appeal courts’ decisions, Nijhawan arrives at a new understanding of the cultural transactions and interpretations that inform adjudication in the field of asylum law. On the one hand, credibility assessments are often highly arbitrary and betray a cultural bias. On the other hand, judges and courts (including the EuHC) have developed theories of religion and religious persecution that intersect with communities where such religion is practiced and where it remains subject to change. In this context, it matters how religious sincerity is defined and validated before the court. Compared to international legal debates, he finds how asylum adjudication influences the debate on the recognition of religious freedoms, even though we do not typically think of this legal domain as affecting the governance of religion.

Impact 2

As religious minorities, Sikhs and Ahmadi migrants are also subject to negative public sentiments. Being entangled within a social nexus of migration, race and religion has at specific points of time led to a ques-



Professor Michael Nijhawan

tioning of their claims to belonging as Germans or Canadians. In Canada this was particularly so in the context of the Air India Inquiry as a consequence of the continuing debate about the support for Sikh militant groups among Canadian Sikhs. In Germany as in other European countries, public anxieties over the presence of foreign bodies have resulted in a discourse of suspicion that is felt as profoundly alienating by both Sikhs and Ahmadis. Members of both communities are often called out and mistakenly profiled as terrorists, something that is widely discussed on social media and has led to new forms of advocacy and recognition campaigns. Nijhawan demonstrates how Islamophobia has had important repercussions in everyday life in places such as Frankfurt or Toronto, despite the significant transatlantic differences with regard to such presence and force by which such sentiments are played out. Prejudiced discourse brands many minority religious groups as inassimilable in mainstream society. Importantly, suspicion co-exists with increasing recognition of Sikhs and Ahmadis as

model minorities and hence the effects of assimilation often remain tacit or are not intelligible to publics and policy makers.

“At a moment when the European Union seals its morally convoluted refugee relocation deal with Turkey and as we see how in North America the debate about admitting more refugees is triggering new moral panics around Muslims as potential terrorists, it is worthwhile to pause and take a deep look into how state policies of immigration affect the displaced and vulnerable even further.”

Impact 3

The group that most openly contests these pressures is the so-called millennial- or next generation of young Sikhs and Ahmadis. Nijhawan contributes to a better understanding of their positioning with respect to institutionalised religion and forms of religious and political organisation that the youth wants to see overhauled. What is moreover interesting is the continuing importance of class

and race when it comes to how families have struggled with legacies of violence. This is seldom understood by a public preoccupied with the many, and certainly important, success and integration stories of Punjabis in Canada. Yet, Nijhawan portrays a next generation of young Sikhs and Ahmadis who openly confront issues of colonialism, genocide and oppression while seeking solidarities across community boundaries and localities in a context in which national identity is being redefined. In this context, he finds that intergenerational transmission is a complex process that entails social narratives around labor, migration and religion. Contrary to the common crisis motif of portraying religious immigrant youth as a problem category, we instead find that these young individuals make sense of their everyday in constructive ways, actively create new and innovative cultural spaces and find ways to imagine their cultural and religious belonging that promise a better future.



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Indigenous education in Canada: Challenging the status quo

Dawn Zinga, Associate Professor and Chair of the Department of Child and Youth Studies at Brock University highlights some of the challenges faced by Indigenous pupils in Canada...

There are decades of research documenting the significant challenges that Indigenous students in Canada face when negotiating the Canadian education systems. This research is often positioned and used to identify a “crisis” in Indigenous education and to turn the focus on Indigenous students, their families, and their communities as being the problem. During his resignation, former AFN Nation Chief Shawn Atleo stressed the importance of the work in Indigenous education that began over 40 years ago, with the Indian Control of Indian Education document in 1972 (Atleo, 2014). In his last statement as the AFN National Chief, Atleo never referred to Indigenous education as being in crisis but rather referred to the importance of the work and the need to “smash the status quo.” In summer 2015, Prime Minister Justin Trudeau committed \$2.6 billion over four years to First Nations education (kindergarten to grade 12) and \$500 million over three years to support education infrastructure for First Nations schools. While this has been seen by Indigenous communities as a welcome change from the previous government’s approach, it is not clear whether Trudeau is ready to do the work required to address the issue of the status quo in education, or if his government will only focus on addressing crisis situations.

There is a clear trend in media



accounts and government speeches that indicates mainstream Canadians are more comfortable with a crisis than addressing the significant problem with the status quo in education. It is much easier to compartmentalise the issue as a problem or crisis in Indigenous education, rather than face the clear evidence that there are significant problems within Canadian education systems. National and provincial trends indicate that Aboriginal adolescents ages 12-18, tend to leave school before completing high school and report 40% drop-out rates among Indigenous young people aged 15 and over in, comparison to 13% rates for their non-Indigenous counterparts. Much of the research focusing on Indigenous student engagement in schools has identified systemic problems within Canada’s

education systems and schools citing alienation, devaluing of Indigenous culture, othering, and racism as systemic problems within education systems.

“Students stressed the importance of teachers and staff understanding First Nations culture and realities, and spoke about how they felt more connected to teachers who had some understanding of First Nation culture.”

According to Battiste (2013, 159), Canadian education and its associated institutions are “neither culturally neutral nor fair” and have been created out of a “patriarchal, Eurocentric society.” Thus, education systems have a self-perpetuating cycle wherein those who are seen to be mainstream are

indoctrinated in accepted beliefs and ideologies associated with mainstream society, while simultaneously those accepted beliefs and ideologies act to subjugate and devalue beliefs, ideologies and people who do not fit the prescribed mould. Educational institutions from elementary through to postsecondary have colonial history embedded within their structures, policies, procedures and classrooms and yet struggle to understand why their specialised outreach programs for Indigenous students are not more effective without questioning that the root of the problem can be found in the structural and systemic imposition of that colonial history.

Research conducted by the Student Success Research Consortium with Six Nations of the Grand River Territory in Southern Ontario found that, students from the Six Nations community felt devalued in provincial schools. Parents and other community members are concerned about how their students are valued in provincial schools and whether or not those schools are safe and welcoming spaces. Students also spoke about their resilience within challenging school contexts where they often faced racism and discrimination. They spoke about finding connection and belonging through friends and sports and the importance of having people in their lives that cared about them. They also described how some provincial teachers “wrote them off” and how they valued teachers who were tough and pushed them to reach their potential, while supporting them with assistance and encouragement.

Similarly, research conducted in Northern Ontario (Zinga & Gordon, 2014) also found that Indigenous stu-

dents routinely encountered racism and discrimination in high school. Students stressed the importance of teachers and staff understanding First Nations culture and realities, and spoke about how they felt more connected to teachers who had some understanding of First Nation culture. Like their counterparts in the Six Nations community, these students from the Northern Nishnawbe Aski territory reported being “written off” by some teachers and connected to teachers who cared about them and pushed them to do their work. They also identified the need for the other mainstream students to be more aware of First Nations history and to challenge their preconceptions of First Nation people.

The realities that Indigenous students face in Southern and Northern Ontario have some interesting parallels and differences. In Southern Ontario, First Nations communities have better access to the internet and to easily accessible provincial schools, although their students’ experiences in those provincial schools is remarkably similar to that of their Northern counterparts. In contrast, First Nations communities in Northern Ontario have more limited access to the internet and the location of the closest provincial school requires most students to live outside their First Nation community for high school. While First Nations communities throughout Ontario struggle with significant educational infrastructure gaps, these are more pronounced in Northern Ontario where school structures are not up to the minimum standards in provincial schools and often take the form of dilapidated portable structures, while communities wait for a proper school building for

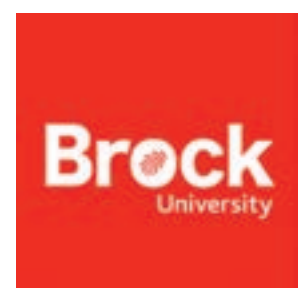
years. The challenges in Indigenous education require significant educational reform that addresses embedded systemic inequalities that devalue and other Indigenous students.

“National and provincial trends indicate that Aboriginal adolescents ages 12-18, tend to leave school before completing high school and report 40% drop-out rates among Indigenous young people aged 15 and over in, comparison to 13% rates for their non-Indigenous counterparts.”

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Development of multiple drug resistance (MDR)

Terra G. Arnason and Troy A.A. Harkness from the Departments of Medicine, and Anatomy and Cell Biology at the University of Saskatchewan detail current strategies to prevent or reverse multiple drug resistant malignancy

Multiple drug resistance (MDR) can be present from the outset (inherent) or develop (acquired) in response to drug therapy, whether it be to treat viral or bacterial infections, or aggressive cancers. MDR implies that treatment resistance is present not only to the original drug(s) used for therapy, but also against chemically and structurally distinct drugs that may have not yet been used in treatment. MDR places a heavy burden on society, with financial, emotional and mental costs, with few effective treatments, particularly those that are tolerable. Not surprisingly, common mechanisms of drug resistance occur in all systems¹. Examples include new mutations of drug targets (to avoid their recognition), such of that the drug-drug target interaction is abolished, or mutations that amplify drug efflux pumps that result in low intracellular drug concentrations; these are universal steps towards drug resistance. However, the development of MDR is not this simple, and as research progresses it is becoming clear that there are multiple, complex ways that cells develop treatment resistance and that the development of an MDR cell population is not arising from a single underlying mechanism, but likely multiple, stacked events. As we identify the numerous biological pathways predicted to be hijacked for MDR cell survival, it is likely that, in turn, this will reveal clinically useful biomarkers of MDR development and novel targets to facilitate MDR reversal.

When considering individuals with cancer, the diagnosis of acquired MDR cancer is based on response to therapy, including the observation of ongoing disease progression during treatment or a robust regrowth/spread of cancer, shortly after therapy is completed². A great limitation to current cancer therapy is our inability to predict, detect, and effectively treat these MDR malignancies. Protein markers of MDR have been described in a variety of unrelated cancer types, but are not currently used to make clinical decisions. Screening cancer patients for expression of these protein markers prior to clinical presentation may be a means to detect MDR development even before ineffective, toxic chemotherapy is given again. Overexpression of the drug efflux pumps, such as MDR-1 (Multiple Drug Resistance 1) and BCRP (Breast Cancer Resistance Protein), are well-established markers of MDR, yet for a variety of reasons inhibitors against MDR-1 have not been successful in clinical trials in part because of toxic side effects to these designer drugs³. Currently, treatment of MDR cancers involve multi-drug cocktails of second line agents that have less tolerable side effects and potentially more significant toxicities to the patients. The decision to forego further therapy and switch to palliation is a common result of the appearance of MDR malignancy. There is an urgent need in this important population of cancer patients to address these issues. In order to effectively treat patients with MDR cancers, it will be critical to

identify markers of MDR to enable early detection of MDR development prior to clinical failure, and to find non-toxic, effective, and synergistic methods to reverse the MDR phenotype.

How to study MDR in a test-tube

The questions our research group are asking currently focus on two concepts: how does MDR develop? and, how can it be reversed? We have developed a rapid method for selecting drug sensitive cancer cell lines, grown in the lab, for drug resistance, as an *in vitro* model to reveal the biological pathways that are recruited during MDR development^{4,5}. We are identifying key pathways necessary for MDR development through comparative gene expression between the original sensitive, and selected resistant, cell populations. Genes that are significantly differentially regulated between these two states may be considered as novel targets so that new therapeutics can be designed against them and alter their function. For example, using breast cancer cells selected for resistance to the first-line anthracycline cancer drug class, we were able to show that proteins that are switched off in developing cancer cells, are turned on again as the cells transform into aggressive MDR cells⁴. One particular protein, called Tissue Factor Pathway Inhibitor 1 (TFPI1), was of interest, as it was one of the most highly expressed genes as cells develop MDR, suggesting that inhibiting this step may abrogate MDR development. Intriguingly, we

found that TFPI1 transitioned from the cell surface to a position within the nucleus called the nucleolus during this transformation, and that artificial overexpression of TFPI1 in drug sensitive cells rapidly led to augmented levels of multiple markers of aggressive cancer. TFPI1 is not currently considered a target for cancer therapies, yet further testing may support development of agents against TFPI1.

Can MDR be reversed or prevented?

As noted above, attempts to treat MDR malignancy frequently involve toxic agents with significant side effects to prolong survival, without providing a cure. For over 10 years, we have appreciated that insulin-sensitising agents contribute synergistically to the effective killing of MDR cells in the lab. Insulin sensitisers, including Troglitazone and Metformin (MET), were used worldwide to treat insulin resistance associated with Type 2 Diabetes and other insulin resistant states ⁶. Currently, MET is globally prescribed to millions of Type 2 Diabetics, with patients taking MET having reduced onset of many types of cancers ⁷, supporting a role in primary prevention, yet we, and others, have demonstrated that these agents inhibit the proliferation of existing cancer cells grown using cell culture, including those classified as MDR. Interestingly, protein expression of the drug efflux pumps (MDR-1 and BCRP) was reduced following MET treatment *in vitro*. We find MET to work synergistically in combination with other drugs to kill MDR cancer cells, even those drugs that the cells are resistant to. Also exciting is our recent observation that MET can prevent the development of MDR cell populations *in vitro*, despite strong selection pressure for drug resistance. If this holds true with further testing, then MET may play an important role following initial treatment response, to

prolong the disease free duration and prevent the development of MDR, particularly in those cancers with high MDR rates such as breast, colon, and lung.

Difficulties in studying MDR malignancy in cancer patients

In vitro artificial cancer cell lines, with their homogeneous genetics, cannot replace the assessment of MDR cancer arising within cancer patients (*in vivo*). However, the years required to follow these patients, and our current inability to identify those who are particularly at risk of developing MDR prior to obvious clinical failure, makes human studies extremely difficult to carry out. We have made use of an excellent heterogeneous animal model of spontaneous MDR. We have recruited companion canines presenting with recurrent, treatment resistant (MDR) lymphoma into our study, where they were treated with MET in addition to their regular failed therapy. In all cases, MET reduced markers of MDR in these very sick dogs, and in 1 of the 4 cases studied, remission was achieved with loss of tumour mass. We are repeatedly sampling these lymph node tumours, and analysing the changes in tumour gene expression of these dogs over time as they progress through their treatment. Using microarray, we are identifying biological pathways involved in the reversal of MDR tumours.

To address the clinical usefulness of MET in preventing, or delaying MDR development, we are again using our *in vivo* companion canine model. In this case, we are recruiting treatment-naïve dogs upon their first presentation of lymphoma and prior to any chemotherapy, to determine if the additional of adjunct oral MET effects relapse rates and MDR development. Canine lymphoma relapses at very

high rates, typically over 1 year, and MDR arises predictably with each subsequent relapse, making this a useful model to study MDR prevention with the addition of MET therapy. Our results using cell and animal models provide hope that MDR cancers can be both prevented and reversed.

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Cognitive brain health in aging: Why is it so important for women?

Yves Joanette from the Institute of Aging, and Cara Tannenbaum from the Institute of Gender and Health at the Canadian Institutes of Health Research, detail why cognitive brain health is so important as we age, specifically for women...

Remaining cognitively healthy as we age is something we all desire. Dementia – a progressive deterioration of cognition accompanied by personality and mood changes – ranks highest among mid-life and older adults' concerns about growing old. This fear is justified, and is based on hard facts: dementia affects less than 3% of adults between the ages of 65-75, with a sharp rise in prevalence to 30 to 40% at age 85 and beyond. Like many other health and social issues, the lifetime probability of being diagnosed with dementia is not an equal gender opportunity for women and men. Women are almost twice as likely as men to be living with dementia, representing 70% of all cases worldwide.

Women's increased longevity is not sufficient to explain the fact that women are far more likely to develop the

disease, and to decline more rapidly, both cognitively and functionally, compared to men. Sex hormones and hormone replacement therapy may play a role. During the 1980's and 1990's, hormone replacement therapy was liberally prescribed to peri- and post-menopausal women prior to the discovery that hormone replacement increases dementia risk, the exact opposite of what was predicted. Women may also be more vulnerable to recurrent stressful life events than men. Stress hormones affect the female brain differently over time, possibly leading to more memory impairment, inflammation, damage and degeneration. The reason why dementia disproportionately affects women in both prevalence and severity, the biologic mechanisms underpinning these sex differences, and the socialised gender roles that make women more vulnerable, have yet to be fully understood.

The World Health Organization (WHO) recognises that dementia is a leading public health threat for the world. Estimates indicate that the number of people living with dementia will double in high-income countries, and more than triple in low- and middle-income countries. Older women will be most affected, and younger women will bear the brunt of the caregiving burden. The effect this will have on the expanded family structure, and on the mental health and resources of affected individuals raises significant concern.

To address this challenge, the UK government led the 2013-2015 joint effort of all G8 countries to establish the Global Action Against Dementia initiative. The WHO scaled up this commitment at its March 2015 First Ministerial Conference on Dementia, where 93 countries agreed to work together to face the challenge of dementia. The World Dementia Council is helping to lead and coordinate this global effort along with the WHO, the OECD and many international and national organisations, including associations representing people living with dementia.

One priority is for future research efforts to be sex sensitive in order to understand the root cause and progression of the neurodegenerative diseases causing dementia. Currently, only a small proportion of national and international research efforts include sex and gender variables or considerations at all levels of their analyses. One example is the Canadian Consortium on Neurodegeneration in Aging, supported by CIHR and many partners, in which more than 350 researchers from across Canada focusing on all aspects of dementia research – from basic biomedical to social dimensions – are encouraged to include sex and gender at all levels of their research. This unique effort was made possible through advocacy from one of the partners of this Consortium, the Women's Brain Health Initiative, who brought attention and extra funding to support the women in dementia dimension.

Fortunately, we now have a better understanding of how brain health can be optimised to push back the onset of dementia. One strategy is to reduce vascular risk factors, such as high blood pressure and obesity. Another is to avoid events known to trigger neurodegenerative conditions, such as early life head injuries and concussions, which occur in women due to sports

and domestic violence. Men are believed to have more cognitive reserve than women; women can be taught compensatory strategies to recruit more parts of their brains. Prevention also requires being physically active throughout the lifespan. Prevention may involve de-prescribing drugs, such as sleeping pills and some classes of anticholinergic medication that are now known to affect memory and concentration. Women are more frequent consumers of these medicines than men. Putting in place de-prescription drug policies that encourage patients, pharmacists and physicians to curb the use of these drugs may help reduce the risk of dementia.

Cognitive brain health in aging is important for everyone, but even more so for women. Innovation and transformation in health care delivery to better serve those living with dementia will need to be considered from an equity standpoint, to include women's priorities. This is equally true for programs meant to encourage the social inclusion of those living with dementia, such as the UK and the Canadian Dementia Friends programs.

A complementary set of research, care and social policies will allow us to tackle and overcome the critical and specific challenges of dementia in women. ■

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Keeping Canadians healthy

Adjacent Government highlights how the Canadian Minister for Health is committed to preventing chronic diseases and supports World Health Day...

Cardiovascular diseases (CVD's) are one of the biggest causes of death globally. In 2012 alone an estimated 17.5 million people died from CVD's, which represents 31% of all global deaths. CVD's are a group of disorders of the heart and blood vessels, which include: coronary heart disease; cerebrovascular disease; congenital heart disease; rheumatic heart disease; deep vein thrombosis; and peripheral arterial disease.

In Canada alone, each year 1.4 million people are diagnosed with heart disease. It is believed that 9 out of 10 Canadians over the age of 20 are said to have at least one risk factor for heart disease. Due to this the Minister for Health, Jane Philpott is taking action. In February's Ministerial Message she outlines steps that can be taken in order to prevent these killer diseases.

"As Minister of Health, I would like to take this opportunity to help raise awareness of the importance of heart health and cardiovascular disease prevention.

"Each year more than 1.4 million Canadians are diagnosed with heart disease. As a family physician, I saw countless patients who were living with chronic diseases that may have been preventable with a few lifestyle changes. We can all reduce our risk by eating healthy foods, being physically active and not smoking."

With so many Canadians being affected by these diseases on a yearly basis, the Minister believes that through investment in research, new treatments could be discovered and help with the prevention.

"Government programs are supporting partnerships in communities across Canada that promote healthy living and that provide Canadians with information to make healthier choices," she said.

"In addition, through the Canadian Institutes of Health Research (CIHR), the Government of Canada has invested in research into heart disease prevention techniques, promising treatments and tackling health inequalities in Canada.

"In Canada alone, each year 1.4 million people are diagnosed with heart disease. It is believed that 9 out of 10 Canadians over the age of 20 said to have at least one risk factor for heart disease."

"The government has also partnered with the Heart and Stroke Foundation and others on the Canadian Resuscitation Outcomes Consortium – the first large scale focused on making Canadians more aware of how to perform life-saving intervention when someone suffers cardiac arrest outside of a hospital setting."

She went on to say, "this Heart Month, I encourage you to think about what can be done within your community, your organisation, or personally to prevent heart disease and stroke. For example, you can start by aiming for 30 minutes of physical activity every day, learning how to cope with stress in a healthy way or teaching your children about heart-healthy habits."

There are a number of ways to help minimise the risk and prevent heart diseases. Smoking is a big contributing factor as it can block arteries and increase the risk of blood clots. It also reduces oxygen in the blood and increases blood pressure. It is estimated that more than 37,000 Canadians die prematurely each year from tobacco use.

Unhealthy eating and a lack of exercise could also contribute. People who are physically inactive are believed to have twice the risk of having heart disease and a stroke. Add on top of that an unhealthy diet, with

some 56% of Canadians eating less than 5 servings of fresh fruit and veg per day. This could put the risk of heart diseases a lot higher.

The Minister also marked World Health Day last month, which celebrates the birth of the World Health Organization (WHO) in 1948. This year the day was dedicated to raising awareness for diabetes, which is on the rise in Canada and around the globe.

WHO estimates that 422 million worldwide have the chronic disease, which includes an estimated 2.4 million Canadians.

"The good news is that Type 2 diabetes is preventable," the Minister said. "The government of Canada is helping understand and address the challenge of diabetes through surveillance activities, diabetes awareness and health prevention programmes.

"The government of Canada supports leading edge research on diabetes. I recently announced funding for a new cross-Canada research network focused on improving the care of Canadians with diabetes and related complications.

"Through the Global Alliance of Chronic Diseases, we are supporting the work of Canadian researchers who are working to improve the prevention and treatment of Type 2 diabetes in low- and middle-income countries." ■

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Research contribution to improvement of pain management

Mathieu Piché, a professor at Université du Québec à Trois-Rivières sheds light onto acute and chronic pain...

Pain is a universal experience that is critical for survival, serving as an alarm system when noxious but undetectable events occur in the body. For instance, myocardial infarction would go unnoticed before its fatal blow without chest and arm pain, which warns us to evoke adaptive behaviours such as seeking medical care, when time allows. Neural processes underlying pain perception also have a defensive function by producing a withdrawal response to protect the body against tissue damage. This response is automatic and is evoked by a spinal cord reflex pathway, even before we notice pain through cerebral processes. Because of this, we all learnt that fire or heat sources can burn and produce injuries. The importance of the protective function of pain can be exemplified by diseases involving congenital pain insensitivity, for which the affected individual cannot feel pain and suffer from multiple and severe injuries, leading to bone fractures, infections and eventually, death.

In spite of these adaptive and protective functions, pain can also have devastating impacts. Indeed, in some individuals, acute pain may lead to modifications in the central nervous system, including the spinal cord and the brain. These changes underlie the transition of acute pain into persistent pain, which lasts over the natural history of a condition or disease and becomes chronic. Chronic pain is a

major issue for most societies. In Canada, approximately 20% of the adult population is affected by some form of chronic pain, which leads to important personal and economic consequences. For example, in affected individuals, chronic pain can lead to a lower quality of life, psychological disorders, such as anxiety and depression, difficulties with interpersonal relationships, as well as decreased work productivity and satisfaction. From a societal point of view, these consequences result in high costs related to the use of health cares, work compensations and reduced incomes. Addressing these issues remains a challenging and demanding task.

“His research is based on a translational approach using various techniques such as electrophysiology and brain imaging, ranging from basic studies on pain mechanisms in animals to clinical studies aiming at developing or improving pain treatments.”

Research perspectives

Considering that more than 50% of individuals with chronic pain cannot obtain pain relief and live with more or less constant pain, solutions are needed to address this serious issue. Basic and clinical pain research can offer several avenues to improve this critical situation. On one hand, basic research provides a window on the mechanisms of acute and chronic pain, which must be understood



thoroughly in order to develop and improve treatments. It also allows for testing new drugs and acting on these mechanisms for pain management. On the other hand, clinical research is essential to validate pain treatments and ensure cost-effectiveness (for example, see RQRCC below).

The team at Université du Québec à Trois-Rivières is currently working on ways to improve brain function that allows pain inhibition in patients with chronic pain. By stimulating the brain with non-invasive magnetic fields and electrical currents, they hope to establish effective protocols to manage chronic pain as part of an interdisciplinary intervention (see CogNAC research group). One example is the stimulation of the dorsolateral prefrontal cortex, which supports working memory, to enhance the capacity of the brain to process information and perform cognitive tasks, without being affected by pain perception. In patients with chronic pain, this ability is altered. Thus, this kind of brain



The RQRCC steering committee. From left to right, Dr. André Bussi res, Samuel Langlois (front), Dr. Mathieu Pich , Dr. Patrice Normandeau, Dr. Johanne Martel and Vincent Gagnon Normandin (back)

stimulation protocol could improve working memory and therefore, pain inhibition mechanisms and pain management.

“Considering that more than 50% of individuals with chronic pain cannot obtain pain relief and live with more or less constant pain, solutions are needed to address this serious issue.”

Pain neurophysiology laboratory

Dr. Mathieu Pich  is professor of neurophysiology in the department of chiropractic at Universit  du Qu bec   Trois-Rivi res (UQTR) where he holds the UQTR research chair in pain neurophysiology and the chiropractic research chair from Fondation Chiropratique du Qu bec. His research is based on a translational approach using various techniques such as electrophysiology and brain imaging, ranging from basic studies on pain mechanisms in animals to clinical

studies aiming at developing or improving pain treatments.

Quebec chiropractic practice-based research network (RQRCC)

The RQRCC is a provincial chiropractic practice-based research network made up of over 150 chiropractors, conducting clinical research to improve the effectiveness and the quality of chiropractic cares, including interventions aiming at relieving pain. One of the current research project aims at determining the factors predicting the evolution of pain, function and quality of life of patients with acute and chronic spinal pain following a chiropractic intervention.

Research group on Cognition, neuroscience, affect and behaviour (CogNAC)

Co-directed by Professor Isabelle Blanchette and Professor Mathieu Pich , the CogNAC is an interdisciplinary research group at the Universit 



du Qu bec   Trois-Rivi res, which includes 13 professors from five departments and over 50 graduate and undergraduate students and postdocs. The team works on various themes related to brain and spinal cord research including emotion, attention, sensorimotor systems and pain, from functional neuroanatomy and single cell recordings to behaviour in animals and humans of all ages. Funded by several sources including the Canadian Funds for Innovation, the Natural Science and Engineering Research Council of Canada, Fonds de Recherche du Qu bec and the Canadian Institutes of Health Research, the CogNAC offers a unique platform to conduct innovative research using a combination of tools to stimulate and record brain activity.



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Living with chronic pain

Barry Ulmer, Executive Director of the Chronic Pain Association of Canada outlines the many challenges faced by people who live with chronic pain...

People living with chronic pain experience significant changes to their physical and psychological health, which often leads to a huge reduction in their quality of life. It is important that they have a management plan in place to help improve their quality of life, so they can actually live life to as full an extent as possible. This means their physician must accept the fact their pain is real and work with them to manage it. In fact, pain affects more people than heart disease, cancer and diabetes combined, yet remains largely ignored by many in the medical community.

“There are 2 main types of pain: nociceptive pain and neuropathic pain. Alternatively, pain may be classified according to the duration of the pain, as acute, chronic or breakthrough pain.”

A major challenge to people living with pain is that pain management is not a unified field, and care is often not coordinated or even available. There are a number of providers who treat pain, from primary care, to interventionists, to psychiatrists, to chiropractors, and others. Each profession has different training, focuses on different areas, and different approaches to treating pain. For example, a primary care physician may rely on prescription medication as a first-line therapy in addressing pain, but may or may not be familiar with the intricacies of dosing, or have experience in the management of chronic pain. This should not be surprising as research shows most physicians receive little training on the subject as they progress through medical school. In fact, in Canada, veterinarians receive far more training on pain than medical doctors do. A psychiatrist may offer an anti-depressant combined with therapy, and so it goes with all disciplines based on what their discipline indicates. Nothing is coordinated. Typically the care that a person receives is



based on a random selection process of providers, which is costly to our health care system and often benefits are limited.

All this leaves the pain sufferer frustrated and isolated. It reduces their quality of life even more with greater impact on their daily lives and stops them from taking part in activities they normally would. In turn, this has an effect on the psychological health of them as they try to deal with changes this brings. It is common for people in pain to feel frustrated or angry, particularly when they are unable to participate in normal everyday life. This stems their social life and many may have difficulty creating and maintaining relationships with loved ones.

To address some of these issues, it is important that people have the resources to enable them to access a strong support network where they feel comfortable to talk about and work through any issues. However,



these resources for peer groups are extremely limited causing the pain sufferer to become more isolated.

“...pain affects more people than heart disease, cancer and diabetes combined, yet remains largely ignored by many in the medical community.”

There are 2 main types of pain: nociceptive pain and neuropathic pain. Alternatively, pain may be classified according to the duration, as acute, chronic or breakthrough pain. Nociceptive pain is the normal response of our body to potential harm and serves to help protect us from dangers that are encountered. It may be acute or chronic in nature. Neuropathic pain is caused by an injury to the nerves involved in the propagation of electrical signals that send messages of pain to the brain. This pain is often described as a sharp, shooting pain and may be quite intense. Acute pain is pain that alerts us to an injury and can vary in intensity. Chronic

pain continues longer than acute pain and is often defined as any pain that lasts 12 weeks or longer.

At any rate people in pain continue to be the most stigmatised and forgotten people within our communities. Pain is expensive to our health care systems, but the cost of pain in humanistic terms (e.g. loss of jobs, relationships, concepts of self and even life itself) is incalculable. ■

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Open access = open science

In a speech delivered in Amsterdam last month, Carlos Moedas, EU Commissioner for Research, Science and Innovation outlines why open science is a good thing...

The Washington Post recently published an article about Alexandra Elbakyan, a 27 year old student from Kazakhstan and Founder of Sci-Hub, an online database of nearly 50 million pirated academic journal articles. To some, she is “The Robin Hood of Science.” To others, she is a notorious cyber-criminal.

Elbakyan’s case raises many questions. To me the most important one is: is this a sign that academic journals will face the same fate as the music and media industries? If so – and there are strong parallels to be drawn – then scientific publishing is about to be transformed.

So, either we open up to a new publishing culture, with new business models, and lead the market... Or we keep things as they are, and let the opportunity pass us by. As I see it, European success now lies in sharing as soon as possible, because the days of “publish or die” are disappearing. The days of open science have arrived.

So today I want to talk to you about:

- Why open science is a good thing;
- A common vision for open science;
- And what we plan to do next.

In my view, there is a strong economic, scientific and moral case for embracing open science. Which brings me to my first point: why open science is a good thing and one of the 3 core priorities of my mandate.

Let’s take the example of open access first of all.

A recent study analysed the economic impact of opening-up research data. Using the example of the

European Bioinformatics Institute of the European Molecular Biology Laboratory, the study demonstrated that the institute generates a benefit to users and their funders of around €1.3 bn per year – just by making scientific information freely available to the global life science community. This is equivalent to more than 20 times the direct operational cost of the institute!

So open access increases the value of public investment in science. But, more than that, it also contributes to scientific excellence and integrity by: opening up research results to wider analysis, allowing research results to be reused for new discoveries, and enabling the kind of multi-disciplinary research that is increasingly needed to solve global problems in the 21st century.

Then, there is the moral case for open access. I think the public have the right to see the results of the research they have invested in.

In short, open access makes complete sense. It generates income, raises excellence and integrity, and involves the public in what they pay for. The question is rather how do we make the transition? Who pays and who benefits, and how do we do this together?

This brings me to my second point today, which is my vision for open science.

First, we need open access. Europe must transition from a pay to read to free to read culture. Free doesn’t mean no revenue, it just means different revenue. I believe every scientific article from Europe should be open access, for the reasons I mentioned before.

Second, we must clarify copyright. Europe must also transition from legal uncertainty, to a clear legal framework for using data for research: so that researchers



are able to reuse and recombine big data – enabling Europe to become a leader of data driven science.

Third, we must create infrastructure. Europe's final transition must be one from fragmented data sets to an integrated European Open Science Cloud. By 2020, we want all European researchers to be able to deposit, access and analyse European scientific data through a European Open Science Cloud.

So what do we need to achieve all this?

Scientific publishing needs to be financially sustainable, so who should pay? The Dutch scientific community has led the way in establishing a new funding arrangement with publishing companies.

This is the kind of new business model that we can all learn from, but one that only works if we remove other barriers to open access. For example, we need to look at how scientific success is measured, and make use of alternative methods that do not rely solely on scientific publications. In Horizon 2020, open access is already mandatory and other funders are beginning to require the same.

Of course, open access naturally leads to researchers reusing data and research results, but often the legal framework for doing so is unclear, or differs from country to country.

So, to answer this need for clarity, the Commission will propose a Copyright Directive that will include research exemptions, and we have introduced specific provisions within the EU Data Protection framework.

On infrastructure, the Commission will set out an action plan to establish a European Open Science Cloud in the next few days. While I cannot go into details now, I can say that this action plan can only be realised in close partnership with the scientific community, because, together, we can not only generate more scientific collaboration, research and education – but innovations in the fast emerging digital economy as well.

So I welcome your ideas, on all of these ambitions and any others you may have, here today and in the future. And I am inviting you to continue to take part in the development of the European Open Science Agenda. Help us decide how to provide incentives for open science. Help us reflect on new ways to reward open scientists. Help us ensure citizen scientists contribute to European Science as valid knowledge producers, by 2020.

Finally, I am pleased to announce that we will soon launch the "Open Science Policy Platform" to advise the Commission on the policy actions required to implement the Open Science Agenda, as well as help with their implementation. We will announce its members at the May 2016 Competitiveness Council.

Only last year, a group of leading international linguists, wanted accessibility to their research results to be independent of expensive commercial publishers. So what did they do? They left the editorial boards of their academic journals and embarked on a new venture. They found an open access publisher that could make their dream of low-cost open access into a viable reality.

So, instead of asking ourselves how to stop the unstoppable... Let's ask ourselves how we're going to make openness work for us. ■

The full speech can be viewed here http://europa.eu/rapid/press-release_SPEECH-16-1225_en.htm

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Carlos Moedas
Commissioner for Research,
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www.ec.europa.eu/commission/2014-2019/moedas_en



Active aging as corporate mission

How 40+Lab is helping organizations and businesses to thrive in attending the senior population and prepare for the silver economy

Disruptive Demographics is the current demographics, as for the first time in human history the proportion of seniors (65+) tends to be higher than that of young people. In this sense, the concept of active aging appears as a way of promoting a positive, as well as socially integrative aging process.

An Age-Friendly society is one where the conditions exist, and are always being recreated, to allow an optimal aging process with clear implications for the economy, because, among other things, it opens up new business opportunities. For this to be possible it is necessary that organisations understand how this demographic

phenomenon affects their business and how they can best be suited, and effectively respond, to this reality. As well as understand how to position themselves in the so called silver economy.

It is in this context that in 2013, the 40+Lab was created in Portugal, the only business strategy consultancy firm specialising in the senior consumer, in the aging process and in how it impacts any organisation's business.

Our mission is to work with organisations and together place them at the forefront of the 21st Century economy, where aging and longevity stand for much of many societies' growth.

Because the senior market, as a promising market for business development, although in reality still a new concept to fully grasp, it calls for organisations to adapt their policies and strategies in order to satisfy a segment with specific and varied needs.

With potential consumers needs and motivations often unmet, it is up to organisations to tailor their services to the market, identifying these segments, often untapped and easily capable, to assure returns on future investments.

Although there are areas in which the impacts of a large proportion of senior consumers are noticed in a more significant way, the need to



change how organisations look at their markets is transversal and not only limited to specific business areas, such as tourism or health.

In Portugal we at 40+Lab are working for a growing transformation of towns in age-friendly cities, in close collaboration with various social and economic players, through structural consulting projects. It is a core work aimed, on one hand, to change mindsets and help economic and social agents to view the positive side of the silver economy, and on the other, to reflect upon the development of products, services and business offers, focusing on the diversity of segments within the macro age group of 50+.

To complement this effort in strategic consulting, we developed a new sphere of activity regarding human resources training. Here, with a specialised team, we give assistance to HR directors of public and private corporations in the development of a HR management policy that takes into account aspects related to the productivity of people 50+ and also retirement friendly processes.

At the individual level, we have a HR training offer (INNOVageing) specially designed to empower all those who interact directly with consumers, particularly seniors. This project is the outcome of a partnership between 40+Lab and the Institute of Negotiation and Sales (INV – www.inv.pt). In this commercial environment, customer care should be adapted, as it cannot express signs of impatience or paternalism towards the elderly that might have greater difficulty in understanding the latest products and services linked, for example, to new technologies. The commercial spaces themselves should also have adequate comfort conditions, in particular the availability of rest areas, the product placement within easy access, among other situations, as stated by Ana Sepulveda, CEO of 40+Lab: *“We should look at these people as normal consumers with specific characteristics”*, she argues.

For all this knowledge, focused on the senior segment, 40+Lab becomes a strategic partner in the development of the silver economy in its various aspects. We act in a comprehensive

method to assist companies wishing to develop a targeted approach to the population over 50, adapting their structures and offer to the undeniable demographic trends. For 40+Lab, 2016 is a year of great prosperity and development where the internationalisation becomes a reality with the entry into the Brazilian market and other European markets as source of study. It is also the year we move forward with HR training for individuals who wish to think their new “half-life”, focusing on the rediscovery of individual talent, retirement planning and support senior (or intergenerational) entrepreneurship projects.



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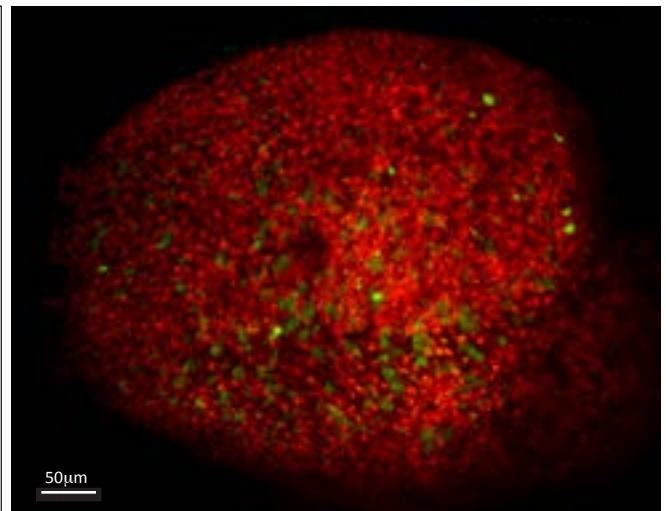
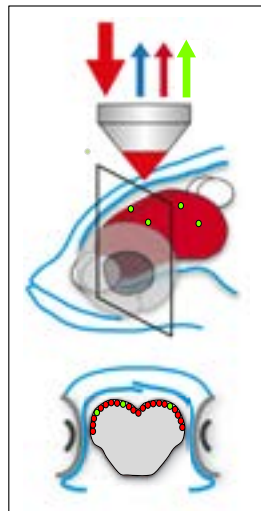
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Fish at the rescue to unravel mechanisms of stem cell maintenance

Stem cells, which retain the capacity to divide and generate newly differentiated cells within a mature tissue, have been identified in many organs of the human body. They serve as a physiological source of “young” cells for rapid cellular turnover (eg. for the replacement of skin or hematopoietic cells), as a source for repair (eg. for muscle cells damaged by exercise) or as a platform for functional plasticity (eg. to provide young and malleable new neurons to brain memory centres). The physiological importance of stem cells is further attested by the functional decline of most organs with ageing, when stem cell pools progressively shrink and exhaust. For their potential to generate fresh mature cells in the adult body, stem cells are also considered as a promising source to be therapeutically mobilised following accidental injury or degeneration. These results motivate the enormous effort placed by today’s biologists to dissect the mechanisms controlling “stemness” (the progenitor potential of stem cells) and its long-lasting maintenance in selected cells of the body. Our understanding of these processes, however, remains fragmented.

A major determinant of stemness maintenance is the extrinsic niche, ie the local context of stem cells in relation within surrounding tissue. In the brain for example, neural stem cells contact blood vessels and the spino-cerebral fluid, two sources of molecules preserving stem cell potential. Another, yet relatively overlooked parameter, is the “intrinsic” niche, ie



Live neural stem cells (red and green) observed in the brain through the skin and skull of an adult zebrafish (*Danio rerio*)

the influence of stem cells themselves and their division activity on the fate of neighbouring stem cells. Recent experiments following stem cells over time in the mouse intestine, skin or brain demonstrate that stem cell pools maintenance is achieved at the population rather than at the individual cell level ¹. In other words, statistically, loss of a stem cell is compensated for by the amplification of another stem cell. Further spatial analyses of neural stem cell populations in the rodent brain highlighted spatially patterned arrangements of stem cells in different states ². Together this argues for communication between stem cells being a fundamental parameter in the maintenance of stem cell pools. Understanding the intrinsic niche will be key to future applications of stem cell research. For this, a major challenge remains to access the behaviour of stem cell populations in the physiological context of their niche.

Our work of the past years revealed the formidable power of a new vertebrate model system, the “zebrafish” (*Danio rerio*), to tackle this challenge in the brain. Teleost fish diverged from mammals some 450 million years ago. This is very recent in evolutionary terms, and zebrafish and man share most molecular, cellular and organic processes underlying vertebrate development, physiology, behaviour, and disease ³. These similarities extend to the neural stem cell field ⁴: in both mouse and zebrafish, constitutively active adult neural stem cells are astroglial cells, organised in ventricular niches, and generally quiescent, activating to enter the cell cycle at low frequency to generate additional astroglial cells and/or neurons. Activation is controlled in both species by identical molecular pathways ⁵. Thus extracting basic neural stem cell principles from zebrafish will likely be, in a large part, translatable to mammals.

Major advantages of the zebrafish over mammals lie in the amount of adult neural stem cells and in their experimental accessibility ^{6,7}. Mammals rapidly exhaust their neural stem cell pools past the juvenile stage and the remaining niches are buried in deep regions of the telencephalon (the most anterior brain territory), making experimental access difficult *in vivo*. Zebrafish efficiently maintain numerous active neural stem cell pools until adulthood and, in the telencephalon, these organise as a large monolayer with some ten thousands cells conveniently arranged at the dorsal surface of the brain ^{8,9}.

Taking advantage of this unique property, a key technical step, achieved in collaboration with Emmanuel Beaurepaire and Willy Supatto (Ecole Polytechnique, Palaiseau, France), was to develop a live imaging technique permitting to film zebrafish adult telencephalic neural stem cells directly in their niche over weeks. We used transgenic lines expressing fluorescent proteins in adult neural stem cells, crossed into a transparent pigmentation mutant ¹⁰. Using a biphoton imaging procedure jointly recording fluorescence (stem cells) and harmonic signals (generated from lipids or collagen-rich structures), we could reach into the telencephalic neural stem cell layer with single cell resolution while imaging through the skin and skull of an anaesthetised animal. This enabled us to reconstruct the life of over a thousand neighbouring neural stem cells over a number of weeks ¹¹.

The zebrafish therefore becomes the first vertebrate model where entire adult neural stem cell pools can be

filmed non-invasively for extensive periods of time, in their endogenous environment, and with single cell resolution.

The perspectives of this model are huge. Using transgenic backgrounds highlighting neural stem cell states, such as for example a cell's activation status, we could position activation events across space and time within the pool. This will now show how the quiescence/activation state of a cell relates spatiotemporally with that of its neighbours and, compared to the behaviour of single cells in a dish, will reveal the properties emerging in real life from neural stem cells being organised in pools. Transgenic lines expressing biosensors or modulators of candidate molecules will reveal some molecular bases for these properties. Finally, like their mammalian counterparts, zebrafish adult neural stem cells are subject to alterations or disease. They exhaust with age, are subject to neoplasia, or can be biased towards generating neurons following lesions. It will now be possible to monitor which single cell rules and/or emerging population properties are affected in these contexts and underlie the observed alterations of the pool.

Overall, we are on the cusp of a new opening into neural stem cell research that will address, for the first time in the context of an unperturbed animal, the coordinated properties of stem cell pools. This will be highly relevant to physiological and disease situations in humans, and will shed unprecedented light on how neural stem cell maintenance can go awry.

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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 are particularly regulated and are 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, are 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 have 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 has 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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LIBRA tackles gender imbalance in European life science research

Capturing and retaining talent is key to fostering a knowledge-based society. Yet we are failing to achieve this goal by not allowing a pool of talent – namely women – to reach its full potential. Indeed, the ratio of women to men progressively decreases along the career ladder, with few women reaching top positions in research and decision-making bodies. Despite improvements in awareness and policies that have been implemented to redress this imbalance, progress is overly slow, such that positive action is needed. The issue is highly complex and comprises multidimensional factors ranging from the general cultural framework of societies to numerous more specific – and more addressable – problems. However, addressing these problems with innovative actions first requires that we better understand them. To tackle both of these steps, thirteen top European life science research institutes from the EU-LIFE alliance – 10 as partners and 3 as associated partners, located in 13 countries (see Figure) – teamed with gender experts of ASDO (Italy) to design the ambitious LIBRA project (<http://www.eu-libra.eu/>). LIBRA, which is coordinated by CRG (Barcelona), has been funded by the European Union from October 2015 to March 2018. The project will benefit from guidance from a board of internationally renowned gender-in-science experts: Dr Ineke Klinge, Prof Kurt Rice and Dr Ines Sánchez de Madariaga.

LIBRA aims to remove institutional barriers and empower women to be as successful as men in their research careers on a European-wide scale. In



The thirteen European life science research institutes from the EU-LIFE alliance that are involved in LIBRA are shown on the map. Sizes of dots reflect the proportional number of staff at each institute. CRG (Centre for Genomic Regulation); CeMM (Research Center for Molecular Medicine of the Austrian Academy of Sciences); IC (Institute Curie); BI (Babraham Institute); IEO (European Institute of Oncology); BRIC (Biotech Research & Innovation Centre); FMI (Friedrich Miescher Institute for Medical Research); MDC (Max Delbrück Center for Molecular Medicine); CEITEC (Central European Institute of Technology); NKI (The Netherlands Cancer Institute); VIB (Flanders Institute for Biotechnology); FiMM (Institute for Molecular Medicine Finland); and IGC (Instituto Gulbenkian de Ciência).

an initial phase, the current status and policies in place for each partner institute will be assessed at group and individual levels. The results from this will provide an excellent snapshot of issues underlying gender imbalances at the top positions in European life science research institutes. LIBRA will also obtain realistic data about the degree of implicit bias towards gender issues amongst the research institute employees and scientists in the 10 partner institutes from an implicit association test (IAT).

In a second phase, LIBRA will design and implement 10 harmonised and institute-tailored Gender Equality Plans (GEPs) based on a process of mutual learning and idea exchanges. The goal is to introduce long-lasting, profound structural changes to these research environments.

Overall, LIBRA will address 4 main areas of intervention for improvement or implementation:

- assuring gender-neutral recruitment

policies and procedures;

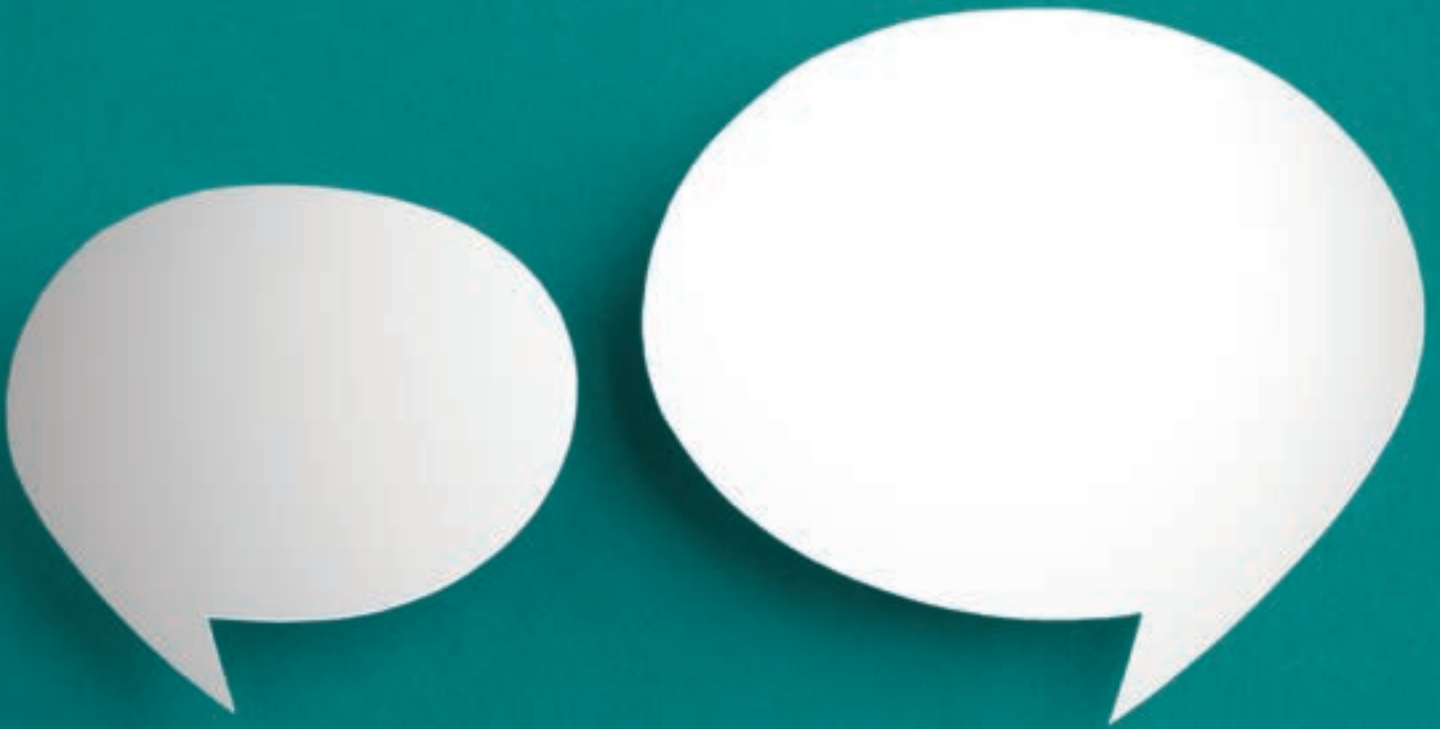
- measures and activities to promote career development and training;
- providing a good work-life balance environment, and;
- including sex and gender dimensions in research.



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The reverberating impacts of detecting gravitational waves

Denise Caldwell, Director of the National Science Foundation's Physics Division in the Directorate for Mathematical and Physical Sciences, looks to the future for gravitational wave research...

On February 11, The National Science Foundation (NSF) hosted a press conference to announce that its Laser Interferometer Gravitational-wave Observatory (LIGO) had detected gravitational waves from 2 merging black holes, approximately 1.3 billion light years away. Since that time, this news – which represents a major breakthrough in observing our universe – has not only excited the scientific community; it has transcended pop culture – from Garrison Keillor's *Prairie Home Companion* and Stephen Colbert's late night show to the annual Washington Post peeps diorama contest.

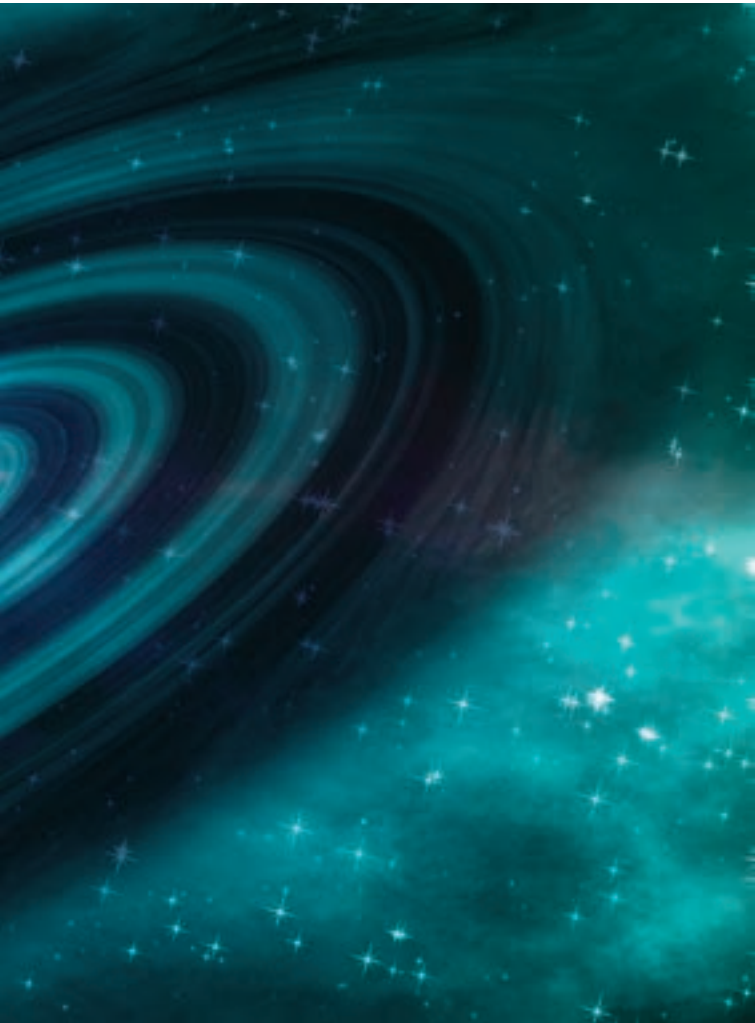
The attention is well deserved, and the tributes that have been paid are intensely gratifying. Not just because the science is so remarkable, but the path to get to this point has not always been so smooth.

LIGO's history reflects notable determination, inspiration and tenacity. It's true, Einstein predicted gravitational waves a hundred years ago, but even he thought detection was likely impossible. However, as Dr. Fleming Crim, our assistant director for NSF's Mathematical and Physical Sciences Directorate noted recently, "the

possibility of opening a new window on the universe was so tantalising that NSF began funding research on prototype laser interferometers in the 1970s. And, in 1994, the agency committed almost \$300m to a group led by Kip Thorne and Ron Drever of Caltech and Rainer Weiss of MIT to transform their prototypes into a full-blown gravitational wave observatory."

For those of us at the agency today, it's hard not to respect the brilliance, vision, enthusiasm, experimental prowess and deep theoretical insights these researchers had, persuading NSF, the National Science Board and Congress to take a risk. Even though NSF had not funded anything on such a scale previously, the potential for transformative science justified such a big commitment. In fact, the agency embarked on a new role by funding this large, high-risk, high-reward research platform. It was basic scientific research with a clear eye toward future possibilities.

While many on the day of the press conference found they might view the discovery as a comfortable landing where one might pause and take in the view, we here



“We have sights on a future of learning even more about the violent phenomena that inhabit these dark corners of our universe.”

Of course, basic research like this provides no promises. And the risk of failure is an ever-present specter lurking in the background. But for those doing the work – as well as those of us who make decisions to fund it – the results can be utterly revolutionary. LIGO may have made international news, but this really is our agency’s daily work: to support science at its earliest stages, being mindful of the long road ahead and being prepared to accept the risk involved. To again quote Fleming Crim, “fundamental science has transformed our world and will continue to change it in ways we have not yet imagined – in much the same way that Einstein’s own theory of relativity is what ensures the accuracy of our GPS or that the same technique used to stabilise LIGO’s sensitive laser frequencies also helps to build the semiconductors in our computers and cellphones.”

Just as in those cases of fundamental science driving innovation forward, we again will keep trying to push the envelope and look toward the future with gravitational wave research. In February, we got to help open a window to our universe that was a long time in coming. Now, we must also be good stewards for ensuring we continue to fund science with the vision to see what’s beyond that window. ■

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at NSF see this as only the beginning of an entirely new subarea of physics and astronomy, the opening of a new window on the cosmos. We have sights on a future of learning even more about the violent phenomena that inhabit these dark corners of our universe.

LIGO is expected to reveal objects out there that no one even knew existed. As the results from LIGO are combined with other observations NSF has fostered over the last decade, we will start to probe the universe closer and closer to its very origin. At the NSF telescope at the South Pole we will, for example, look for the imprint of gravitational waves on the cosmic microwave background, that faint, leftover light from when hydrogen atoms first formed after the Big Bang. At an NSF funded Physics Frontiers Center, scientists studying pulsars will search for indirect evidence of gravitational waves. As these discoveries are combined with measurements utilising electromagnetic radiation and elementary particles, this multi-messenger approach will enable us to paint a more comprehensive picture of this vast cosmos we inhabit.

The X-ray free electron laser for biomolecular structure determination

The US funding agencies were perhaps the first to realise the potential of the X-ray free electron laser (XFEL). They responded immediately by pumping unusually large amounts of funds into these unproven machines. The world's first XFEL was developed at the Stanford Linear Accelerator Center for the cost of several hundreds of millions of dollars. This is a machine capable of producing X-rays of some 10 billion times brighter than any previous X-ray source on earth. One of the crucial applications is the novel opportunity for biomolecular structure determination. The ultrashort pulses produced by XFELs allows the possibility of circumventing radiation damage altogether by scattering off a particle before radiation damage can manifest itself¹. Subsequently an XFEL was developed in Japan, just outside Osaka. A European XFEL is now planned for Hamburg in Germany, due to come online in 2017. Others are also planned for Korea, Switzerland and China. The enormous novel capabilities of the XFEL are now perhaps becoming more widely appreciated.

Up until the development of the XFEL, almost all structure determination at the atomic scale was done on macroscopic crystals, where the relatively weak X-rays from conventional sources scatter off perhaps trillions of identical unit cells to reveal the structure of a single unit cell.

The ultra-brightness of X-rays from an XFEL may allow structure determination to be performed on individual mole-

cules without a need to crystallise them. This is of significance, as there are some important biomolecules, e.g. membrane proteins that are very resistant to crystallisation. In any case, a crystalline state is not one which, in general biomolecules perform their functions in nature. The ultra-brightness of an XFEL will allow meaningful diffraction patterns to be measured from individual biomolecules in environments closer to those in which they may be found in nature, e.g. in solution. The shortness of the X-ray pulse could allow one to outrun radiation damage which takes place over a time period longer than the X-ray pulse. Thus the X-ray diffraction patterns would be characteristic of their native states before radiation damage. One may also use any degree of incident flux and be completely impervious to radiation damage!

Of course, the use of such completely different conditions for structure determination also requires the development of a completely new theory². No longer can one use the theory originally developed by the Braggs, von Laue and other pioneers of x-ray crystallography which were designed for crystals³. In fact, x-ray diffraction patterns from individual molecules look very different from those from crystals. The latter are dominated by the "Bragg spots" which arise from the crystalline periodicity. This is both a boon and a curse. The maximum intensities of the Bragg spots increase with the number of "unit cells" in a crystal and make them much more

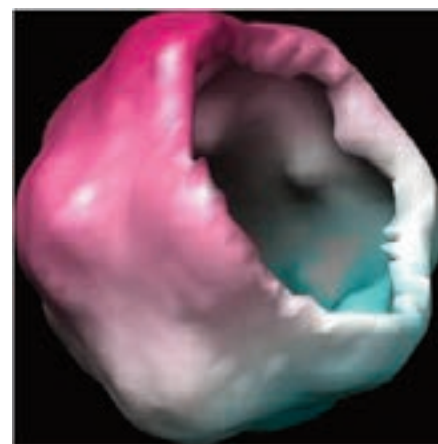


Figure 1. Structure of an icosahedral virus, satellite tobacco necrosis virus (STNV) recovered from simulated diffraction patterns by the method of angular correlations. The artificial cut allows us to show that the reconstruction of the PDB structure assumed in the calculations, which contains only the capsid structure.

visible even with much weaker X-rays. On the other hand, the crystal periodicity prevents the sampling of these intensities at intervals smaller than the positions of the Bragg peaks. Although that scattering is weaker from an individual molecule the possibility of measuring such "oversampled" intensities is often crucial for structure determination. Here is the advantage of the 10 billion-fold increase in brightness of the incident x-rays allowed by the XFEL. However it should be borne in mind that a single molecule is perhaps a trillion times smaller than a typical crystal used in x-ray crystallography, so the measured intensities would inevitably be significantly smaller even with the use of an XFEL. This also necessitates a careful consideration of signal to noise ratios in any theory. Also, the absence of Bragg spots in scattering by individual molecules



Figure 2. Structure of tobacco mosaic virus (TMV) recovered from simulated XFEL diffraction patterns by the method of angular correlations.

requires entirely new methods of taking account of the orientations of the individual scatters.

It has been found that the angular correlation of the intensities when averaged over all the million or so diffraction patterns expected to be measured in an XFEL (the repetition rate is about 100 diffraction patterns (DPs) per second) is found to be inde-

pendent of orientation. Over a typical experimental shift it is not unexpected that about a million DPs will be measured. This means that at long last one has a quantity that is characteristic of the structure and independent of the orientation of an individual molecule. This means that once one cracks the code for recovering the structure from the correlations one had a method for recovering the structure of a molecule



Dr Dilano K Saldin

from ensembles that may not be perfectly aligned as in a crystal. The potential for recovering the structures of molecules from such misaligned ensembles as may be found from ensembles of molecules as they are found in nature.

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A boost for stem cell research

Adrian Heuss, Head of Knowledge Transfer on the NRP63 Programme tells
Editor Laura Evans more about NRP63 and Stem Cell Research...

Stem cell research can play an integral role in developing new treatments and therapies for major healthcare challenges, such as cancer. It is still considered a relatively new area with high potential. At the Swiss National Science Foundation (SNSF) their National Research Programme – Stem Cells and Regenerative Medicine (NRP 63) aims at boosting basic research on stem cells and regenerative medicine.

Editor Laura Evans spoke to Adrian Heuss, Head of Knowledge Transfer for NRP 63, to find out why stem cell research is so interesting and how the programme offers this much needed boost.

“Stem cell research is interesting because it is not just about one specific illness,” explains Heuss. “There are a number of different illnesses that you can look at, including: cancer, diabetes, and Parkinson’s.”

Stem cell research can benefit a number of different areas, even for muscle regeneration or repairing the retina. “There are so many different projects going on, not just in Switzerland, but worldwide.”

Connected to stem cell research is regenerative medicine, which can be defined as the ‘process of replacing, engineering or regenerating human cells, tissues or organs to restore or establish normal function’.

“Regenerative medicine could in theory be used for more or less all diseases where cells die off or are damaged,” says Heuss.

For example, one NRP 63 research team worked on diabetes, they found a way to develop new insulin producing cells. Another team worked on an ear project: they developed a new material that can be used to reconstruct ears for patients who have lost theirs in an accident or whose ear didn’t grow or form properly when they were born.

At the moment the standard technique for these patients is to use cartilage from other parts of the body, but what they have developed is a new material which has more or less the same stability as natural cartilage. “This new material could be used for any part of the body where the cartilage is damaged,” says Heuss.

“For a long time everyone believed that there are no real stem cells in the brain. They believed that you had constant number of nerve cells from birth, and with age they reduce in number. In the last 10 or 15 years we have realised that’s not true and how much actually is regenerated – there are stem cells in the brain that make new nerve cells.”

The NRP 63’s intention was to boost basic research on stem cells and regenerative medicine, as well as encouraging top scientists with an excellent track record in development and cell biology to engage in this field.

“The NRP 63 increased the visibility of Swiss research in the international arena”, explains Heuss. “Most projects were basic research, but several groups are already in touch with biotech and pharmaceutical companies that are interested in utilising their results for the good of patients in the future. This, I think, is really interesting and worth the money.”

Over a 5 year period, the SNSF dedicated 10 million Swiss francs. Between 2010 and 2015 12 research groups based in Basel, Berne, Geneva, Lausanne and Zurich investigated new approaches to the treatment of various diseases.

“In order to further boost research in this area, the programme also focused on young scientists. In Switzerland, research in molecular biology is well



established, but the stem cell part could do better.” The idea behind the NRP 63 was to encourage more experts into the stem cell field.” Heuss says.

With the help of programmes such as NRP 63 and others across Europe, research in stem cells and regenerative medicine is able to progress and develop further. Over the last 10 years, advances in regenerative medicine and stem cell research have been huge.

“For a long time everyone believed that there are no real stem cells in the brain. They believed that you had a definite number of nerve cells from birth, and with age they decreased in number. In the last 10 or 15 years we have realised that this is not true and how much actually is regenerated – there are stem cells in the brain that make new nerve cells,” says Heuss.

Researchers are now looking at ways to boost those cells in the brain, for example using substances to make the stem cells in the brain produce new nerve cells. This would really help with illnesses such as Parkinson’s or multiple sclerosis – diseases where the cells die off. The good thing about this would be that these new cells are your own cells and they wouldn’t be transplanted from someone else. “It is always problematic if you transplant

cells, as there’s the question of whether they are accepted,” Heuss adds.

As with any research, regenerative medicine comes with its own challenges. Heuss explains that one of the main issues when working with stem cells is the development of tumours.

“Stem cells in their natural environment are tightly controlled by different signals – they are in a niche and the niche will make sure that these cells only produce new cells when they have to. If you take these cells out of their niche and transplant them into another patient then the surrounding is different, the signals to control their growth change, and then you could get tumours. ■

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Transforming regenerative medicine into an opportunity for patients

Regenerative medicine is the medical revolution that is increasingly challenging the way we approach and fight diseases. At the Swiss Institute for Regenerative Medicine, hospitals, research institutions, companies and universities are joining forces to bring innovation from bench to bedside

The medical revolution

Though great progress has been made in medicine, current treatments are increasingly unable to keep pace with patients' need, especially given our aging population. In fact, there are few effective ways to treat the root causes of many common diseases, injuries, and congenital conditions. In many cases clinicians can only manage patients' symptoms using medications or devices. This is especially true, for example, in the case of acute myocardial infarction and other heart diseases. If most tissues and organs in the human body have in fact a regular turnover of cells (meaning that entire tissues or organs are replaced over a period of weeks or years depending on the type of cells), heart cells are an exception. Adult cardiac cells experience no (or extremely slow) replacement over time. This means that any injury of the heart has serious consequences for the patients.

Regenerative medicine is a game-changing area of medicine because it intervenes exactly where traditional medicine fails, by regenerating damaged tissues or organs and therefore restore the normal functions of the body. This is made possible through the development and the application of new therapies based on the use of stem cells, i.e. undifferentiated progenitors cells that have the ability to evolve – through a process called “differentiation” – into diverse types of specialised cells.

By studying the properties of each kind of stem cell, scientists are today able to regenerate entire organs or at least part of them, and therefore cure damages that were previously considered irreversible. Heart disease is just one example of a condition that is going to be completely revolutionised by regenerative medicine. Other potential applications are found in Parkinson's disease, cerebral palsy, degenerative retinal diseases, pulmonary disease, spinal cord injury, arthritis, and many more.

Only a few decades ago, the concept of regenerating parts of the human body was firmly restricted to the realm of science fiction; however, in a very short space of time, it has become a tangible scientific and therapeutic reality all over the world. In fact, even though many people perceive regenerative medicine as a matter of the future, it is already a tangible reality. A significant quantity of regenerative medicine products are in fact already commercially and clinically successful. In addition to over 60,000 stem cell transplants that are annually performed worldwide for the treatment of oncology and blood disorders, in 2012 over 160,000 patients were treated using new, experimental regenerative medicine drugs. At the same time, more products are being approved and new data are becoming available from mid and late-stage regenerative medicine clinical trials. Going forward, the industry expects the approvals to multiply annually.



Obviously, research in regenerative medicine requires significant effort and investments. Treatment, before becoming a reality, may take up to 10 or 15 years of development and testing. This has not stopped some particularly forward-thinking countries in investing in what is often called “the medicine of the future”, also because research in this field is capable of producing an extremely important scientific and economic advancement. An example of forward-thinking in this regard is in the state of California which, following the so-called “Proposition 71” – the state law approved by referendum in 2004 – has allocated \$3bn to regenerative medicine. Thanks to this major investment, California can now rely on 2,600 biomedical companies, 87 university and private research institutes generating an annual revenue of \$32.3bn, 15 of which are reinvested annually for research.



Making the dream true: the Swiss Institute for Regenerative Medicine

In the last decade, the growth of the biotech sector in the southern and Italian-speaking Ticino Canton has become increasingly important for the economy of the region and for the surrounding scientific environment. It is here, just 15 minutes far from the Italian city of Como, less than an hour from Milan, in a region known for its ability to blend Italian lifestyle and culture with Swiss precision, top-level services and political stability, that the first stem cell transplant of the country has been performed in 2004, on a patient with acute myocardial infarction. The intervention was carried out by a cardiology team led by Prof. Tiziano Moccetti at Cardiocentro Ticino, a Lugano based, cutting edge heart clinic, known to be one of the most important cardiac centres in Switzerland. This pioneering and encouraging experience eventually led the clinic to investigate further on the matter by building the first authorised “cell factory” of the country, which is a special facility to safely produce experimental drugs based on stem cells. Starting in 2005, these experiences led to the creation of a growing biomedical cluster of companies, research institutes and other clinics interested in the exploration and application of regenerative medi-

cine in various medical fields. In 2013, this group finally created the Swiss Institute for Regenerative Medicine (SIRM), a new research centre entirely committed to exploring the full potential of regenerative medicine. The institute, supported by the Cardiocentro Ticino Foundation, and funded by the Foundation for Cardiological and Research Education (FCRE), has a bold mission: To unleash the enormous potential of human body regeneration and thereby support the development of next generation therapies and cures that will shape the medicine of the future.

This is not a simple task, explains Antonino Tramonte, SIRM Managing director: “To effectively become a real solution for patients, the new therapies require several years of research and development. At SIRM we strive to accelerate this process by combining and integrating competences of several different but complementary institutions that are actually part of the same ecosystem: Clinicians, researchers and biotech companies.

“This is why SIRM laboratories, based in Taverne, currently host 5 partner institutions: Cardiocentro Ticino, Neurocenter of Southern Switzerland, University of Applied Sciences and Arts of Southern Switzerland (SUPSI) and two innovative biotech companies: Swiss Stem Cell Bank and Hyperstem.”

“This is indeed a successful example of cooperation,” explains Claudio Massa, President of the FCRE Foundation. “In just 3 years of activity, we completely saturated the spaces in our current headquarter and we deal quite on a daily basis with new requests from new companies and new research institutes that would like to join us in our research for regenerative medicine. We’re now talking with new partners and with Lugano municipality to buy together a new building, big enough to support our growth in the medtech field. We’re amazed by the SIRM project so far, it truly exceeded our most optimistic prevision”.

“Our dream”, concludes Prof. Tiziano Moccetti, scientific director of Cardiocentro Ticino and of SIRM, “is to create with our joint work a real treatment opportunity for patients. Everything starts from the patient whose needs are the main goals for the clinician. Doctors’ research for solutions creates research projects and consequently opportunities for the biomedical industry. Only when all these stakeholders communicate and cooperate patients’ needs are finally met. This is the real meaning of the translational research we do at SIRM. Literally: From bench to bedside, that is our philosophy and the path we want to follow for the medicine of the future.”

SIRM

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Personalised medicine in bone regeneration

Around 2500 years ago, Hippocrates realised that bone can heal without scarring. However, the natural healing potential is restricted to small defects and large bone defects caused by trauma or during tumour resections still pose a huge problem in orthopaedics and cranio-maxillofacial surgery, not mentioning the immense costs associated with non-healing fractures or bony defects.

Personalised bone substitutes

The natural healing potential of bone is based on three pillars:

- Mesenchymal stem cells;
- Osteoinduction by growth factors deposited in bone;
- Osteoconduction, as potential of bone tissue to grow into 3D structures.

Mesenchymal stem cells can be harvested from bone marrow or adipose tissue and therapies, applying them clinically as tested or already used. However, the costs associated with any stem cell therapy are very high. Mesenchymal stem cells can be differentiated to bone forming osteoblasts by growth factors like bone morphogenetic proteins, which entered clinics as FDA approved medical devices in 2002 as option for spinal fusion to treat degenerative disc disease and tibia fractures, not able to heal by themselves. Both advanced and cost intensive therapies need delivery systems to properly apply the cells or the growth factors. Ideally the delivery

system should be osteoconductive, to further enhance bone healing and to minimise the need for stem cells or growth factors.

The research at Oral Biotechnology & Bioengineering (Center of Dental Medicine, University Zurich) has a long track record of the clinical use of osteoinduction in dental medicine and the delivery of bone morphogenetic proteins. To optimise osteoinduction, the combination with an osteoconductive bone substitute material appears to be a promising strategy. To that end we started a project on scaffold design and osteoconduction to develop osteoconductive/osteoinductive bone substitutes and initially got funding from the AOCMF, the Cranio-Maxillofacial Specialty of the AO Foundation and since 2014 full funding from the Swiss National Science Foundation (SNF).

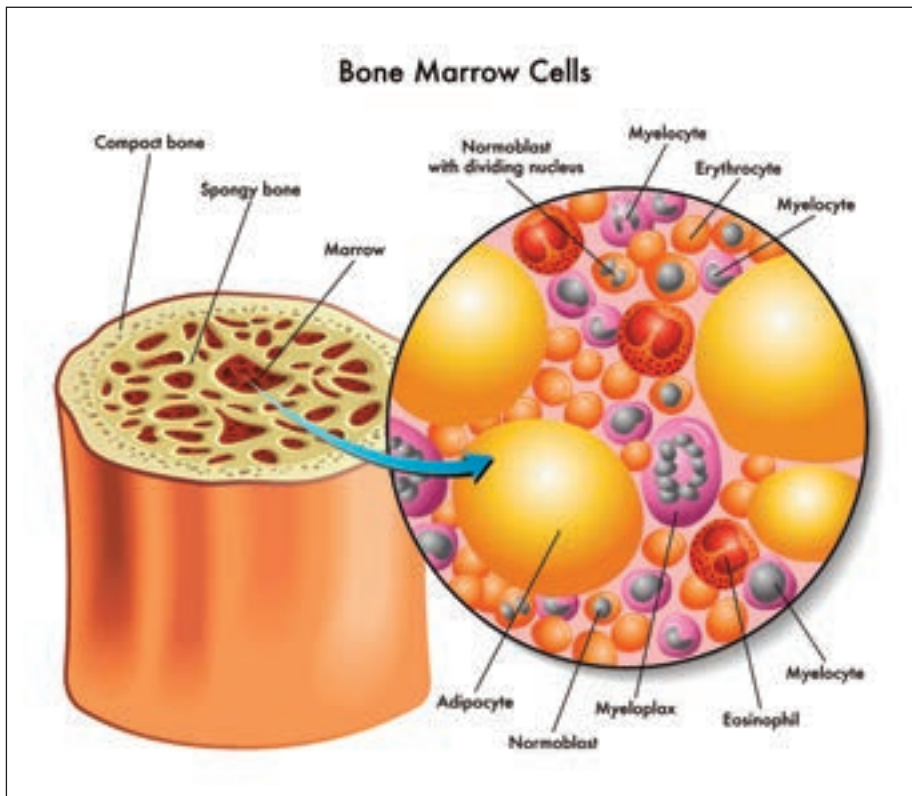
The SNF project: "Osteoconductive and osteoinductive customised implants for large mandibular defects" is set to run for a period of three years and involves collaborators from around the world. Experience of titanium implants and their production through rapid prototyping is provided by researchers at the University of Applied Sciences North-western Switzerland (Professor Michael de Wild and Professor Ralf Schumacher); technologies on extracellular matrices, osteoinductive hydrogels and osteoconductive bone substitutes are provided by researchers at the University of Zurich (Prof. Franz E. Weber and Dr. Chafik Ghayor); and the Hong Kong Polytechnic University offers



Professor Dr. Franz E. Weber

experience in selective magnesium alloys laser melting (Professor H Man and Professor Monica Mahesh Savalani). In combining a unique body of knowledge, the team, headed by Prof. Franz E. Weber as principle investigator, hopes to achieve the aims of the project and develop a much needed personalised treatment for large mandibular defects. The solutions found in this project can easily be translated in osteoconductive bone substitutes for use in orthopaedics and increase the number of patients to profit from our research results substantially.

The ultimate goal of research performed at: Oral Biotechnology & Bioengineering (Center of Dental Medicine, University Zurich) is to bring research results from the bench to the bedside. To that end, we recently acquired a lithography-based additive manufacturing machine which allows the production of osteoconductive bone substitutes from calcium-phosphates. Seventy per cent of bone is



made up from calcium-phosphates in the form of hydroxyapatite. Therefore we aim at to develop personalised, biomimetic, osteoconductive bone substitutes which can be produced in our laboratory by additive manufacturing and clinically applied to perfectly match and treat bone defects located either in the mandible or any other bone.

Epigenetics and bone regeneration

Epigenetics describes changes to the expression of genes that are not linked to changes in the DNA sequence. In another SNF funded project with the title "The potential of N-methylpyrrolidone (NMP) to prevent osteoporosis and to enhance bone regeneration" we found that NMP and 2 other small molecules to possess an activity on the level of epigenetics and patented these findings (Unitetra, University of Zurich) for treatment and prevention of osteoporosis, adiposity, periodontitis, peri-implantitis and several other disorders. Although this project fin-

ished at the end of 2015, we hope to continue on this novel approach to use epigenetics for bone regeneration and to combine these findings with osteoconductive bone substitutes.

Funding

- Swiss National Science Foundation (SNF);
- EU Seventh Framework Programme (FP7);
- Swiss Dental Society (SSO); AOCMF, the Cranio-Maxillofacial Specialty of the AO Foundation.

Biography of the principle investigator

FRANZ E WEBER graduated from the University of Konstanz (Germany) with a PhD in Biology/Muscle Biochemistry. He completed three years of postdoctoral training on muscle cell biology at Cornell University Medical College in New York City and served as a lecturer in the Department of Cell Biology and Anatomy. He spent the following two

years at the Biochemistry Department of ETH Zurich (Federal Institutes of Technology in Zurich) working on the lipid uptake from the small intestine. In 1995, he joined the Department of Cranio-Maxillofacial and Oral Surgery at the University Hospital Zurich, and the Dental School of the University of Zurich. In addition to his obligations at the University of Zurich, he became Director of the European Technical Center of Inion Ltd in Cambridge (UK) in 2005 and occupied this position until 2009. His main area of interest is bone regeneration. His research encompasses bone morphogenetic proteins, delivery systems, bone substitute materials, osteoconduction, epigenetics, additive manufacturing and in vitro bone tissue engineering. Weber has authored 94 original research articles published in international journals amounting to more than 3,800 citations and has an h-index of 30. He is member of TERMIS (Tissue Engineering international & Regenerative Medicine Society), IADR (International Association for Dental Research), and SSB+RM (Swiss Society for Biomaterials and Regenerative Medicine).



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Effective after-school programs?

Supporting student well-being and learning – The development of after-school programs

According to a recent publication by the OECD, after-school programs (ASPs) have been evolving all over the world in the last decades, providing institutionalised care before school, at lunch time and after the compulsory school hours. Those reports point out that in most countries, the coverage of ASP activities ranges (with some exceptions) between 15 and 45% of the elementary student populations. Nevertheless, official guidelines, documentation and monitoring systems often vary by jurisdiction or state and therefore impede the comparison of the use and effectiveness of such programs on a national and international level.

Yet, there remains an increased demand for institutionalised care since ASPs are a reaction to changing societal, economic and family structures and are often promoted as an instrument to reduce social inequality. Accordingly, since ASPs not only provide recreational activities, but also homework support, they are often connected to the school. Therefore, ASPs are educational reform projects, which have to be integrated in the school system. So how can this integration be achieved? How can educational officials secure a well-developed after-school system, which accounts for the demands of the parents, provides activities of good quality for the children and achieve the manifold educational goals?

In a longitudinal study conducted in Switzerland, we were able to analyse these questions carefully.

Schools in Switzerland usually run between 8am and 3pm, whereas many children have the afternoons off and are not supervised during lunch. The Canton of Bern (one of the 26 provinces in Switzerland) has found one first solution to this declared “state of emergency” in the lack of available hours of institutionalised care. The local government in Bern passed an amendment to the public school law that the municipalities have to assess the parent’s needs and supply this demand appropriately. According to the register data from the Canton of Bern, the development of ASPs indeed has increased by 67% in hours of care between 2010 and 2016. Studying these ASPs, we investigate how the government guidelines and other development mechanisms may influence the ASP’s collaboration with the school.

In the study, we were interested how the ASPs are organised and how after-school directors (ASD) and personnel evaluate their role and influence on student development. We argue that there are four main dimensions which need to be considered, when developing ASPs: The quality of the activities and the ASP institution as a whole, the competences and leadership behavior of the ASD, the actions and attitudes of the staff, as well as, the collaboration with the school.

Quality of the activities and the ASPs

A systematic observation in 22 ASPs points out that they vary considerably

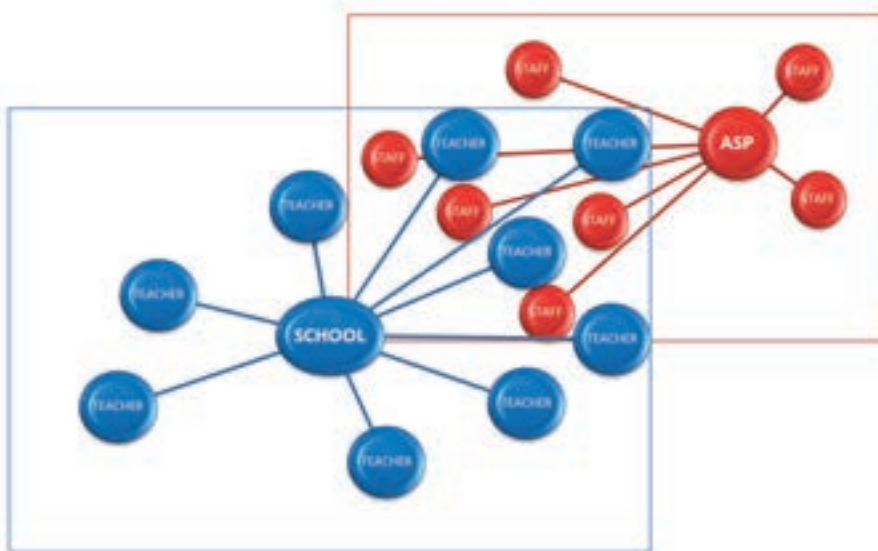
concerning the observed quality of the program and activities. Whereas some ASPs reach very good overall quality ratings, some ASPs range between minimal and inadequate quality. According to the applied School-Age Care Environment Rating Scale (SACERS), the ASPs on average reach high ratings for space and furnishing, and interactions but could improve concerning health regulations, staff development and the organisation of activities. ASDs report that most activities in ASPs are not preplanned and are more oriented towards physical activities than reflection of project-based activities.

Competences and leadership behavior

We asked 47 ASP directors about how they perceive their role and how they manage the ASPs. The most common professional role category that ASDs relate to is the “Primus inter Pares”, in which leaders have little professional distance to the team and rather position themselves at a similar status level as their coworkers. Furthermore, ASDs report that they spend most of their work-day engaged in staff management as well as organisation and administrative tasks. Quality development and evaluation is less focused in the daily practice of the ASD.

Actions and attitudes of the staff

We looked at how the ASP personnel feel about their work on a range of scales from organisational psychology. About 250 ASP staff report that the working climate concerning the inter-



actions with students and the general atmosphere is very positive. Furthermore, they rate their collective self-efficacy as a team high and feel capable of promoting activities of good quality and deal with daily problems. Nevertheless, clear goals and guidelines for improvement and innovation are not yet main targets of the ASP and the staff is less aware of needs for improvement. Lastly, the perception of the individual capacity of engaging students in activities and leading the group of students differs considerably between the staff.

Collaboration with the school

We investigated how the ASPs take up position in relation to the school. The ASDs report that the connection to school subjects and learning goals is less important in the planning of the activities, whereas the organisation of the ASP is more oriented towards the individual needs as well as previous and practical knowledge of the students. Moreover, even though the ASP staff report that if they collaborate with the school, this mainly happens in situations of informal exchange and is seldom clearly structured or directly linked to improvement. Nevertheless, they strongly agree that the collaboration with the school should be focused on providing better learning opportunities.

What can we learn from these results?

Our study on Swiss ASPs highlights that even though the context-oriented governance strategy leads to a high autonomy of ASP personnel, it may also result in an increasing heterogeneity of the quality. When further developing ASP systems, governments and educational officials should consider how the ASP can be actively integrated in the school system. For example by supporting the empowerment of ASPs to be autonomous and innovative institutions which encourage student's cognitive activation in recreational and learning activities. To assist ASPs in exploiting their full potential, governments should consider the following development actions:

- Joint development of guidelines and monitoring systems for ASP quality with ASP professionals and school staff;
- Encourage ASDs to develop a clearly defined role in managing the ASP and establishing strong and stable relationships with school teachers and principals ;
- Provide additional time resources to invest in quality assessment and in designing more diversified, pre-planned and individualised program activities;

- Help develop a professional habitus with ASDs and staff by strengthening competences in workshops, training and coaching;
- Motivate schools to call in ASP professionals in situation where they may open up new vistas for supporting student learning and well-being.

Relating back to the OECD report, countries on average spend about 50% of the time in elementary education on language, math and science and only 5 to 20% on arts, music and physical education. For after-school programs, the question remains, whether they should mainly focus on student learning due to their proximity to the school, or – on the other hand focus on leisure activities. Should they “just” provide the students with a place to play and relax as opposed to the school? The position of the ASP in the school system is still not clearly defined and more systematic research into this topic is needed. Yet, without a doubt, ASPs are important institutions who, in collaboration with the schools and families, combine informal and formal opportunities for learning and development.



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IQ-KOOP

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The brain challenge

Professor David Nutt, President of The European Brain Council highlights the economic impact of poor brain health and how they are calling for new thinking towards how it is treated...

The brain is the key to humanity, providing the immense capabilities of our species. However despite its considerable capacity for self-repair the brain also frequently fails. The costs of poor brain health to Europe are enormous. Traumatic brain injuries, mental illness and cognitive disorders are likely to afflict more than a third of European Union citizens – 179 million people. They cost Europe €798bn per annum – more than any other medical area. This is 7 times the €110bn cost of the 2010 Greek financial rescue, and it is every year.

The economic crisis has put health back on the European Union (EU) agenda. Austerity, low growth and demographic change are calling into question the sustainability of our healthcare and social protection systems. Nowhere is the situation starker than in the area of brain health.

Speaking in one voice

The European Brain Council (EBC) was formed in 2002 to bring together all of the major stakeholders in European “brain space”, in order to talk at the high strategic level with a single voice for brain health and brain disorders. As such, it is working in partnership with patients, scientists, healthcare specialists, industry professionals and policymakers to harness science and innovation for better societal outcomes.

The EBC is calling for new thinking on European brain health and the quality, productivity and mental well-being of the EU workforce. There are practical measures we can take that would make a significant, long-term difference.

We need to focus on outcomes

Within the European Semester – the EU’s new economic governance framework – the European Commission

recommends Member States to improve the cost-effectiveness of their healthcare systems. While the objective of sustainable health systems is essential, it is imperative that the emphasis is not just on cost-limitation, but on the outcomes that health systems deliver – for the patient and society. We need to understand the benefits that come from more active and productive populations, and less social exclusion.

“Healthy brains need to be put right at the hearth of Europe and its 2020 Strategy if indeed we are to increase health of European citizens as well as to increase European’s economic competitiveness.”

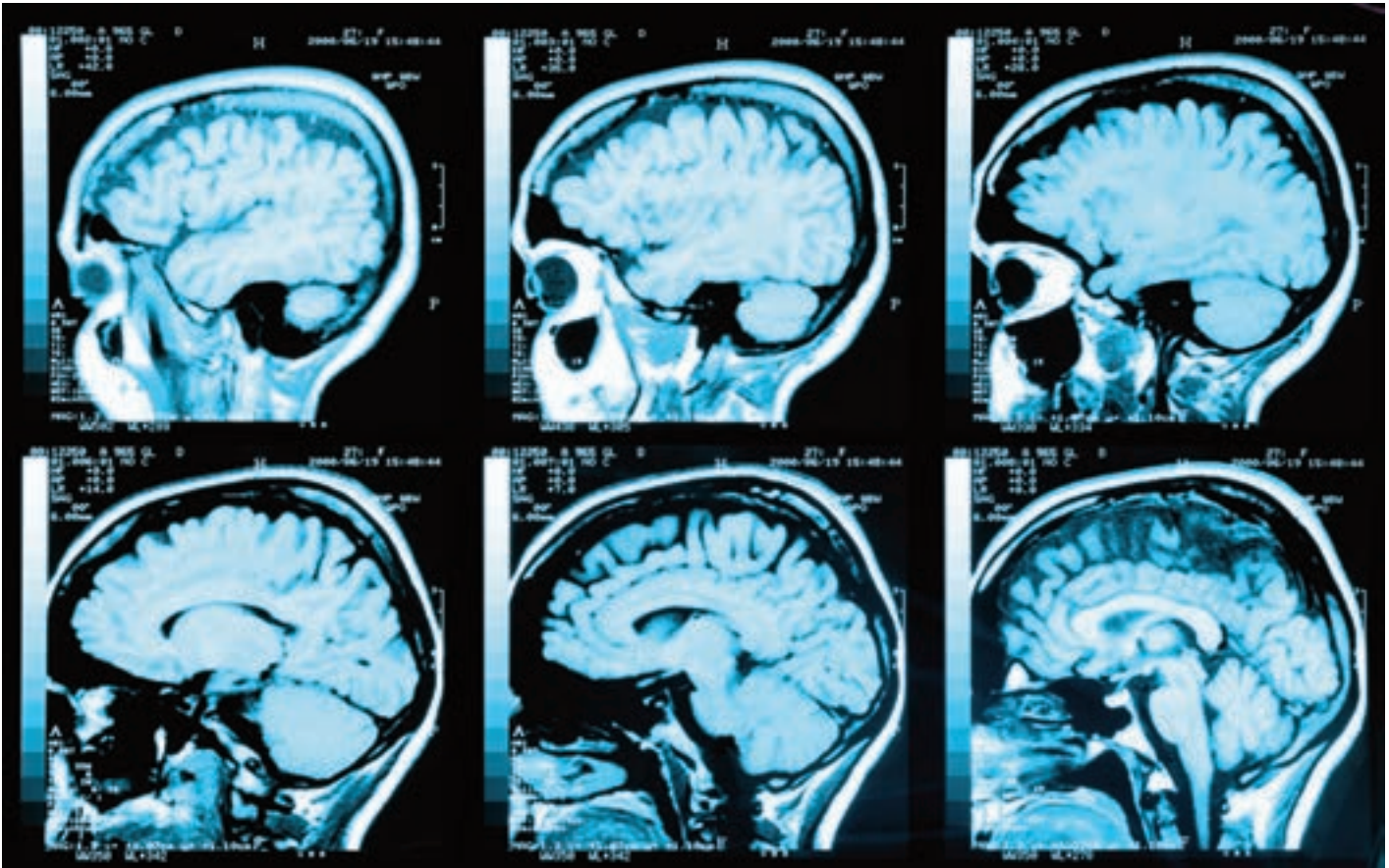
We need to recognise how investments now – for example, in early diagnosis and prevention – contribute to more sustainable health systems later.

We need to analyse and understand how well our health systems are currently performing, and which investments deliver the most lasting value.

To make the transition to an outcome-focused approach, we need data to provide us with indicators and benchmarks of best practice. In the area of mental health, the Organisation for Economic Co-operation and Development’s (OECD) work on assessing health systems performance provides an excellent starting point.

Cost-effective investments are critical

Data alone is not enough. We also need a readiness to make investments that will deliver better outcomes and improve effectiveness in the future. From a financial perspective, the message is clear: by improving the brain health of our citizens, we can enable them to live more active and productive lives, to the benefit of all our economies, including our public finances.



Given its relevance to the sustainability challenge, action to address brain-related disorders must be a high priority.

Value of treatment for brain disorders

EBC is responding to current challenges and in January 2016 it has launched its new research project on the value of treatment (VoT) for brain disorders. Analyses demonstrate that there is a considerable treatment gap in Europe, with only about a third of cases receiving the therapy or medication needed. EBC's VoT project will generate evidence on the socio-economic benefits of healthcare interventions through analysis of case studies in order to build towards closing this treatment gap and develop a workable model of care for brain disorders. The study results will be released during EU Maltese Presidency in the first half of 2017.

European and national brain plans

EBC considers that improved cooperation and coordination are absolutely critical to address in an efficient manner both the challenges and opportunities posed by our brains. With this in mind, in November 2015 it

launched a call to foster a dialogue on developing National Brain Plans, which would be brought under the umbrella of an EU-wide plan addressing brain health in an integrated, collaborative and comprehensive way. Successful examples of strategies in other disease areas already exist in Europe. These efforts shall focus on implementing evidence based strategies for research, prevention, early detection and diagnosis, and adequate treatment. The aim is to meet the needs of patients, carers, doctors, researchers and industry.

Healthy brains need to be put right at the hearth of Europe and its 2020 Strategy if indeed we are to increase health of European citizens as well as to increase European's economic competitiveness. ■

Professor David Nutt President

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Denmark – a strong research nation

Professor Peter Munk Christiansen, Chair of the Danish Council for Independent Research outlines how independent research funds were awarded to a record-high number of young researchers in 2015...

A strong research nation relies on having a well-supported growth segment where inventiveness thrives. The Danish Council for Independent Research (DFF) emphasises the cultivation of excellent ideas, not least those coming from Denmark's most talented young researchers. In 2015, more than 50% of the Council's grants went to researchers aged 40 or less.

In order for Denmark to keep developing as a strong research nation, it is important to continue to attend to the growth segment of promising research ideas and talents that is nurtured at universities and in private sector research labs. Having a comprehensive research funding system in Denmark is essential for capturing and promoting the most talented researchers and ideas within all academic genres. In this regard the Danish Council for Independent Research plays a central role as catalyst for young researchers in the early stages of their careers.

This testifies to the Council's emphasis on strengthening the growth segment of research. By providing funding through postdoc grants and the Sapere Aude Elite Programme, DFF is undertaking the important task of encouraging young researchers to pursue their research interests, thereby ensuring the presence of excellent research profiles within Danish research.

Sapere Aude

The Sapere Aude Programme offers the most talented researchers in Denmark the best possible conditions for conducting scientific research at the highest international level. DFF both invests in ground-breaking ideas and the researchers' careers through the DFF-Research Talent grants, Sapere Aude: DFF-Starting Grants and Sapere Aude: DFF-Advanced Grants. For Danish top level researchers, the Sapere Aude Pro-

gramme offers an important launch pad for an international career, and moreover it creates important synergy effects by furthering new expertise, e.g. in relation to research methods and the application of advanced equipment that the researchers are able to acquire for their Danish research environments.

Between 2010–2015, DFF has awarded 981 individual postdoc grants and MOBILEX grants to promising young research talents, and 411 grants under the Sapere Aude Elite Programme, 242 of which were Research Talent grants. In addition, the Council has awarded a large number of postdocs embedded in larger research projects.

Does it make a difference?

The question is whether it makes a discernible difference that the Danish research system focuses so heavily on helping the young research talents at the early stages of their careers? The answer is clearly 'Yes'. With its emphasis on scientific excellence and originality, the Danish Council for Independent Research serves as a catalyst for research funding from other private and public foundations, both nationally and internationally. For example, 95% of the researchers heading the Danish National Research Foundation's Centre's of Excellence between 2005 and 2015 have also been recipients of DFF funding, while 65% of those receiving European Research Council grants between 2007 and 2014 have previously been awarded one or more grants from DFF.

The effects of investing in the growth segments of scientific research are not just discernible here and now. It takes time to build a capacity of young elite researchers, whose task is to conduct research, as well as research-based teaching at the universities, contributing to a high level of knowledge as well as societal



growth and welfare. Some of these researchers will be collaborating with private enterprises and take up jobs in researched-based industries. At the same time, having a healthy growth segment is a precondition for allowing the universities to meet the future demands concerning prioritised areas of strategic research. The growth segment of Danish research ensures the necessary capacity to meet the knowledge demands of the future.

“In 2015, more than 50% of the Council’s grants have been awarded to researchers aged 40 years old or less. This testifies to the Council’s emphasis on strengthening the growth segment of research.”

Ideas generate new ideas

There is no shortage of research ideas. Autumn 2015 saw an 11% increase in the number of applicants competing for the Council’s research funds for 2016. The high number of applicants and the fierce competition among them actually go hand in hand with the Council’s focus on research excellence, helping to ensure that only the very best talents are awarded

funding for the most promising research ideas. In addition, due to the competition for the Council’s funds, talented young candidates are at an early stage encouraged to develop their research ideas into more ambitious projects, while the DFF grants give them an opportunity to establish a research career at a similar stage. In a survey among researchers conducted in the autumn of 2015, 97% of the respondents stated that their research carried out on the basis of funding from DFF became a source for new research ideas. Ideas can be turned into research that is valuable to both society and the business sector. ■

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<http://ufm.dk/en/research-and-innovation/councils-and-commissions/the-danish-council-for-independent-research>

deNO_x catalysis with copper zeolites

Susanne Mossin, Associate Professor at DTU Chemistry

Copper substituted zeolites are considered prime candidates as catalysts for reducing NO_x emissions from exhaust fumes. Until recently, the mechanism by which they work has not been fully understood, but researchers from DTU Chemistry believe they may have finally found the answer.

Stricter laws regarding emission requirements for exhaust gases are being introduced in many countries around the world as concern for the environment increases. Reducing NO_x emissions from the exhausts of diesel engines and power plants is an important part of this, which can be achieved through the selective catalytic reduction of NO to N₂ by ammonia, NH₃. Copper substituted zeolites have been shown to be effective catalysts for this reaction. Especially copper chabazite, which has been proven to be particularly useful for application in diesel engines, due to a high catalytic activity and resistance to the harsh conditions in the exhaust after treatment system.

These catalysts will no doubt see widespread use in the future, although a problem facing scientists studying them has been to understand the reactant mechanisms by which the catalysis occurs. Suggestions have been put forward and all have had shortcomings, but Associate Professor Susanne Mossin from DTU Chemistry believes that she, collaborators at Haldor Topsoe A/S and the



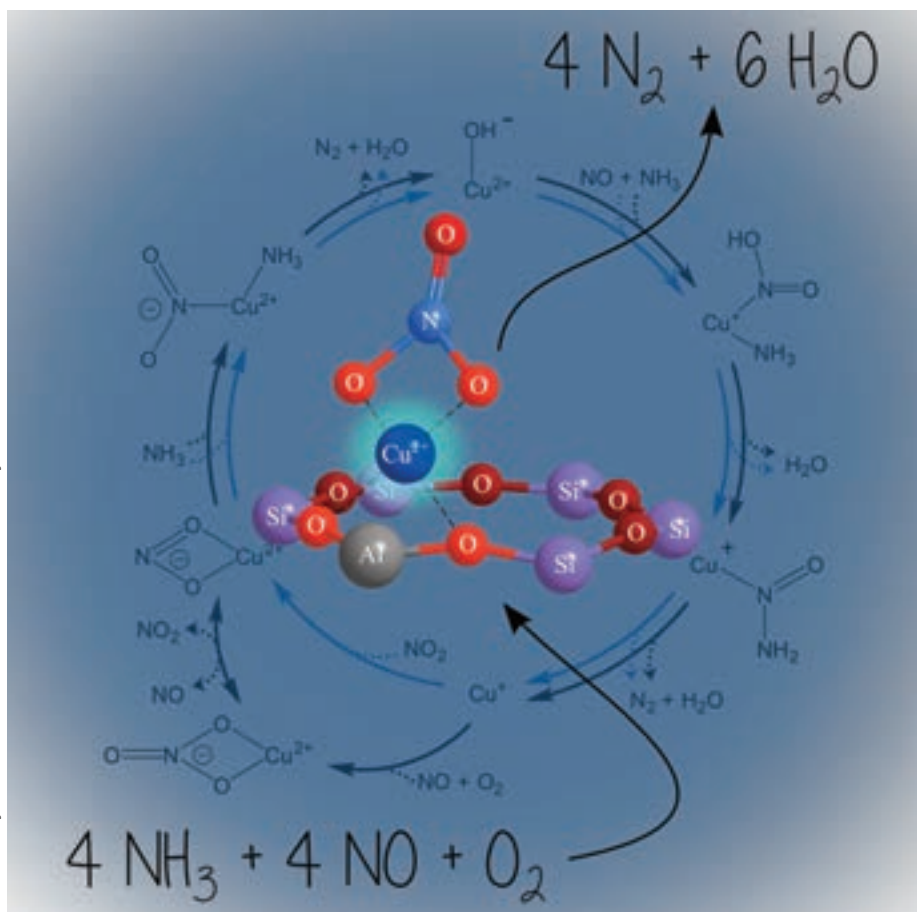
University of Turin have now solved the conundrum.

A new catalytic cycle

A specialist in electron paramagnetic resonance (EPR) spectroscopy, Susanne Mossin originally approached the task by evaluating the existing literature.

"I could see that the suggestions put forward for the mechanism did not seem right," she explains. "I tend to

approach these challenges from an inorganic chemistry perspective, so in the end, rather than try and find fault in these suggestions, we tried to come up with a solution working from the very beginning, writing down all the possible reactions that could take place between the molecules involved. After working on it for a while, everything suddenly fell into place and I could see straight away that we had something promising."



The catalytic cycle. For the first time a chemically consistent reaction cycle is suggested for the environmentally important selective catalytic reduction (SCR) reaction for removal of harmful NO and NO₂ from exhaust gases.

According to the scheme, which was recently published in the journal ACS Catalysis, the reaction can be very simply divided into a reduction of the catalyst by NO + NH₃ and an oxidation either by NO + O₂ or by NO₂. N₂ and water are produced in both the oxidation and reduction steps. Together these constitute a complete catalytic cycle. Every step of the cycle uses only stable molecules known to be present in the system, eliminating the issues of charged or “half molecules” present in other suggestions.

Since finding a solution to the catalytic cycle, Susanne Mossin, and her PhD student Anita Godiksen have been performing *in situ* EPR spectroscopy to back up their work.

“Catalysts do not enter their active state until you expose the catalyst

system to the conditions of the reaction,” says Susanne Mossin.

“It is therefore not good enough to investigate these materials with *ex situ* methods – you need to look at them under *in situ* or *operando* conditions.”

EPR spectroscopy is undemanding instrument-wise compared to other advanced spectroscopic methods, making it particularly suited for *in situ* and *operando* investigations for systems containing EPR active species such as copper ions. The relevant copper species have a distinct spectroscopic fingerprint that can be used to follow the distribution of species under elevated temperatures and under relevant reaction conditions. The information gained is complementary to the information gained from other methods. Collaborators

from the University of Turin have provided extra experimental evidence on the catalytic cycle in the form of *in situ* X-ray absorption spectroscopy and Fourier transform infrared spectroscopy.

Further investigation

With the framework for the catalysis mechanism now in place, Susanne Mossin will spend the remainder of the three year project confirming the individual steps, investigating differences between the different types of active sites, as well as looking for the mechanism of deactivation when the catalyst is exposed to high temperatures and traces of impurity gases.

“Knowing what makes a catalyst work and what stops it working is useful,” she explains. “Catalysts must be designed to fit specific criteria such as lifespan and stability. The more knowledge you have about how they work, the more you can tweak them to work more efficiently under certain conditions.”

Next step...

...is twofold: To use the unrivaled sensitivity of EPR spectroscopy to investigate the reactivity and rate of the individual active sites and to investigate the mechanism of catalyst deactivation.

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Funding research excellence in Germany

Adjacent Government highlights the work of the German Research Foundation and in particular their Excellence Initiative...

Research and development (R&D) are 2 key areas for public funding in Germany, as they are the basis for new ideas and technologies of the future. In 2013 the gross domestic expenditure on R&D in Germany was estimated at €80bn. Higher education institutions are said to account for 18% of this spending, while non-university research institutions such as the Helmholtz Centres and the Institutes of Fraunhofer-Gesellschaft invest 15% of the R&D total.

In recent years, Germany's power to innovate is said to have grown considerably. In order to further the growth in R&D, research organisations such as The German Research Foundation (DFG) aim to support and promote research excellence and facilitate national and international collaboration among researchers.

In its [mission statement](#), the Foundation states: *"In meeting its responsibilities as a research funding organisation, the DFG must remain abreast of current developments in higher education. In doing so, the DFG is able to*

address challenges such as the need to provide sustainable support for young researchers, the interdisciplinaryisation of the sciences and humanities, and support for networking in the field of research."

The DFG can achieve their mission through funding programmes such as The Excellence Initiative. This began in 2006/2007 and aims to promote top-level research and to improve the quality of German universities and research institutions in general. Through this programme the DFG hopes to make the country a more attractive research location, and internationally competitive.

At the beginning of the year the DFG outlined expectations of the research community with regards to the planned new federal-state initiative for further development of the Excellence Initiative.

Speaking in January 2016, Professor Dr. Peter Strohschneider, President of the DFG, detailed the aims of the Initiative.

"The Excellence Initiative had a clear objective, towards which the funding lines, clearly categorised by function and format, were oriented," he said. "The different criteria of the funding lines determined the competition, and the distribution of funds was in accordance with the results of this competition, as established through scientific review and evaluation and therefore with the aims of the Excellence Initiative."

"The key features of the new federal-state initiative will include a science-based selection process that will promote the transparency and acceptance of funding decisions. Indeed, it was the very nature of the trusting collaboration between politicians and the research community in the realisation of the aims in the Excellence Initiative, as well as the science-based nature of its processes, that earned this competition and the resulting funding decisions such exceptional recognition both nationally and internationally."

The DFG is jointly responsible for running the initiative together with the German Council of Science and Humanities. Between 2006 and 2011, €1.9bn in additional funding was received by the DFG for 3 funding lines of the Initiative:

- Graduate schools to promote early career researchers;
- Clusters of excellence to promote top-level research;
- Institutional strategies to promote top-level university research.

In June 2009 the Initiative was given approval for a further 5 years from the federal and state government, allocating €2.7bn of funding for the period 2012 to 2017.

"The DFG, which has acquired a wealth of experience in the Excellence Initiative, has described many times over the last 2 years the directions that it believes the funding formats and processes of the new round of competition should follow," said Strohschneider.

"We have proposed concrete development measures for the clusters of excellence funding line, which have

been broadly welcomed both in the research community and by politicians.

"The broad consensus in the DFG is that the following points are crucial in the new initiative as a whole: Funding lines and procedures must satisfy the standard of excellence; universities and top level research must be the focus of all measures; and there must be a competitive process at the level of both research fields and institutions.

"Equally importantly, there must be openness in competition for all research fields and topics, there must be funding periods that can extend beyond normal project durations, and there must be access to the competition for both previously funded projects and new proposals," he said.

The DFG is the largest independent research organisation in Germany and its work to support and promote research across the country is integral to its success. As well as supporting researchers already in work, the DFG is leading the charge to support new young researchers make their first proposals for creative and innovative ideas.

The DFG provides useful information to young scientists in the process of submitting their first funding proposal. Through programmes such as this and the Excellence Initiative, research in Germany has some great backing and the ability to grow and tackle some of society's main challenges. ■

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Ageing, immunity and metabolism

Ageing and age-related morbidity is unavoidable at the moment, but research to understand and alleviate age-related health issues is the need of the hour to ascertain healthy-ageing...

Ageing

"Youth is the gift of nature, but age is a work of art". Stanislaw Jerzy Lec.

Ageing is the process of growing older. Every living being undergoes this process which is genetically determined but modulated by various environmental factors. Demographic ageing is characterised by increased mortality rate and decreased reproductive rate. The aged population in the world is rapidly increasing. WHO estimates that between 2020 and 2050, the world's population above 60

year will increase from 12% to 22%. Already, by 2020, the number of people aged 60 year and older will surpass the number of children younger than 5 years. Currently this demographic shift is being sensed in developed nations and focused measures to improve health and social systems are discussed. However, older people are increasing in low- and middle-income countries at an alarming rate. Therefore it becomes a global challenge to ensure that health systems are in place to accommodate this demographic shift. Ageing and

age-related morbidity is unavoidable at the moment, but research to understand and alleviate age-related health issues is the need of the hour to ascertain healthy-ageing.

Metabolism and Immunity are fundamental for survival

Metabolic and immune systems are fundamental for any organism, as the ability to tolerate under energy limiting situations and to fight against pathogens are vital for their survival. Infections pose the strongest selective pressure on immune systems and



Dr. Nirmal Robinson
Principal Investigator

mankind, particularly after the massive decline in population during periods of infectious disease epidemics and pandemics. Hence, deterioration of immune and metabolic functions are hallmarks of most of the age-associated pathologies. Interestingly, metabolic regulation and immune responses are integrated. This is evident from many infectious diseases; e.g. infectious diseases caused by pathogens such as, *Mycobacterium tuberculosis* and HIV can lead to disruption in metabolism and result in wasting of metabolically active lean tissues. This phenomenon is also apparent in patients with cancer, obstructive pulmonary disease and congestive heart failure. Tissue wasting is mediated by inflammatory cytokines such as tumor necrosis factor alpha (TNF- α), interleukin-6 (IL-6) and interferon gamma (IFN- γ), which are components of the immune system. On the other hand, several metabolic disorders such as diabetes and obesity possess a chronic inflam-

matory condition, which is thought to propel the pathology associated with these diseases.

Intimate relationship between metabolism and immunity

When nutrient availability is diminished, an organism opts to operate in an energy efficient mode. For instance, cells undergo autophagy, a process by which some of the damaged cellular components such as damaged-mitochondria are taken into a vesicle, degraded and recycled to derive energy. This process is analogous to products made out of recycled materials, and it also cleans up the intracellular milieu. During this time pathogens that present within the cells are also taken for degradation and the immune system is alerted (e.g. autophagy is employed by immune cells in clearing intracellular pathogens such as *Mycobacterium tuberculosis* and *Salmonella Typhimurium*). In laboratory animals, autophagy, which is triggered upon caloric restriction have also been shown to increase lifespan. A cell can also utilise alternate resources such as lipids instead of glucose to derive energy when glucose availability is reduced, thereby depletes stored fat. However, when surplus nutrients are available, the metabolic state which was beneficial could lead to the storage of excess fat and its associated diseases. A combination of these traits to use energy efficiently during strife and to use metabolic functions to mount immune responses have given rise to a biological organisation that is not only capable of processing and storing energy but also utilising the metabolic pathways to generate immune responses.

“WHO estimates that between 2020 and 2050, the world’s population above 60 year will increase from 12% to 22%. Already, by 2020, the number of people aged 60 year and older will surpass the number of children younger than 5 years.”

Understanding the molecular mechanisms which tether the energy generating metabolic and immune systems is very important to resolve age-associated diseases and improve health span. *“Hackers don’t take realities of the world for granted; they seek to break and rebuild what they don’t like. They seek to outsmart the world”, said Sarah Lacy.*

Similarly, pathogens which hack our immune system break in and rebuild it to their advantage. Therefore, in our laboratory we have chosen to follow the pathogens to understand the intricate molecular interface between metabolism and immunity.



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Religious elites and societal organisation in south-eastern Europe

Dr. rer. pol. Jochen Töpfer of the Free University of Berlin, Institute for East European Studies outlines how region can play a role in modern society...

The relationship between traditional religion and processes of modernity is a central issue in contemporary public discussions, as well as in debates within the field of social sciences. The latter shall ask about short-term incidents like topics such as Islamist terrorist attacks, anti-Islamic populism, and new developments in the Arabic world, which prevail in the daily news, give an empirical basis, and integrate them into long-term concepts. Overall, there is a strong relevance of a scientific analysis of religion in pluralist society today.

The research project 'Religious Elites and Societal Organization in South-Eastern Europe' includes two central issues. The first one is to detect types of attitudes regarding the societal order within the religious elite of south-eastern Europe without a normative background. Thus, this part of the project also has no thesis and seeks to find out the perspective of the religious sphere in an explorative way. Several major branches of Christianity and Islam are traditionally rooted in this region, so the second part asks for the integrative as well as the conflict-afflicted potentials of religion in multi-religious societies. Do these attitudes have rather integrating or separating consequences for society? And how important is religion at all in building identity today? Are reasons for so-called 'religious conflict' located exclusively within the religious sphere,

Image: © Dr. rer. pol. Jochen Töpfer



or rather caused by external factors as political power arrangements? The selection of cases is based on the specific differences in the structure of the religious field and comprises Albania, Macedonia, and Slovenia.

Why south-eastern Europe?

In order to represent the traditional religions and religious communities with a large amount of followers in Europe adequately, central types of attitudes of religious dignitaries towards the triangle religion – politics – population in multi-religious societies of south-eastern Europe are in focus. Here, Christianity with its major branches (Roman-Catholic, Orthodox, Protestant), Islam (mostly Sunni but also Shiite), and other religious communities are represented since centuries. Since the collapse of socialism

in 1989 and the beginning of transformation of the societies in Eastern Europe, religion experienced a recovery and was able to enhance its influence over wider parts of society and politics.

Why religion today?

Today, we as Europeans experience a strong revival of religion in the public and political sphere as daily news indicate (terrorist attacks in the name of a religion, 'Anti-Islam' movements that become violent, and the reaction of democratic politics). Additionally, above-mentioned remarks show that religion was brought back to the political arena recently by political actors in south-eastern Europe. Hence, religious dignitaries are able to influence the (positive and negative) political decision-making of parts of the population. Over the 20th century, they lost

their function as economic and political power-elite but can be regarded today as value-elite.

The existence of attitudes towards the societal order originates also from considered world religions themselves: a major characteristic of them is the claim to handle reality in its entirety ('Ganzheit') – hence, they follow a holistic program.

How to catch attitudes adequately and consider subjectivity

In order to determine these attitudes adequately, an innovative qualitative method¹ is applied which refers explicitly to the internal frame of reference of the respondents, called Q-method. It is designed for explorative approaches; e.g. a data collection in areas of society which were rarely subject of scientific analysis before. The method takes into account the subjectivity of the researcher and of the respondents: Therefore, no questions for the interview are pre-formulated, which would ask just for the acceptance of models of the researcher among the religious elite. In a first step, a scientific content analysis of speeches and public statements of religious dignitaries in Albania, Macedonia, and Slovenia was conducted. Extracting 36 central statements regarding the topic, the researcher in a second step presents these to the religious dignitaries in focus, who are the origin, and asks for a grading and a comment of them.

The Q-method needs a relatively small number of respondents (20-40) in order to explore types of attitudes within a group in focus. Although the field work is not completed, results of a first analysis show two central types of attitudes: rather modern and progressive views prevail in a first group of respondents, while conservative attitudes can be

located just in a minority of cases whereas the overall potential for religious conflict is rather small.

Goals

After a quantitative and qualitative analysis of all three societies and a comparison of attitudes, the results shall answer the questions: Which discourses dominate within religious communities in south-eastern Europe towards the society, the state, and other religions? And, how far do these perceptions correlate with current societal arrangements? Identifying discourses in the framework of the project does not mean you need to focus on short-term issues or scandals – rather, long-term conceptions of society are of interest.

The specific goals of the project are manifold and can be classified along four groups: theoretical as well as empirical objectives following current debates in the social sciences, links for further research, and the generation of applicable recommendations for policy makers (and responsible persons in the religious sphere).

The overall goal is the detection of attitudes towards the above-mentioned triangle of religion – state – society from the perspective of religion and more precisely of religious dignitaries. From the point of view of the scientific discipline of sociology of religion, there are only very few empirical studies asking for the attitudes of religious elites towards the societal order in the multi-religious sphere of south-eastern Europe. Beyond external ascriptions – which discourses can be revealed by the application of the Q-method? Where are convergences and divergences – among different religions, states, or communities? Do these attitudes foster cultural and political integration or exclusion in the societies under scrutiny?

Results from the empirical study are able to bring about conclusions also for the development of existing theoretical models in branches of science as 'religion and politics' or 'religion and conflict' that are of importance to a wider public audience. The first contribution in the area of religion and politics is the capture of the actual spectrum of attitudes of religious elites and a comparison with classification about the relationship of religion and politics. In the area of religion and conflict there is the need to ask whether religion is an important element of basic distinctions between social groups and to analyse here the differences and convergences in intra- and interreligious comparison. Additionally, patterns for analysing sources of societal conflict can be specified.

The third point is the strong connection to further research. On the empirical side, a basis is produced for the quantification of the results. To what extent are the attitudes and discourses represented among religious people or the whole population? Additionally, the types of attitudes found in south-eastern Europe can be surveyed in other societies of the continent in order to see their distribution.

¹ Contrary to its rare application in Social Sciences, there's extensive scientific literature on Q-method available. See also the International Society for the Scientific Study of Subjectivity (ISSSS).



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Strengthening science and research in Portugal

Adjacent Government highlights a speech by Portuguese Minister of Science, Technology and Higher Education, Manuel Heitor, which details key priorities over the coming years...

Science in Portugal has been steadily progressing over the last 20 years. Under the responsibility of the Ministry of Science, Technology and Higher Education, the country has gained a place in the international research panorama. Manuel Heitor has been the Minister responsible for this area since 2011, having previously filled the role of Secretary of State from 2005.

Under the auspices of the Ministry is the Fundação para a Ciência e a Tecnologia (FCT), which is Portugal's national funding agency for the support of science, technology and innovation in all domains. Since being established in 1997, the FCT has continually promoted the advancement of knowledge in science and technology across Portugal.

“It remains an ongoing effort to support scientific activity, its institutions, relationship mechanisms and proximity to society.”

In a speech delivered in February announcing the new Board of Directors for the FCT, Minister Manuel Heitor outlined the priorities of the government over the next few years, as well as the role that the FCT and new Board of Directors will play in the science and research arena.

“It is now the consensus in Portuguese society that FCT has been an essential entity for the development of science and technology in Portugal. Following the investment in training and development plan in recent decades this has contributed to its success and the results achieved. Their role has been fundamental to the rationale, development and affirmation of the Portuguese scientific system, and to the development and internationalisation of researchers, universities, polytechnics, scientific institutions and production of science, including the introduction of practices and

evaluation methodologies indispensable to national recognition and internationally.

“FCT has established itself as an indisputable reference on a national and international level, recognised and respected by the academic and scientific community. However, in recent years, the policy options that were imposed by changing expectations and priorities of scientific development and the national technology plan, led to growing criticism and debate, generalised to the entire scientific community.

“It is exactly the reverse of this process and the reaffirmation of the mission of FCT, as the central institution in the implementation of science and technology policy based on appropriate assessment practices and funding, which I entrust to the new Board Directors FCT.

“Our priority for the coming months and until 2017, when we celebrate 50 years of the creation of JNICT and 20 years of the FCT, is to establish an indispensable framework for strengthening the autonomy of academic and scientific institutions, implement an evaluation system based on best practices and recognised by the community, and ensure a scenario of stable funding projects and R&D activities.

“In order to meet these objectives, we ensured that the proposed State 2016 budget delivered last week devotes a budget change, finally reversing the little investment in science, technology and higher education, which we all targeted in recent years.

“But times are bringing increasing demand and great fiscal restraints, requiring a community of co-responsibility in the context of science for the development of Portugal, as well as in the first instance, the agents of science policy, including the FCT, playing a unique

role in Portuguese society. Immediate priorities of FCT will be:

- Ensure in the coming weeks the launch of a new process and evaluation system of R&D activity, complying with international standards and clear and transparent rules recognised by the scientific community. This will give credibility to the practice of independent scientific assessment, excluding the use of irresponsible and uncritical metrics for evaluation and ensuring processes allow the use of results as a strategic management tool within institutions;
- Ensure a versatile and open organisational environment for innovation, able to provide institutional and financial stability essential for the proper functioning of institutions;
- Encourage and support the continuous renewal of the scientific community, ensuring generational transition and maintenance of scientific capital via the statute for research and teaching careers; Guidance for the Foundation for Science and Technology, FCT.

"I would also like to refer to two critical issues for FCT and science policy, which we are now promoting.

"First, the absolute need to promote the dissemination and sharing of knowledge; promoting the systematic dissemination of results of R&D activity, along with the development and coordination of digital repositories and pursuing an active strategy on open access. It is in this context that today, we also launched the principle of national open science policy collaboration and close coordination at the European level.

"We intend to ensure comprehensive open access to content, data and results of scientific research activities funded by FCT.

"Thank you for the action of the Secretary of State Fernanda Rollo in preparing this policy and its implementation in the coming months, in close collaboration with scientists and researchers, FCT, and all those involved in and with access to scientific information.

"Secondly, it is crucial to strengthen the development of the social base of support for knowledge and

systematic R&D activity. So today we also launch a new action policy to strengthen research activity in the polytechnics and value its impact on Portuguese society and economy.

"The network infrastructure and integrated human capital in polytechnics at the national level is an important asset with strong regional integration, and it should be promoted to stimulate the development of regions and the country. It requires incentives, and it is for this purpose that FCT and ANI, the Coordination Committees and Regional Development, local authorities and the Agency Life Science, are launching a programme of support for R&D activity, specifically dedicated to polytechnics.

"This is a structured programme in observational skills specific to each polytechnic and territorial, economic and social context of which it is part, considering the system as a whole and the clear importance for the development of the country and the valuation of each particular region.

"Betting on knowledge and strengthening polytechnics represents a collective responsibility which must be continuous and persistent, demanding the participation of all of society, involving, at all levels, its various political, social and economic actors.

"It remains an ongoing effort to support scientific activity, its institutions, relationship mechanisms and proximity to society.

"Certainly investing in advanced training and scientific jobs brings scientists closer to the general population and especially its young people, encouraging public participation inform agendas of scientific and cultural development." ■

The full version of the speech can be viewed here –

https://www.fct.pt/docs/Intervencao_Posse_FCT_10fev2016.pdf

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Building bridges between research and society

Joana Camilo, Executive Director of CREATING HEALTH outlines how Universidade Católica Portuguesa (UCP) is a leading research university and presents its new office dedicated to support institutions to apply to health research and innovation funding...

“A solid reputation, a passion for research, a commitment to a better future. This is Católica – visit us and feel inspired”

(Maria da Glória Garcia, Rector)

Universidade Católica Portuguesa (UCP) is a leading research university with a humanist vision committed to the well-being of society, with a global outreach and ground breaking contributions in all areas of knowledge.

A propitious environment for teachers and students, along with a competitive hub for research and innovation (R&I), are provided by UCP through its 4 regional campi (Lisboa, Porto, Braga and Viseu), favouring strong intersectoral ties to the surrounding regions. In addition to the commitment to fundamental research, the University is recognised for both the social impact of its research agenda and its contribution to policy making.

UCP's Research Strategy (UCP2020) for the upcoming years focuses on subjects that meet transversal and complex social challenges, gathering research domains with international excellence that produce a differentiating global impact: 1) economy and digital culture; 2) environment, health and sustainability; 3) citizenship and social responsibility; and 4) memory, change and innovation. With an intellectual and inherently international agenda, the UCP2020 Strategy aims to



advance research and impact knowledge production, to foster international and intersectoral cooperation, and to contribute to the global innovation agenda.

UCP is leading research in the areas of business, social sciences and biotechnology, having within the National Scientific System one of the 26 Portuguese Associate Laboratories – the Centre of Biotechnology and Fine Chemistry (CBQF) – and two nationally recognised Excellence Research Centres in Business & Social Sciences – the Católica Research Unit in Business and Economics (CUBE) and the Research Centre for Communication and Culture (CECC), as well as the recently created Interdisciplinary Research Centre in Health (CIIS), which works across different areas to tackle socially relevant scientific challenges in the fields of health and ageing.

The core competences of CBQF are based around biosciences, analytical

chemistry and engineering applied within two main thematic challenges: Health and well-being of the citizen and the competitiveness of agriculture and food. CUBE, hosted by the Católica Lisbon School of Business and Economics – ranking 25 on the Financial Times Business School List – elected as main research areas: economics and evaluation of policy; business and banking, namely proving its capability to translate fundamental research into policy-making tools, such as the Patient Innovation Platform. CECC's research agenda focuses on the development of studies at the intersection of a) culture and conflict; b) cognition and creativity; and c) media and digital innovation. This Centre has done extensive work across the social and cultural impact of risk and hazard. CIIS, under UCP's Institute of Health Sciences (UCP-ICS), has research programmes ranging from dentistry to nursing (in tandem with the national School of Nursing), public health and also excels in the areas of cognition,



neurosciences and aged related diseases (Parkinson, Dementia, and Alzheimer).

Recognising the importance of efficiently exploring the European funding opportunities for health R&I in a professional but affordable manner, the researcher and Head of ICS Public Health Department, Ricardo Baptista Leite, felt the need to create an office that could provide the required assistance in applying to European funding for health R&I projects, releasing both institutions and researchers from its time-consuming and sometimes discouraging technical procedures.

In current moments of budgetary restraints, the European Union HORIZON 2020 programme is the oxygen mask many researchers and companies are looking for to allow their research and innovative projects to breathe and hopefully improve people's health.

Within this context, «CREATING HEALTH – Research and Innovation Funding» Office – launched by the UCP-ICS – opened its doors to any institution in 2015, providing support at the pre-application stage, throughout the preparation and submission

of the application, and if necessary post-award assistance.

To accomplish its mission, the office gathered the support of 16 private institutions and the High Patronage of the President of the Portuguese Republic and of the Portuguese Government.

Who we are: CREATING HEALTH is a non-profit office that provides support for applying to the multiple health R&I funding opportunities under HORIZON 2020 and other programmes, with the guidance of a Scientific and Ethical Council and a Social Council, aimed at extending the social impact of its mission by bridging research and society.

What we do: endorse the fulfillment of the national R&I potential by providing a tailored support to access European and national funds for health related projects. This office also bestows international collaborations by bridging local and international players in order to establish strategic and synergetic partnerships for building competitive consortia.

Who can rely on us: all entities (academia, scientific institutions, health

care providers, NGOs like patient associations, public and private companies, etc).

Why CREATING HEALTH: this office distinguishes itself by its public, academic based, non-profit and specialised in health R&I funding services.



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Future-proofing our talent pipeline – A national approach

Niamh Lyons, Interim Director of communications, Education and Public Engagement at Science Foundation Ireland highlights the importance of STEM in Ireland, and how the funding agency is supporting projects in this arena...

A St. Patrick's Day card I received this year told that the Intel Quark chip which is powering the internet of things around the world is proudly marked 'Designed in Ireland'. The card also extolled the engineers and scientists working in Ireland who are responsible for the production of 80% of the world's life-saving stents and 33% of the global requirement for contact lenses. Only days before a local supermarket sent a brochure of great things to do during Easter school holidays with a full 2 page spread dedicated to science experiments to explore at home. There is a sense that the true importance and relevance of science, technology and engineering in our lives is bubbling up amongst the Irish public to take its place in our culture alongside our recognised ability as writers, poets and artists. With the #ScienceRising campaign, Science Foundation Ireland aims to build on this emerging pride and motivate industry, the public and policymakers to celebrate our innovators, discoverers,

inventors, scientists, coders, engineers and entrepreneurs. To stand proud of past achievements and confident of the future potential and it couldn't be more important than now to do this.

Globally we face challenges. The world population is estimated to grow to 8 billion people by 2020. Experts are predicting that existing land used for food production will need to increase yield by 70% by 2050; challenging when more people will live on what land we have and climates change. Solutions from how we feed this population to ensuring our aging population enjoys good quality of life to protecting and using the information and data we produce as citizens every minute of the day rely heavily on the public engaging, debating and developing skills in the areas of science and technology. In January 2016 the National Skills Strategy for Ireland identified that leading employment sectors in Ireland will need to fill over 200,000 jobs by 2020.

Over 70% of these jobs will be filled by those with backgrounds and qualifications in science, technology, engineering and maths, widely known as STEM. As the national funding agency for research in these areas Science Foundation Ireland is committed to achieving the most engaged and scientifically informed public in Ireland. What does this mean to the agency? An engaged public understands the role of science in our society; it can debate on competing priorities and arguments; it encourages our young people to be curious and confident to study STEM; and it feels engaged with, and has an influence upon, research.

We are all shaped by the environment we grow up in. Research has shown that people are more likely to go on to study in STEM if they have grown up with families and friends who actively embrace science as part of normal life. These families view is that science is for everybody and not just for the elite. With such skills needs facing the Irish economy, it is important to create a science culture where people value the underpinning role of science and technology in their lives and how it addresses the economic, social and environmental challenges we face as a society.

In 2015 the Science in Ireland Barometer research was commissioned by Science Foundation Ireland. The research sought to examine the Irish public's awareness and value of STEM in our society. Amongst the results the barometer found that 1 in 2 people in Ireland feel informed in science and technology but 71% feel that these areas are often too specialised to understand. These findings have informed national targets set out in the national science strategy, Innovation 2020, and the National Skills Strategy 2025. The barometer also identified particular groups within Irish society that are more disconnected from science such as those from socially or economically disadvantaged backgrounds and in particular those aged 30-55 and women. These findings, which are reflective of similar research throughout the western world, have directly informed the Science Foundation Ireland approach to engaging the public.

Through its education and public engagement programme Science Foundation Ireland aims to build public confidence and pride in Ireland's STEM achievements to date and our future potential. The diversity of projects supported through the programme ensure that there is an offering for a wide cross section of

society. Some of the projects are large scale, one off type events like festivals and others are deeper engagements such as mentor projects, teacher supports or developing coding skills. In 2015, Science Foundation Ireland directly managed initiatives such as Science Week and Smart Futures, a careers role model programme. It also supported the wider research community to engage with the public and through its Discover funding call funded 54 new projects with a direct audience reach of over 4.6 million people. In 2016 a further 42 initiatives have been supported through the call to reach over 3.6 million people by the end of 2017.

Since 2015 Science Foundation Ireland entered a joint agreement with the national broadcaster RTÉ to catalyse an increase in science related programming. The objectives of the agreement are to encourage the broader public, who normally don't engage in typical science or technology programming, to tune in. At the same time the Discover funding call invited broadcast proposals from other national broadcasters, film makers and animators. This strategic approach has resulted in Science Foundation Ireland supporting projects such as a big-event live programme on technology in our rural lives, a comedy panel series, documentary film making, a travel series, and a science in sport programme. Brain Freeze, co-supported by Science Foundation Ireland, CBBC and RTÉ, picked up the Kid's Choice Award for Best Animated Series at the Irish Animation Awards.

Science Foundation Ireland has concentrated on building networks and shared knowledge of practice amongst the public engagement community. The agency will commission a further Science in Ireland barometer in 2 to 3 year cycles to measure the impact of this engagement portfolio with the aim of a noted improvement on the attitudes of the Irish public to science, technology and engineering in our lives. ■

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Niamh Lyons

**Interim Director of Communications,
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HPC fuelling innovation: The Irish experience

Jean-Christophe Desplat, Director at the Irish Centre for High-End Computing (ICHEC) explains the benefits of high-performance computing...

High-performance computing (HPC) has emerged as a key platform technology of modern times. Its ability to boost performance and speed is transforming domains such as energy exploration, environmental monitoring, next-generation computing and medical devices, to name but a few.

People often assume that HPC simply means supercomputers, but supercomputing is just one aspect, and the growth of cloud computing will make HPC services more readily available.

High-performance = high-power

HPC lets us make better use of big data and computer modelling. Practical outputs include more accurate weather forecasts to help mitigate the deadly impacts of extreme weather events, and HPC will underpin the emerging Internet of Things and decision-making in the increasingly interconnected digital economy and the Digital Single Market.

This power has not gone unnoticed, the European Commission now regards HPC as essential for innovation, growth and jobs¹ and its impact, both societal and economic, is gaining widespread recognition with leading policy-makers such as the Commissioner for Digital Economy & Society, Günther Oettinger. Through the planned European Open Science Cloud, Europe is putting in place infrastructure

to ensure it participates in the global race for high-performance computing.

There are plenty of reasons why HPC can boost productivity and innovation. It performs at speed and it increases energy efficiency, which means we can do more in less time with less power. It enables upscaling, high-throughput and handling of larger datasets, problems and models, and we can process large volumes of data in near real-time, which is critical for financial services, telecoms and harnessing satellite imagery.

Ireland: small country, big ambitions for HPC

The Irish Centre for High-End Computing (ICHEC) provides the National HPC Service to academia in Ireland, supporting more than 1,400 researchers to date. It also conducts industrial R&D collaboration across sectors including high-resolution weather forecasting, bioinformatics, oil & gas exploration and remote observation for precision agriculture and land planning.

ICHEC's strength comes from its human capital and its expert technologists, which places Ireland at the forefront of HPC-enabled innovation. This expertise allows ICHEC to engage in high profile R&D collaborations with leading companies as part of its industry engagement programme.

So where is ICHEC making its mark?

Mining for energy resources

At ICHEC we focus on challenges posed by data-intensive applications. The oil and gas industry faces such a challenge: exploring for underground resources involves processing extremely large seismic datasets. However, much of the software used on a daily basis in the field was built before the era of big data, which makes it difficult to process information within a required time.

Together with Tullow Oil plc, and HPC storage specialists DDN, ICHEC is researching and developing leading-edge data management software for handling large seismic datasets. A new, three year research project funded by Science Foundation Ireland is expected to make an impact in the energy industry through more cost-efficient and time-effective exploration.

ICHEC is also at the forefront in promoting the use of renewable energy technologies in Ireland. We have collaborated with Irish energy companies on prediction modelling and data processing to generate high-resolution short-term forecasts of wind and solar fields for use in renewable energy applications.

Eyes on Earth

The new "Sentinel" generation of Earth Observation satellites provides an unprecedented capacity for monitoring our environment for climate change, agriculture and maritime



safety. ICHEC is working with Irish technology company Skytek to provide an archive for the European Space Agency for Sentinel and other data. A portal will provide archived products, real-time data and on-demand processing for public sector and commercial users in Ireland.

ICHEC also operates an Earth System Grid Federation node, providing climate model information to scientists around the globe, supplying the data we need to manage and adapt to climate change.

Next-generation software

As one of the very first Intel Parallel Computing Centres (IPCCs) to be established by Intel, ICHEC has positioned itself at the leading edge of many-core R&D, HPC software design and end-user exploitation.

ICHEC's focus is currently placed on "revolutionary" approaches for next-generation computing platforms.

In close partnership with Intel engineers, we are investigating advanced parallel programming methods, models and tools to modernise and re-factor complex and mission-critical software applications across a wide range of domains, including materials science, weather forecasting, ocean-wave modelling, seismic imaging and cryptanalysis, and the core aim is to significantly boost software performance and lower energy costs.

New blood test

At ICHEC we like HPC to get to the heart of a problem, and our ongoing collaboration with Prof. Dermot Kenny at the Royal College of Surgeons in Ireland, Prof. Antonio Ricco at Stanford

University, NASA Ames and Dublin City University, and more recently the global medical technology company BD (Becton, Dickinson and Company), is no exception.

The consortium is developing a point-of-care technology for heart disease that monitors the behaviour of small particles in the blood called platelets. The patient provides a small amount of blood, which is then videoed as it flows on a vascular protein-coated surface within a microfluidic chip.

HPC has shortened the time to results from 24 hours down to five minutes, and the ultimate end product could help doctors to quickly identify individuals at risk of heart disease and better manage existing patients who are commonly prescribed anti-platelet medication.

Transformative technology

HPC is a transformative technology of global significance. As a small country, Ireland cannot compete on infrastructure, but the renowned expertise of our HPC technologists can ensure that we play a role in significant international developments in this key international platform.

¹ <https://ec.europa.eu/digital-single-market/en/high-performance-computing>



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Using semantic technologies for GRC in the financial industry

Peter G Cowap and Professor Tom Butler from the GRC Technology Centre

Much has changed in the financial industry since 2008. In 2016, the industry faces higher levels of regulatory oversight than ever before. This is reflected in the truly enormous volume, variety, breadth, and complexity of regulations that need to be complied with. This places burdens on financial organisations of all shapes and sizes. While compliance with regulatory principles and rules is now more problematic, so too is the management of risks, such as operational risks, particularly sub-categories such as conduct risk and cyber risk. Thus, the problems of governance, risk management, and compliance reporting have grown to almost unmanageable proportions.

In response to these challenges, the Governance Risk and Compliance Technology Centre (GRCTC) was instituted in 2013 by Enterprise Ireland and the IDA, on behalf of the Irish Government. Its mission was to investigate how semantic technologies could be employed to solve the problems of regulatory compliance and risk management in the financial industry. In this, the GRCTC is unique as it is the only industry-led, multi-institutional, and multi-disciplinary research centre to be addressing such problems.

Avoiding the groundhog day of regulatory compliance in the financial industry

It is clear from our research at the GRCTC that the approaches financial institutions are applying in order to

deal with the mountain of ever-complex regulations are analogous to that of the mythical Greek King Sisyphus, or the experiences of Phil Connors, the central character in the film *Groundhog Day*. Financial institutions are seemingly repeating the same regulatory compliance process over and over and are not developing a cumulative knowledge of financial regulations and rules. They are effectively stuck in what Harvard Business School Professor Chris Argyris called single-loop learning. Take the Markets in Financial Instruments Directive (MiFID), for example, researchers at the Governance Risk and Compliance Technology Centre found no evidence of cumulative, double-loop learning in major financial institutions as they began to address MiFID II. And so it will be with MiFID III, when it comes along, as the organisational mental models or knowledge bases are not enriched by previous experience in unpacking MiFID II.

The multi-disciplinary team of researchers at the GRC Technology Centre have developed a standards-based methodology for unpacking regulations and extracting the knowledge contained therein. The methodology's semantic model and related guidelines form the architectural basis of a prototype software application called Ganesha – named after the Hindu God associated with wisdom and learning, and known as the remover of obstacles. Ganesha is designed to be both a regulatory compliance information system and knowledge

base. Based on the Object Management Group (OMG) standard, the Semantics of Business Vocabulary and Rules (SBVR), the methodology, guidelines, and Ganesha software application enable business practitioners to capture regulations in a Regulatory Natural Language (RNL), that is both human readable (in structured English) and machine readable in XML and, in a future version, RDF/OWL. Essentially, it stores the unstructured data of a regulatory text or rule as semantically enriched structured data in XML and, ultimately, in an RDF triple store or knowledge base. This XML data store/knowledge base can then be queried using Xquery/SPARQL to identify obligations, derogations, exemptions, exclusions, etc. expressed as regulatory rules. The advantage of this approach is that an organisation can cumulatively build a knowledge base of regulations represented as regulatory vocabulary elements and regulatory rules.

Ganesha currently provides the capabilities for legal or financial SMEs to cumulatively build disambiguated and clarified vocabularies and rules in a regulatory natural language (RNL) that is complete, logical and free of legalese, complexity, and ambiguity. We are also developing the capability to use a combination of semantic technologies such as our Financial Industry Regulatory Ontology (FIRO) and standard Natural Language Processing (NLP) tools to identify, extract and load into Ganesha obligations, prohibitions and so on, in a semi-

structured XML format thereby automating part of this process. Building on these innovations, sophisticated tagging of knowledge in SBVR-compliant XML documents by the Ganesha application provides powerful capabilities for practitioners to query, extract, transform and load regulatory compliance information into a user interface for the purpose of knowledge sharing or training inexperienced personnel. Future versions will enable the creation of knowledge bases using semantic technologies such as RDF and triple stores.

Navigating the digital labyrinth of structured and unstructured data

At the core of many of the problems financial institutions face in managing risk is the manner in which they manage their data – structured and unstructured. In contrast with regulatory oversight, the approach has seen little change since 2008. It remains to be seen whether BCBS 239 will herald in a new era for risk data governance, let alone risk data aggregation.

In an industry that generates more data, and spends more on its storage than any other, there still persists a basic inability to manage that data, to interconnect it, link it with external information, and to make inferences from disparate and diverse data, wherever it exists. This makes risk management and compliance reporting hugely problematic and expensive.

The solution to the problem of the digital labyrinth is technically feasible and practically possible, although there are few players in the market providing comprehensive solutions for the financial industry. One approach that is receiving much attention is Data

Virtualisation. This approach provides access to data directly from one or more disparate data sources, without physically moving the data, and presenting it in a form that makes the technical complexity transparent to the end-user. There is broad agreement across industry sectors that semantic metadata is required to make data virtualisation and other NoSQL approaches work.

In our view, semantic metadata should be expressed in the Web Ontology Language (OWL). Indeed this is exactly the approach adopted by the EDM Council and the application of their Financial Industry Business Ontology (FIBO). In the area of operational risk, we have created the Financial Industry Operational Risk Ontology (FIORO). Two approaches are then available to underpin data virtualisation. In the first, the ontology-based semantic metadata is used to develop SPARQL queries, which are then translated to SQL queries that are then used to query relational database silos and extract the data of interest for further analysis, without disruption to the financial systems of record. In the second approach, semantic technologies are used to perform extraction, Transformation and Loading (ETL) of data from heterogeneous data stores, such as relational databases and spreadsheets, into RDF and persist it in a triple store, which is one type of graph data store. A combination of semantic metadata and instance data in the RDF triple store will enable enhanced querying and relationship identification among data. The existence of a semantic metadata in OWL will also enable sophisticated inferencing of data, to identify previously unknown relationships. Take, for example, FIORO, which could be applied to

the classification of operational risk data with greater precision through the semantic enrichment of multiple relational databases and other data stores. It could also enable enhanced predictive analytics using the data.

Once of the clear benefits of such a model is that the semantic metadata model in OWL with instance data in RDF, and using Uniform Resource Indicators-URIs, is that such models can be linked automatically with related semantic models like the Financial Industry Business Ontology (FIBO) and any other standards-based knowledge base. Also unlike traditional SQL-based approaches, the model can be extended easily. In addition, adopting such an approach avoids the danger of floundering in the digital labyrinth.



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Investing in scientists of the future

Adjacent Government Editor Laura Evans highlights new investments for UK science and what Minister for Science and Universities, Jo Johnson thinks a Brexit could mean for our status in this arena...

The UK has developed some keystone discoveries in science, including: hydrogen by Henry Cavendish, and penicillin by Alexander Fleming, and not forgetting the structure of DNA, [Francis Crick](#). So in terms of progress made, the UK continues to play a major role in the development of science and new technologies.

Scientific research also remains an integral part of universities in Britain, with 6% of the world's scientific research papers being produced in the UK between 2004 and 2012. This goes to show why the UK could be considered as one of the world's leaders in this arena.

UK science has certainly had a boost in recent years and only in March did the government [announce a budget of £26.3bn](#) for science over the next 5 years. They also confirmed that the science resource budget of £4.7bn will continue to be protected in real-terms, along with a continual investment in scientific infrastructure on a record scale.

The new budget will also include the introduction of the Global Challenges Research Fund. This will be used to invest in British science projects that tackle some of the world's life threatening issues. For example, the £1.5bn fund has already been used for a Rapid Response call for research grant applications to tackle the Zika virus.

"From the invention of the lightbulb to the creation of the World Wide Web, UK scientists have been instrumental in many of the world's most significant discoveries, and we are determined to continue this legacy on a global scale," Johnson said about the new budget.

"In a time of tight control over public spending, we have guaranteed record investment for UK scientists

so they can help us tackle climate change, produce disease-resistant crops and cure rare diseases."

Following these allocations, over the course of this Parliament, the UK government will have invested a massive £30.3bn in science, which includes £6.9bn in capital infrastructure. That shows a major commitment to supporting science and research up and down the country.

Funding for PhD students in engineering and physical sciences has also recently been boosted. With [over £200m allocated](#) to support the UK's research into quantum technologies. This funding is crucial to support cutting-edge research across the UK and help top students into a PhD.

The government believes that the UK's quantum technologies programme helps to develop important relationships with EU partners. The hope is that the funding will further strengthen the position of UK scientists, who are able to access a much broader range of academic research through the EU.

"We are committed to securing the UK's position as a world leader in science and innovation," add Johnson. "The government is ensuring major new discoveries happen here, such as the creation of super-powerful quantum computers which scientists are working in Oxford."

One thing in coming months that could have a major impact on UK science and research is the upcoming EU Referendum in June. For Minister Jo Johnson however, there is only one result he believes should be achieved in a few months and that is for Britain to remain. Johnson recently put his views across and spoke about the impact it would have on UK science should we leave.



Minister for Science and Universities, Jo Johnson

“European research funding offers a good example of how the EU can get things right – and how the UK benefits from a seat at the table when the rules are framed in Brussels,” the [Minister told the Financial Times](#).

He added: “We have successfully argued for the EU research money only to flow to where the best science is done, regardless of geography or pork barrel pressures. And because of the excellence of our research base, we end up winning an outsized slice of EU research programmes.

“The UK puts in about 12% of all EU funding yet wins about 15% of research funding, making us one of the largest beneficiaries of EU science programmes. In the latest funding round, we have to date secured 15.4% second only behind Germany.”

The Minister believes that UK universities flourish under this system and have even benefited from free travel across Europe in order to study in other countries, as well as the UK benefiting from attracting talent from Europe. Since 2010 the UK has had a protected science budget and British scientists should be able to call on this for support. However, Johnson stated that “we should not pretend that replacing these rich additional European funding streams would be easy.”

“Scientific research also remains an integral part of universities in Britain, with 6% of the world’s scientific research papers being produced in the UK between 2004 and 2012. This goes to show why the UK could be considered as one of the world’s leaders in this arena.”

Investment is crucial if the UK is to flourish and become the science leader that we want it to be. Despite what might happen in June, the government’s commitment to science cannot be denied. Johnson stated that those who are campaigning for a Brexit, must explain how these levels of investment will be sustained with the same depth of partnerships.

“I’m not suggesting that Brexit would reverse 8 centuries of progress,” Johnson added. “A vote in to leave would be a leap into the dark that would put our status as a science superpower at risk.” ■

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Newton Fund's novel development opportunities

The UK's Newton Fund is enabling new scientific collaborations with developing countries to be built in many different areas. Here a programme where radio astronomy is being used to inspire young people to take up STEM training in Africa is described. A partnership between universities in the UK and South Africa, along with industrial partners from the space sector, are creating a next generation of scientists in countries such as Ghana, Kenya and Zambia.

The UK government's commitment to spending 0.7% of GDP on Overseas Development Assistance (ODA) is being utilised for innovative new ways of promoting development via the Newton Fund. The People strand of this new fund aims to train and inspire a next generation of scientists in developing countries through collaboration with the UK. It is well recognised that the highly developed science and technology sector that the government supports in the UK is a driver for economic growth. Therefore, growing a highly trained cadre of scientists and inspiring the take-up of STEM subjects in a developing country is seen as a new way to meet ODA goals.

Astronomy has long been known as a subject that inspires young people to take an interest in science. In Africa it is radio astronomy that is coming to the fore with the continent hosting its



Three Ghanaian students getting a close up view of the radio dish from two South African trainers

first big science project in the form of the Square Kilometre Array (SKA) – the world's next generation radio telescope. One half of the first phase of this €650M international project will be constructed in South Africa and completed by 2023. This is an endeavour in which the UK is playing a leading role. The second phase is planned to extend the network of advanced radio antennas into eight African partner countries by around 2030. In the run up to the full SKA, South African engineers are currently constructing a network of more traditional radio dishes in the eight African partner countries called the African Very-Long-Baseline-Interferometry Network (AVN). These will be linked together to simulate a telescope the size of the continent and deliver very high spatial resolution radio images.

At present there is little or no astrophysics activity in the African partner countries. The construction of the AVN has been the catalyst for a Newton Fund project called Development in Africa with Radio Astronomy (DARA). This has received £650k in its first three years to train a first generation of radio astronomers in Kenya, Zambia, Ghana, Namibia and Botswana. The project is a partnership between the universities of Leeds, Manchester, Oxford and Hertfordshire and various South African partners. Industrial partners include Goonhilly Earth Station Ltd. (GES), an SME that is running a satellite communications business on the ex-BT site in Cornwall, with some assistance from the UK's Regional Growth Fund. GES are also working with university partners to develop radio astronomy capabilities on the large



Goonhilly Earth Station where a similar conversion of ex-telecommunications antennas into radio telescopes is ongoing in partnership between UK universities and the SME GES Ltd

Goonhilly dishes. This re-purposing of defunct telecommunications infrastructure is also the model for some of the AVN dishes in Africa.

Training by the DARA project is delivered in a three-tiered approach. Advanced training is provided to a few students via PhD and MSc placements in the UK and SA, with the aim of establishing the cores of sustainable astrophysics research groups in each of the AVN partner countries. Basic training is delivered to ten students per year, per partner country to provide a pool of candidates for advanced training and to educate the trainees in the many industrial opportunities in areas related to radio astronomy, especially in the burgeoning space sector that is growing at a rapid rate in the UK. The trainees also receive training in science outreach and this leads directly to the third tier. An outreach programme is going into

many schools in each of the partner countries to bring the excitement of astronomy and space science to a large number of young people. One such event at the high school situated next to the dish to be converted in Zambia involved hands-on astronomy activities for the whole school delivered by the newly recruited team of basic trainees and was very well received.

These activities have the aim of increasing STEM take-up at all levels and hence growing the fraction of the population who are equipped to use this knowledge for economic development.

It has been clear from the start of the DARA project that despite the circumstances in these developing countries the appetite for learning about radio astronomy and the related skills in science and technology is huge. Applications for places on

both the advanced and basic training programmes have been significantly over-subscribed and there is great interest from the local universities to start-up astrophysics provision in their curricula. This is a good step on the way to self-sustainability for the project with those returning from advanced training in the UK able to teach the subsequent generations.

The partnerships and collaborations built up between the UK, South African and the African partners during the project will be sustained and grow into the era when the SKA is up and running in Africa. This will benefit the UK partners through increased research activity and the development of deep links with African universities. The long-standing commitment of the UK to science and technology together with the new use of scientific collaboration to achieve international development goals will result in economic benefits for both the UK and Africa.



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Disruptive innovation and 'smart' natural materials

Challenging pharmaceutical cold chain packaging convention

It's time to break down credibility barriers, challenge conventional regulatory standards, blow away the smoke and mirrors data claimed for man-made packaging materials and raise the global performance bar for insulated pharmaceutical packaging by using 'smart' materials such as pure wool – a natural technical fibre.

Why is change needed?

Incredibly, up to 50% of certain vaccines delivered globally still arrive unfit for use due to failings in cold chain distribution and insulated packaging, despite The World Health Organization (WHO) having published a paper in 2005 drawing attention to the fact and by inference, the inevitable loss of human life.

This is an unacceptable situation. What has been done to address it?

Nothing much until 2013, when the European Commission recognised this serious challenge and published revised 'Guidelines on Good Distribution Practice of Medicinal Products for Human Use', to ensure stricter procedures and greater accountability throughout the supply chain.

The new GDP regulations have turned the global pharmaceutical distribution sector on its head. No longer can 'pre-validated' temperature control performance data be relied upon for insulated packaging.



Packaging validation trials conducted in real-time summer and winter conditions, with real product on real journeys to real customers must now prove the tight cold chain temperature controls for chilled medicines, such as vaccines (2°C to 8°C), and controlled room temperature (CRT) products, (e.g. 15°C to 25°C). The latter often being those everyday items found on the chemist's shelf, such as cough medicines or paracetamol.

Put simply, the temperature control range (e.g. 2°C to 8°C) shown on the product label must be maintained throughout the cold chain journey from dispatch to eventual destination, which may take 72 hours and longer.

Only if the packaging passes these stringent tests, will licenses to distribute medicines for human and veterinary use be issued by the Medical & Healthcare Regulatory Authority (MHRA)

in the UK or Food & Drug Administration (FDA) in the USA.

Concentrates the mind, doesn't it?

How enthusiastically is the pharmaceutical and healthcare sector embracing this regulatory change?

It varies. At the positive end, responsible pharmaceutical manufacturers, wholesale distributors and logistics companies are actively re-examining cold chain distribution practice and insulated packaging performance to ensure compliance with the new GDP guidelines.

In the middle sit many companies and organisations that do not actually understand what the new GDP regulations require, or indeed where to begin to implement changes. This category can also include our NHS hospitals, doctor's surgeries and phar-

macies. Many also fail to appreciate the whole company training required for personnel to understand their personal responsibility for maintaining cold chain integrity.

At the negative end, beyond the confused category, sit those cynical organisations for whom it is just 'business as usual' – simply waiting until the MHRA or FDA turns up on their doorstep, and they are forced to comply.

Astonishingly, we meet many companies in this latter category, where the priority is to avoid on-cost associated with regulatory compliance and the potential impact on margin for as long as possible. CEO's that promote this short-term thinking are putting their businesses and stakeholders at risk. Non-compliance ultimately means no license to distribute. That should be pretty clear shouldn't it?

What insulated packaging solutions are responsible companies considering to achieve GDP compliance?

Quite wrongly, a common perception is that if conventional passive plastic insulated packaging is not cutting the mustard, then the only solution to GDP compliance must be to make greater use of more expensive temperature controlled transport and/or active packaging solutions. (Active packaging frequently relies on integral and/or external power sources for refrigeration control)

This strategy continues to fail to recognise the weak link in cold chain – damage caused by exposure to uncontrolled temperature excursions during transit.

Damage often occurs when goods are trans-shipped from one mode of

transport to another. Perhaps from temperature controlled truck to air-plane hold, where pallets might sit on the runway for several hours, exposed to extreme heat or cold, depending upon time of day, season and geography.

Even active packaging is vulnerable. Keynote speakers at the January 2016 Cold Chain Conference in Frankfurt, recently described how difficult it is for sea and air freight companies to guarantee no interruptions to power sources for active packaging containers during transit.

Can conventional plastic passive packaging be made more effective?

Passive packaging is often described as a system typically insulated with polystyrene, polyurethane or vacuum insulated panels. Many have been 'pre-qualified' to hold temperature for a certain payload capacity for a specified period of time: 24, 72 or 96 hours, and more. With these types of configurations, gel packs or other types of phase change materials (PCM's) are used to help maintain desired temperatures.

To further improve temperature control performance, the only option for conventional plastic passive packaging is to 'go large' – with bigger, heavier cartons and more PCM's, making the unit cost of shipment more expensive.

What disruptive design innovation is needed in the packaging sector to deliver GDP compliance?

In our view, the lowest common denominator in the whole cold chain equation is passive packaging.

Since 2012 Woolcool has been quietly innovating. With £1.5m funding support from UK Government via Innovate UK

and close scientific collaboration with leading UK Universities such as Cambridge, Bangor and Leeds, Woolcool has gained a deep understanding of how wool works at the molecular level and successfully translated natural insulative properties that have evolved over millennia into a disruptive, groundbreaking solution for passive insulated pharmaceutical packaging – 'LifeGUARDIAN'.

Exceeding all internationally recognised standards, Woolcool brings superior performance and cost savings to the party. Better insulation means fewer ice-packs, meaning smaller packs, meaning in turn lower weight, lower logistics costs – the list of 'no-brainers' goes on.

What is our vision for the future?

The Woolcool passive packaging solution for pharmaceuticals isn't just for today; it's a genuinely sustainable, economically viable game changer that will contribute to improvement in the health of future generations and potentially save lives.



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Researchers come together to push green science forward

Martin Warren, Professor of Biochemistry at the University of Kent and co-director of the Metals in Biology Network describes how a recent meeting of academic and industrial scientists helped to cross-fertilise research on the role of metals in the sustainable production of chemicals and the removal of pollutants.

It is well known that metals play key roles in many essential biological processes and indeed, it has been estimated that nearly a third of proteins and almost half of all enzymes are associated with at least one metal¹. Given the biological importance of metals, one of the Networks in Biotechnology and Bioenergy set up by the BBSRC to promote collaboration between academia and industry² was entitled Metals in Biology. Many metals – in particular iron, copper and nickel – also have unique properties that endear them to specific functions in the production of industrially useful chemicals from gases by biological organisms. Indeed, another BBSRC network, known as C1net, aims to understand the processes associated with gas fermentation and to realise the potential of this through commercial application. Given the shared interest of the role of metals in biological processes, such as gas fermentation, members from the two networks recently met in Canterbury to explore the scope for joint research.

A better knowledge of the important role of metal-containing enzymes that are used in gas fermentation could

aid the production of low-carbon fuels and chemicals, as well as reduce pollution caused by greenhouse gases and other waste products. Iron is known to be central to the role of a range of hydrogenases as well as methane mono-oxygenase and carbon monoxide dehydrogenase. Copper is involved in the function of particulate methane monooxygenase. However, nickel wins the title for being the most versatile in terms of its involvement with gas biogenesis; it is linked with eight enzymes that are associated with the production or use of methane, carbon monoxide, carbon dioxide, hydrogen, ammonia and oxygen³.

The production of fuels and chemicals from gases often uses microbes that have been re-engineered using biotechnology processes to optimise the supply of metals to their enzymes; this re-engineering process is often referred to as synthetic biology. So understanding how metals are handled and stored within the microbes will help generate synthetic metal supply systems that can be incorporated into microbes to allow them to produce chemicals both efficiently and greenly. Moreover, synthetic biology offers the opportunity to incorporate non-biological metals into novel cellular processes, allowing the chance to employ metals such as palladium or platinum, which are currently used as catalysts in many chemical reactions.

With this in mind the meeting in Canterbury brought together academic scientists and industrialists with shared

interests in exploiting the power of metals for the use of C1 gases (that is, gases containing one carbon atom) in chemical production systems and other applications such as bioremediation – the use of biological organisms to remove or neutralise pollutants. Nigel Minton introduced C1net and the Synthetic Biology Research Centre at the University of Nottingham, which together aim to facilitate the enhanced production of commodity chemicals such as hydroxypropionic acid, isoprene, ethylene, isobutene, propylene and butadiene from either carbon monoxide or carbon dioxide. He highlighted that although challenges remain concerning the use of some gas-fermenting microbes – such as acetogens (microbes that generate acetate) and methanotrophs (microbes that metabolise methane) – the potential very much exists for the redesign of their metabolism.

Therefore, there is a need to understand the full repertoire of cellular components and other cofactors that aid the supply of metals to enzymes. In this respect Peter Chivers (Durham University) was able to outline the challenges and problems associated with intracellular metal supply. He explained how it may be possible to reset metallosensors to allow the incorporation of suitable levels of metals in recombinant strains of microbes. Developing the theme of the redesign of enzymatic function, Frank Sargent (University of Dundee) described how his team were able to engineer an hydrogenlyase enzyme to allow it to fix carbon dioxide into

the more environmentally friendly formate.

Companies such as AlgaeCytes explained their remit, which included developing healthcare, personal care and agro-science products from algal extracts. They are looking at the potential of algal extracts for antimicrobial effects, production of metal-related nutrient supplements (such as vitamin B12) and the synthesis of high-value industrial feedstocks, all from renewable sources. Mike Allen (Plymouth Marine Laboratory) developed the algae theme further, explaining how algae can be used in the remediation of potentially pollutant metals from contaminated sites. He also described a novel technology – known as vortex bioreactors – that was developed to recover and purify products from biofuel production, yet now has the potential to facilitate waste water treatment in low-income countries.

The idea of compartmentalisation of metabolic processes in cells was introduced by Jon Marles-Wright (University of Edinburgh) as a way of enhancing not only metabolic flux (the turnover of molecules through a metabolic pathway) but also for metal storage in the form of ferritins. He revealed how ferritins store iron within a protein cage and how their biochemical features can be exploited for the production of metal nanoparticles, which could have a broad range of medical and biological uses. Bernard Golding (NewChem Technologies and University of Newcastle) provided an education on the amazing reactions catalysed by the biological forms of vitamin B12, which are often involved in enzymatic catalysis that proceeds through mechanisms involving free radicals. This led to a further discus-

sion among delegates about the advantages of anaerobic fermentation, which generally employs a greater array of radical chemistry than aerobic fermentation and has the potential to be exploited for industrial biotechnology uses.

“A better knowledge of the role of metal-containing enzymes that are used in gas fermentation could aid the production of low-carbon fuels and chemicals as well as reduce pollution.”

Tom Smith (Sheffield Hallam University) returned to the problems of methane oxidation by discussing research he has been undertaking with Colin Murrell at the University of East Anglia. Together they have been looking at the soluble methane monooxygenase. Using a recombinant system, they have gained new insights into the use of the enzyme to oxidise a range of other organic substrates. As such the enzyme could have uses in bioremediation of hydrophobic organic pollutants and in the synthesis of fine chemicals. Hendrik Schäfer (University of Warwick) talked about a novel but widespread copper-dependent enzyme that is associated with the degradation of methanethiol (a naturally produced gas with a putrid smell). His ideas on C1 gas-degrading bacteria included their use for the deodorisation of waste gas and the purification of sulphur-containing gases from feedstocks.

The workshop revealed a broad range of interests across the biological metal-sphere and the application of this expertise to C1 gas fermentation. The meeting also had attendees from the Universities of Kent, Durham, Greenwich, Southampton, Dublin, and Sheffield and further afield from Ulm,

Germany, as well as, delegates from the biotech companies ZuvaSyntha, Green Biologics, Sasol, Chain Biologics and HGEN Cleantech. What became clear was that the imagination of synthetic biology approaches has to be met with the careful design of appropriate metal supply systems to allow for the integration of the metal species in a form that allows for full functionality of the enzymes. Several of the attendees are now planning collaborative projects to valorise ideas discussed at the meeting.

¹ Waldron KJ, Rutherford JC, Ford D, Robinson NJ. Metalloproteins and metal sensing. *Nature* 460: 823-830 (2009).

² <http://www.bbsrc.ac.uk/about/institutes/nibb/>

³ Ragsdale SW. Biochemistry of methyl-coenzyme M reductase: the nickel metalloenzyme that catalyzes the final step in synthesis and the first step in anaerobic oxidation of the greenhouse gas methane. *Met. Ions Life Sci.* 14: 125-145 (2014).



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Increasing skills in the aerospace sector

Following on from the last edition, John Laughlin, Aerospace Programme Lead at Innovate UK answers further questions from Adjacent Government on the UK aerospace sector and challenges that lie ahead...

UK businesses are well placed to take advantage of growing global demand for faster, quieter and greener aircraft. With 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.

The aerospace sector and its supply chain employ 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 export business. Sustaining growth in sectors such as aerospace is a critical part of supporting the UK economy.

Given the highly competitive global nature of the aerospace sector, increasing the skills capacity in the sector is crucial. A decline in a country's skills base can happen very quickly and recovering those skills can be expensive and can take a generation, a risk that cannot be taken with the UK aerospace sector.

The worldwide push for more energy efficient, less polluting aircraft presents a potentially lucrative opportunity to harness a range of key skills we have in the UK (from across multiple industries) and significantly enhance returns for the UK plc.

In addition, the mission-critical nature of aerospace products mean that the timescales for R&D, testing and introduction of new products to market are elongated within the aerospace sector compared to other sectors. This presents challenges around retaining the skills and experience necessary to design the next generation of aircraft, whether it be skills in aerodynamics, propulsion, advanced systems or structures. Maintaining and growing the necessary skills required to maintain the UK's position in the aerospace market-



place (no. 2 globally) requires us to continue to encourage new, skilled staff into the aerospace sector (rather than other buoyant sectors such as automotive) to offset both the ageing workforce, and renewing the skills and knowledge in the sector.

The government's £3.9bn Aerospace Technology Institute (ATI) programme, which stimulates new research which would not have happened under normal market conditions, not only creates new technology and commercial offerings, but creates and refines the skills needed in the longer-term.

How important are investments such as these in order to bring forward solutions to key aerospace industry challenges?

The aerospace sector is very competitive, with high barriers to entry both technically and financially, if we are to maintain and then grow our world class capability we need to harness all the resources at our disposal to advance technology innovation. It is with that in mind that we, with our partners – including government, are constantly refining the development pathway for aerospace innovation from academic research, through to Innovate UK's support for translating technology

from other sectors, such as advances in materials and from new emerging technologies such as graphene and quantum, into commercial reality.

The (ATI) programme is then well placed to harness these new innovations to exploit the significant global potential.

What are the key challenges currently facing the aerospace sector? And how can these be overcome?

In order to effectively compete for a significant share of a potential \$5 trillion market, we need to look at how we overcome some of the challenges from the profitability of airlines, to the ability for the UK supply chain to rapidly respond to market demands as well as addressing the threat of global competition.

Profitability of the airlines themselves is a major challenge, as it is a strained part of the value chain with small operating margins. The pressure on airlines to remain profitable is complex and is driven by a number of market and industry factors. The fall in the price of oil will undoubtedly see a short term profitability boost. However, with aircraft assets being in service for upwards of 30 years, capacity and fleet planning requires a long term view and many market factors need to be considered. At Innovate UK, we are looking to invest in technologies that reduce the cost of ownership for the airline, reducing the amount of downtime for the aircraft by investing in technologies that can better predict the health of systems, reducing the amount of maintenance and increasing the time between intervals for repair and overhaul.

Another challenge is the expected increase in volumes for our current products, as we work to grow our market share UK companies need to be able to respond to the increased uptake from the primes right through the smaller players in the supply chain. Innovate UK looks to enhance the competitiveness of the UK by investing in new advanced manufacturing technologies, to meet the market demand for increased volumes and also to increase productivity and reduce manufacturing costs. We are achieving this through our Manufacturing and Materials team and our investment in the High Value Manufacturing Catapult network.

Alongside global competition from the existing established countries in the aerospace supply chain, we can expect China, India and Russia to play a part in the future market. These countries will be looking to place large orders for new aircraft and will also look to increase their proportion of supplying high value components for the new platforms and also potentially enter into the market themselves with new product offerings.

“A decline in a country’s skills base can happen very quickly and recovering those skills can be expensive and can take a generation, a risk that cannot be taken with the UK aerospace sector.”

We are looking to support (and ultimately improve) the UK’s position as the world’s second largest aerospace manufacturer by investing in new technologies that can create value within the supply chain, keeping ahead of the global competition and anchoring high value, highly innovative technology solutions to the UK for the long-term. This is particularly challenging for SME’s as the cost of developing new aerospace technologies – and the time required to achieve the required certifications and get product to market, can be prohibitive. We are addressing this challenge by looking at potential virtual product development tools to reduce these cycle times and reduce cost overall, potentially allowing SME’s to disrupt current supply chains, by getting new, game-changing solutions to market. We also are looking to other industries that have mature technologies where we pull these into the aerospace sector. For example, some of the developments in battery power density and power and efficiency of electric machines developed in the automotive industry could have a part to play. ■

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John Laughlin

Programme Lead – Aerospace

Innovate UK

www.gov.uk/government/organisations/innovate-uk

World class mechanical property assessments

Colin Small, Chief Operating Officer at Swansea Materials Research and Testing (SMaRT) Ltd outlines how the company provides industry and academia many forms of mechanical property assessment...

Swansea Materials Research and Testing Ltd (SMaRT) is a specialist spin out materials testing company created by Swansea University in 2009 to combine two long standing areas of expertise: world class characterisation of advanced structural materials and the academic interpretation of the mechanisms controlling materials deformation and fracture. Starting with one customer and three staff in 2009 SMaRT has now grown to eleven full time staff working with over thirty companies, turning over approximately £1M per year. Based on this success, in August 2015 SMaRT moved to a purpose built facility located in the Institute of Structural Materials Building on the new Swansea University Bay Campus. This provides world class accommodation for the test and research activities and allows a close working relationship between the research and testing activities the building houses.

With this unique combination of testing facilities and academic research, SMaRT provides industry and academia many forms of mechanical property assessment, whilst at the same time addressing bespoke forms of specimen or sub-element testing where novel test method development is required. In addition to generating mechanical test data, SMaRT has the capability to undertake post-test failure analysis utilising optical and scanning electron microscopy, electron back scattered detection and metallographic sectioning.

Academic staff affiliated to SMaRT, based in the Institute of Structural Materials, Swansea University, offer particular expertise in the fields of aerospace and power generation materials, including titanium and nickel based super alloys, advanced steels, metal and ceramic matrix composites. We have the capabilities to conduct short-term consultancies or support

large scale, long term, research programmes.

Our equipment base offers an extensive creep laboratory (75 frames) and fatigue machines (60 frames) with ancillary facilities to support monotonic and cyclic waveforms under load or strain control at loads up to 250kN and temperatures ranging from -190°C to 1400°C. Environmental chambers allow for assessments under high vacuum, aqueous salt and hot corrosion conditions, including SO₂ and alternative gaseous atmospheres. Torsion and thermomechanical fatigue (TMF) testing are available, particularly relevant to sub-element or even component test pieces (e.g. full scale aerofoils etc).

SMaRT is registered for ISO17025 accreditation under the regular surveillance of the United Kingdom Accreditation Service (UKAS), ensuring the quality of our operation. Five specific test types are accredited (detailed below):

- Tensile testing: BS EN ISO 6892-1:2009, BS EN ISO 6892-2:2011, BS EN2002-1:2005, BS EN 2002-2:2005;
- Creep testing: BS EN ISO 204:2009, BS EN 2002-005:2007;
- Stress rupture: BS EN ISO204:2009, BS EN 2002-005:20007;
- Low and High Cycle fatigue (Load Control):BS EN 7270:2006;



Institute of Structural Materials Building, Swansea University Bay Campus



Swansea Materials Research and Testing Ltd, Creep Laboratory

- Fatigue crack growth: BS ISO 12108:2012.

In addition, the range of test frames and skills enables SMaRT to undertake a wide range of bespoke and novel testing outside of these directly accredited test types for a wide range of customers from the UK and overseas. Where necessary, SMaRT, in collaboration with the customer and ISM staff, actively develops testing to meet new customer needs, resulting in some unique test capabilities that give SMaRT world class capability, e.g. in thermomechanical testing and high temperature fatigue behaviour in hostile, gaseous, environments.

As a result, SMaRT has a direct input into many large UK materials research and development programmes through the provision of high quality materials test data, through both the academic research run through the Institute of Structural Materials and as a direct subcontractor to the programme participants. These programmes are focussed around 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 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.

“Starting with one customer and three staff in 2009 SMaRT has now grown to eleven full time staff working with over thirty companies, turning over approximately £1M per year.”

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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Scientific progress in Israel

Adjacent Government details how science and technology is progressing in Israel, with comment from Minister of Science, Technology and Space, Ofir Akunis...

Science and technology is said to be one of the most developed sectors in Israel. Ranked 13th in the World for scientific activity, the nation boasts the highest number of scientists, technicians and engineers per capita in the World.

Scientists in the country have contributed to a number of different areas, such as agriculture, computer sciences, electronics, health care and solar energy. And, in 1998, Tel Aviv was named as one of the 10 most technologically influential cities.

The Ministry of Science, Technology and Space, in Israel is responsible for advancing and encouraging science to its highest level. In March the Ministry launched a year-long exhibit of 60 Israeli science developments and discoveries that have affected the World. By doing so, the Ministry hopes to raise public awareness of science in the country and what is being achieved, as they believe many people in Israel and worldwide are unaware of some of its achievements.

This was highlighted [in a recent survey](#), which revealed that 43% of Israeli's are unaware that the country's first President, Chaim Weizmann was originally a chemist, and 50% said they were unable to name even one Israeli Nobel laureate scientist.

Commenting on the exhibition, Minister for Science, Technology and Space, Ofir Akunis said: "The exhibit is a major public diplomacy asset for Israel.

"We are showing the vast contributions of Israel science and technology to the world and all humanity. We have what and who to be proud of. Israel is a pioneering country and innovative leader. The entire world admires, and is amazed by our achievements, therefore it is fitting that they be shown at the gateway into and out of Israel."

The exhibition is to be held at the Ben-Gurion International (BGI) Airport, in cooperation with the Israel Young Academy.

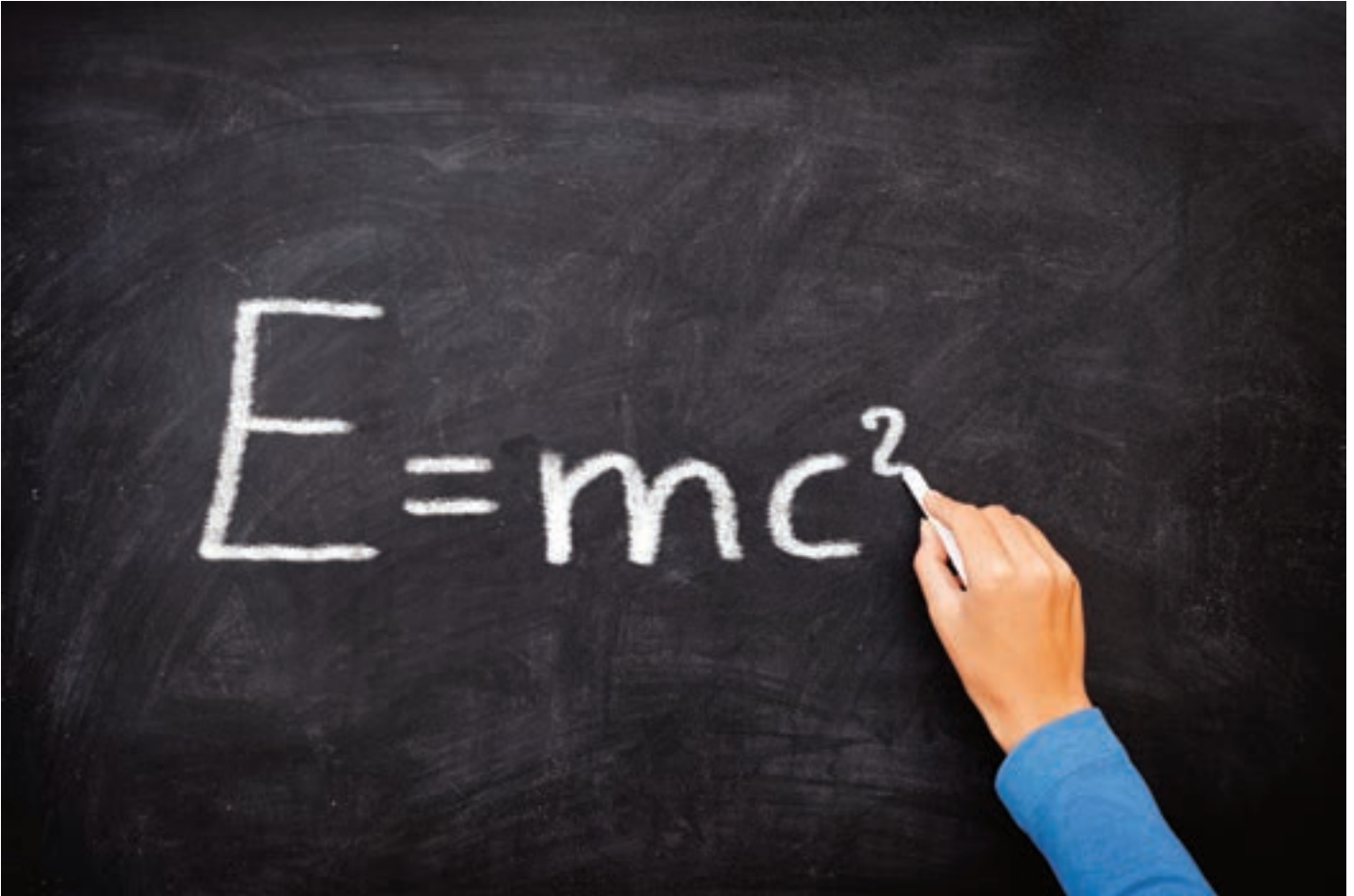
"One of the main goals of the Ministry of Science, Technology and Space is to connect links between basic research, applied research and industrial development, as well as strengthening international scientific collaborations with other countries."

Akunis was appointed as the Minister of Science, Technology and Space in August 2015. On his appointment, he said: "I thank the Prime Minister for his confidence. I am proud to head a ministry that is a growth engine for industry in Israel. Israel's astounding achievements and breakthroughs in science and technology have a global reputation. The challenge facing me is to advance and encourage technological innovation in Israel and prevent a brain drain overseas."

Prior to his appointment, Akunis was given the responsibility to lead the 'Computer for Every Child' project. Discussing this he said: "This is one of the most important social projects taking place in Israel.

"That reducing the technological gaps is a critical element in reducing social disparities," and he promised that he would work to "promote strengthen and upgrade", the project. In 2013, the project was indeed upgraded to "Tablet for Every Child", to coincide with advances in technology. In 2014 the Minister announced the government had allocated NIS 1.8 million to provide tablets for each and every child living in the south of the country.

One of the main goals of the Ministry of Science, Technology and Space is to connect links between basic research, applied research and industrial



development, as well as strengthening international scientific collaborations with other countries.

In a survey conducted across the country, results reveal that most Israeli parents would be happy for their children to take job roles in science and technology when they are older.

Results of the report were revealed to coincide with Israeli Science Day on 14 March, which showed that doctors and scientists are perceived in the country as the greatest contribution to the country's strength and deemed the most prestigious profession.

The survey showed that 59% of Israelis would like their children to be doctors, followed by tech workers and engineers. Scientists were fourth on the list with 36%. Minister Ofir Akunis saw the results as positive.

"The survey results demonstrate that the Israelis believe in the future of medicine, science and technology and how professions such as these will benefit

their children. The fact that Israel is a superpower in hi-tech and technology and a leader in innovation permeates all Israeli citizens.

"Encouragements from parents to their children regarding these subject will strengthen Israel for breakthroughs in the future."

It is encouraging to see that not only people involved in the sector are aware of the power and importance of science and technology to their country. Through the Ministry's firm goals and vision, science in Israel could have a great impact in the near future. ■

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Visualising the human genome like beads on a string

The human genome is composed of over 3 billion letters, around 2500 more than the number of letters in the bible. If we were to write down this code in small print it would span over 3000km but written in molecules, our genome is about 3 meters long. DNA sequencing provides means to read this code from DNA molecules that are extracted from cells. Today, the major part of the human genome is known and is used as a reference for research and medicine. But can there be a human genome reference? Are we all made by the same set of instructions?

The short answer is “NO”. It is clear to all, that humans (and to this end any population of living things) are variable. How could they all be represented by a single set of code, i.e the human genome? It turns out that despite its extreme length and dense information content, the sequence of letters composing the human genome is identical to over 99% between different people. Could 1% of sequence encompass all the variation we see around us? Furthermore, a cell from your heart has exactly the same genome sequence as a cell from the tip of your toe; they both carry your own genome and yet they are extremely different in shape and function and this difference has to be encoded somewhere.

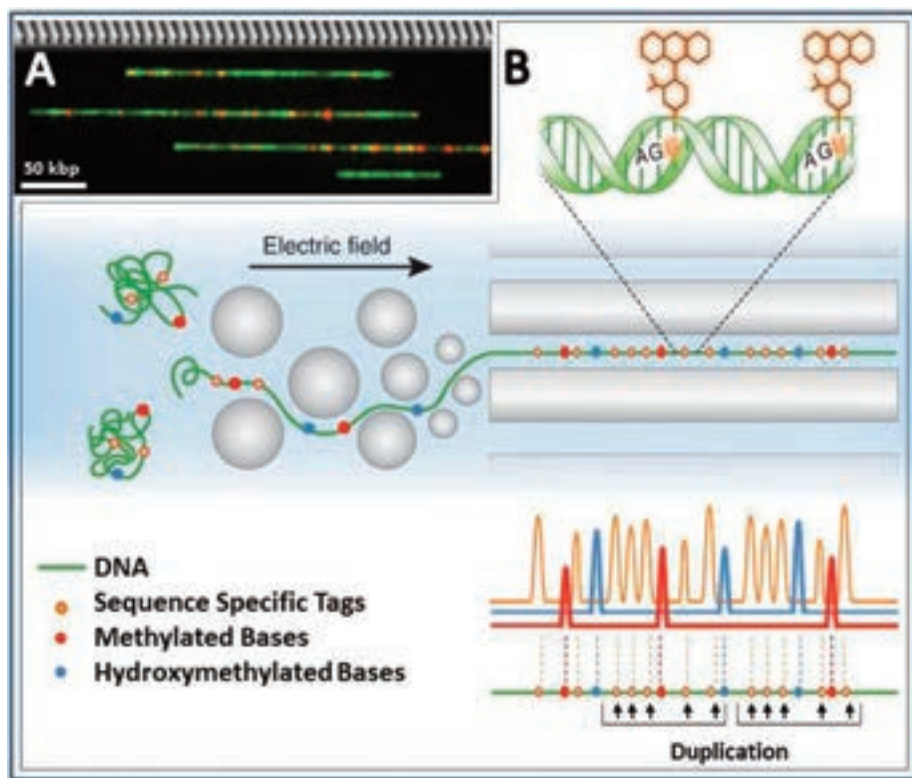
Epigenetics is a field of research that looks at this additional information that is beyond the sequence. Scientists have discovered several layers of information that are “written” into the



genome without changing the identity of the letters composing it. This code is manifested for example in the form of slight chemical changes to the DNA molecules, changes that carry functional information for the cell machinery and define a cell as a specific type. Such epigenetic marks can be thought of as bits of information laid out along the genome. Knowing the identity and position of these marks is a topic of intensive research and the focus of the ‘Beads on String’ project led by Dr. Yuval Ebanstein and his team at Tel-Aviv University in Israel. Coming from a physics and chemistry background, Dr. Ebanstein has taken a novel approach to reading genomic information. The team in Tel-Aviv uses cutting edge nanotechnology combined with the use of colour and light in order to unveil the hidden secrets of the genome. In the first step, the

research team is developing chemical reactions that allow highlighting genomic information with light emitting molecules. By using different colours of molecules for the various kinds of epigenetic marks, the genome is decorated by these labels just like a necklace composed of colourful beads on a string, where each colour represents a unique genomic feature.

But, how do you extract information from such colourful spaghetti? The strategy taken by the Ebanstein team was to stretch the DNA molecules into a straight line and use a powerful microscope in order to read the information along those molecules in the order it is presented. In order to do this, the team uses tiny silicon nano-channels, less than one thousandth of a human hair in cross section. When DNA molecules are



squeezed into these channels the molecules are straightened and can be visualised by a scientific microscope as straight lines decorated with luminous spots.

The Beads on String project, funded by a European Research Council (ERC) starter grant, aims at developing a new genomics research toolbox that will offer the ability to profile individual genomic DNA molecules. As opposed to existing methods, the name of the game is “Multiplexing” i.e. visualising a rich variety of information coexisting on the same stretch of DNA, meaning that it originated from a single cell. By comparing hundreds or thousands of molecules to each other and to the known properties of these genomic regions we may open a window to new landscapes of genomic variation. Allowing researchers to pin point the differences between individual cells and perhaps tracking down unique cell populations with distinct genetic and epigenetic properties. In order to achieve this goal,

the Ebenstein group is developing a pellet of biochemical assays aimed at “painting” various genomic marks with distinct colours by chemically attaching light emitting molecules to these marks. Thus far, the team has demonstrated the ability to tag different kinds of DNA damage types and the epigenetic mark 5hmC, a chemical change in DNA that alters its function.

One example for the utility of this approach is demonstrated in another research project performed in the lab. The BeyondSeq project (www.beyondseq.eu), a consortium of seven research groups across Europe and Israel, which was recently funded by the European Commission with the aim of bringing single molecule genomics technologies into the clinic. Within this large effort, the Ebenstein team is developing an ultra-sensitive test for several types of blood cancer. It is based on evidence that shows that the epigenetic mark 5hmC is reduced significantly in many types of cancer and may serve as a biomarker

for detecting and monitoring the disease. Due to the low levels of 5hmC in blood, it has been extremely challenging to reliably measure and requires alternative solutions to the methods used today. The single molecule approach developed by the Ebenstein team is specifically tailored for such sensitive detection, being able to detect single marks along individual DNA molecules. Preliminary results measuring the 5hmC levels of cancer patients compared to healthy volunteers show a 30% reduction in cancer, and the team is now working to collect more data in order to establish these findings. Further development of the assay and its adaptation for clinical use may provide doctors with a new tool for monitoring blood cancer patients. Another exciting potential for this test is personalised medicine. Treatment could be administered to the blood cells taken from the patient in order to evaluate the effect of several therapy options before choosing the best option for the actual patient.

BeyondSeq

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Protecting your R&D

Gary Townley, Business Manager at the UK Intellectual Property Office outlines the importance of protecting your innovation and research through Intellectual Property protection...

Staying ahead of the competition and innovating are key elements to the success of any business. Without innovation it is only a matter of time before your rivals leave you behind and your business quickly becomes yesterday's news.

For many, research and development (R&D) is the answer however it is often an expensive and time-consuming process. With this cost and effort in mind, protecting the resulting breakthroughs should be a priority for any business.

At the outset of any R&D project, businesses should decide what type of Intellectual Property (IP) protection is appropriate, whether to register the rights and who will own them. IP protection falls into 4 main categories:

- Patents (for inventions);
- Copyright (for creative works);
- Trade marks (for brands);
- Design Rights (for appearance).

Patents, designs, copyright and trade marks all have different advantages but cover different aspects of innovation or inventiveness.

Patents vs trade secrets

Most businesses instantly think of patents if they have developed a new product or process. Patents protect these developments but by filing a patent your tech-



Gary Townley, Business Manager

nology will be published (usually at 18 months). This gives anyone access to how your invention works. So although you get a limited monopoly on your invention for 20 years, you are allowing others and competitors to see a detailed description of how it works.

Would a trade secret be better? After all, a trade secret such as the recipe for Coca Cola can last potentially indefinitely. Can the product or process be reverse engineered, can confidentiality obligations be maintained? These are decisions that a company needs to make. Filing patents, however, can flag up to financial institutions and potential investors that the invention is worth investment and will often deter would be infringers.

Filing patents & collaboration

So having created something new and decided that patents are the best form of protection the first thing to remember is that your application must be filed before the invention is disclosed. Prior to filing, a strict policy of secrecy should be applied and the proper use of confidentiality agreements should be made.

To ensure you get the right advice it is often best to consult a patent attorney who can formulate a strategy for protecting your invention in the UK and overseas. A patent attorney will also draft your application to give the broadest protection, and will prepare the documents so they are technically and legally correct.

Many R&D projects can require collaboration, using the skills, expertise and facilities of other parties, either businesses or more often than not universities. If you are thinking of undertaking collaborative research with a university, the UK IPO has developed a set of agreements that you can put in place to cover the ownership, financial, and other contributions made by the commercial partner and the use of the results for academic purposes. [The Lambert agreements](#) can be accessed via the IPO website.

Look before you leap

Patents are also a great source of technical information. Businesses have access to millions of patent documents giving full disclosure of the invention and often this technology is free to use as the patent has expired, been withdrawn or lapsed.

It is often said that a lot of R&D is wasted because the technology is already available in a patent document. So before investing significant amounts of money in research projects, why not search the free patents database, [Espacenet](#). This can give you an early indication of whether the technology is worth pursuing further and whether investment should be made. But remember patent searching is a specialist art and another reason why consulting a patent expert is beneficial. ■

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Gary Townley Business Manager

UK Intellectual Property Office
<https://www.gov.uk/government/organisations/intellectual-property-office>



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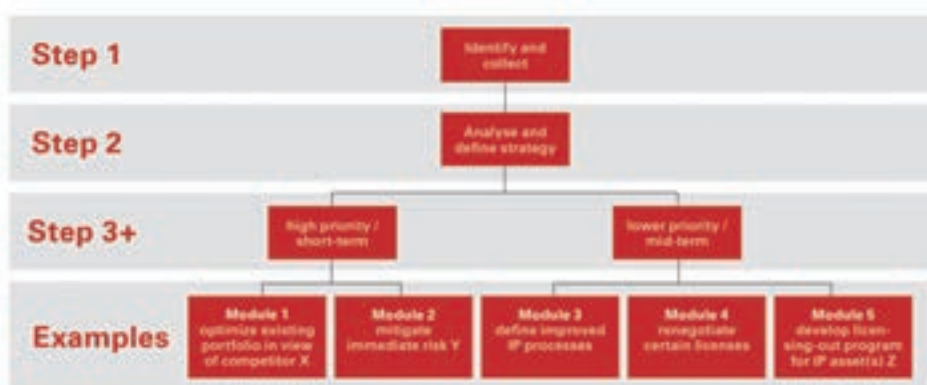
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Need to build an effective Intellectual Property (IP) approach?

Here's a frequent **problem**: On the one hand, "smaller-than-corporate" entities such as SMEs, scientific organisations, or sometimes even specific business units or affiliates of a larger company typically have only limited IP budgets, few IP activities and small patent portfolios, if any. Thus, they usually cannot afford an own IP department with sophisticated senior IP attorneys having many years of experience across the relevant technical and legal fields, including the marketing and strategic use of IP assets. On the other hand, in many industries IP increasingly forms a key element of commercial opportunities and risks. Therefore a professional targeted approach towards IP is needed for both solving short term issues and ensuring mid- and long-term success.

Against this background, we have developed our **IP 360°-solution**, a modular multi-step and cost-efficient approach for defining and implementing a professional IP-strategy tailored to the specific needs of "smaller-than-corporate" entities and reflecting all IP aspects of their business:

In a **first step**, all of the entity's potentially relevant IP assets, IP-related agreements, IP- and Research and Development (R&D) processes etc., known risks and opportunities as well as its related business objectives and strategies are identified and collected. Based thereon, a suitable fixed budget range for the second step is defined. This first step is offered at a limited



fixed fee that is defined once an initial idea about the amount of relevant information exists.

The **second step** is an IP 360°-review process, where all the material and information collected during the first step is analysed and based thereon a report is created that characterises all identified opportunities and risks including their priority and urgency as well as suggested measures and budgets for properly addressing them. In other words, the results of the second step provide management with a solid basis for taking decisions regarding the further IP strategy and its implementation according to individually defined action modules.

The **third and potential further steps** are directed to the modular implementation of the IP strategy resulting from the second step. Usually this means that in view of budget and bandwidth limitations only selected high priority modules of the IP strategy are implemented in the short term, while other modules having been rated as being less urgent or having

lower priority might be implemented only at a later stage.

“Against this background, we have developed our IP 360°-solution, a modular multi-step and cost-efficient approach for defining and implementing a professional IP-strategy tailored to the specific needs of “smaller-than-corporate” entities and reflecting all IP aspects of their business.”

Interested?

Any further questions?

Please let us know.

WALLINGER RICKER SCHLOTTER TOSTMANN
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Internationalisation through the Linnaeus-Palme programme

The Swedish Council for Higher Education outlines the benefits of exchange programmes such as Linnaeus-Palme...

Linnaeus-Palme is an international exchange programme that supports long-term, bilateral collaboration at the department level between higher education institutions in low and middle-income countries, and Sweden. In 2015 the qualitative effects of the programme were summarised in a publication based on 2 earlier reports¹.

The importance of reciprocity

Reciprocity is one of the basic pillars of the Linnaeus-Palme programme. The collaboration takes place in the form of projects based on teacher and student exchanges, each of which must have a concrete academic purpose and usefulness. The studies indicate that a mutual understanding within the programme is of great importance and plays an important part in the success of any given project. Both Linnaeus and Palme participants² agree that projects which are founded on close collaboration, common interests and a mutual benefit achieve the best results with the greatest effects.

Global knowledge

One thing that unites almost all of the teachers interviewed is their belief that the knowledge gained during an international exchange cannot be gained through theory. It is in the meeting with phenomena perceived as different – in the place that is being studied – that the added value we understand as global knowledge is founded. One teacher expresses the experience like this:

“It’s when you meet others that something happens, and something new is created. The exchange does not just shape the research, but also the way you write and think. It gives you a new perspective and raises new questions.”

For teachers, this can involve new methods, educational models and new teaching perspectives. Several of the

teachers interviewed stated that the Linnaeus-Palme collaboration has enabled structural changes to take place, as it has allowed elements of other educational systems to be introduced into their system.

Specialist knowledge in a different way

However, the predominant view is that the major academic gains are at content level. One way of adding content is by exchanging specialist skills. New specialist knowledge sometimes leads to the institutes developing new courses together, or offering more courses in English; yet, the greatest benefit is usually described as a change of perspective. As one of the teachers interviewed explains:

“The skills are perhaps not that different, compared to Swedish teachers. It’s more to do with the South African perspective. Their context – which in turn shapes their research – is very different and we cannot access it if we bring in a lecturer from Sweden. When South African teachers use examples from South Africa this often proves successful. We are not doing something entirely new, but the ordinary is given a new angle. It is done differently.”

New perspectives

The academic specialities do not depend on the teacher’s origin. The difference is the contextual starting points. Shifting perspectives means seeing the world in a new way, and this forces teachers and students to formulate new problems and ask new questions. New knowledge is created and this results in a greater understanding of global contexts and problems. Teachers who have participated in the Linnaeus-Palme collaboration note an increased understanding of political, financial, social, and environmental situations. This can be defined as a form of global knowledge that increases the ability to interpret and question global



Image: © Jesper Klermedsson

issues, for instance. As such, this kind of global knowledge establishes common and nuanced images of global problems. This process develops reflective thinking and creates greater diversity within their teaching.

Other effects

Apart from global knowledge and new perspectives qualitative effects shown in the studies can be summarised as:

- Personal development;
- The teachers' professional development meaning the gain of new insights into the subject and their own teaching – a consequence of having to explain ideas in another context and having the time and opportunity to review and reflect;
- Development within the participating institutes as the teachers and organisations complement each other. This leads, amongst other things, to the exchange of specialist knowledge and the creation of new networks and generates an interest in moving forward together, for instance through offering joint courses. This in turn creates new formulations of problems and new pedagogical approaches and often lay the foundations for collaboration to continue, even after the project has ended. Another positive effect is that

the participating institutes often attract talented students to their masters and doctoral programmes.

One might also come to the conclusion that teachers with this new experience and knowledge, as well as foreign teachers participating in an exchange, also cause impacts for their students.

Read more about the effects of the Linnaeus-Palme programme in the publication *Internationalisation through the Linnaeus-Palme programme – effects and result* that can be required at linnaeuspalme@uhr.se ■

¹ To develop global learning with Linnaeus-Palme – Added value through international collaboration within higher education. Report no. 37, the International Programme Office for Education and Training, 2011. Site visit to Indonesia in 2014. Internal report, the Swedish Council for Higher Education, 2014 and *Internationalisation through the Linnaeus-Palme programme – effects and results*, the Swedish Council for Higher Education, 2015.

² Within the programme the Swedish participants are referred to as Linnaeus and foreign partners are referred to as Palme.

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Swedish Council for Higher Education
www.uhr.se



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WHAT DO YOU MEAN?

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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Poor educational performance – the challenge for individuals and nations

Andreas Schleicher, Director for Education and Skills at the OECD highlights the long term consequences of poor performing students and the importance of reducing them...

Far too many students around the world are trapped in a vicious cycle of poor performance and demotivation that leads only to more bad marks and further disengagement from school.

Results from PISA 2012 show that more than one in four 15-year-old students in OECD countries were not able to read a simple text, perform a simple mathematical operation, or demonstrate the understanding of basic scientific concepts, even after being at school for at least 9 years.

Poor performance at school has long-term consequences that are hard to compensate, both for individuals and nations. Students who perform poorly at age 15 face a high risk of dropping out of school altogether. And when a large share of the population lacks basic skills, a country's long-term economic growth is severely compromised. In fact, the economic output that is lost because of poor education policies and practices leaves many countries in what amounts to a permanent state of economic recession – and one that can be larger and deeper than the one that resulted from the financial crisis at the beginning of the millennium, out of which many countries are still struggling to climb. Put the other way round, for lower-middle income countries, the discounted present value of economic future gains from ensuring that all 15-year-olds would at least reach the PISA baseline level of performance would be 13 times current GDP and would average out to a 28% higher GDP over the next 80 years. And for upper-middle income countries, which generally show higher levels of learning outcomes, it would average out to a 16% higher GDP.

Reducing the number of low-performing students is not only a goal in its own right but also an effective way to improve an education system's overall performance



– and equity, since low performers are disproportionately from socio-economically disadvantaged families. Brazil, Germany, Italy, Mexico, Poland, Portugal, Tunisia and Turkey, for example, improved their performance in mathematics between 2003 and 2012 by reducing the share of low performers in this subject.

Multiple risk factors acting in concert

Poor performance at age 15 is not the result of any single risk factor, but rather of a combination and accumulation of various barriers and disadvantages that affect students throughout their lives. Who is most likely to be a low performer in mathematics? On average across OECD countries, a socio-economically disadvantaged girl who lives in a single-parent family in a rural area, has an immigrant background, speaks a different language at home from the language of instruction, had not attended pre-primary school, had repeated a grade, and is enrolled in a vocational track has a 83% probability of being a low performer in mathematics.

While these background factors can affect all students, among low performers the combination of risk factors is much more detrimental to disadvantaged than to advantaged students. Indeed, all of the demographic characteristics considered by PISA, as well as the lack

of pre-primary education, increase the probability of low performance by a larger margin among disadvantaged than among advantaged students, on average across OECD countries. In contrast, only repeating a grade or enrolment in a vocational track have greater penalties for advantaged students. In other words, disadvantaged students tend not only to be encumbered with more risk factors, but those risk factors have a stronger impact on these students' performance.

“Results from PISA 2012 show that more than one in four 15-year-old students in OECD countries were not able to read a simple text, perform a simple mathematical operation, or demonstrate the understanding of basic scientific concepts, even after being at school for at least 9 years.”

Less supportive teachers and schools

Students attending schools where teachers are more supportive and have better morale are less likely to be low performers, while students whose teachers have low expectations for them and are absent more often are more likely to be low performers in mathematics, even after accounting for the socio-economic status of students and schools.

In addition, in schools with larger concentrations of low performers, the quality of educational resources is lower, and the incidence of teacher shortage is higher, on average across OECD countries, even after accounting for students' and schools' socio-economic status. In countries and economies where educational resources are distributed more equitably across schools, there is less incidence of low performance in mathematics, and a larger share of top performers, even when comparing school systems whose educational resources are of similar quality.

Policies that can help to break the cycle of disengagement and low performance

Given the extent to which the profile of low performers varies across countries, tackling low performance

requires a multi-pronged approach, tailored to national and local circumstances. An agenda to reduce the incidence of low performance should therefore include several dimensions:

- Dismantle the multiple barriers to learning;
- Create demanding and supportive learning environments at school;
- Provide remedial support as early as possible;
- Encourage the involvement of parents and local communities;
- Inspire students to make the most of available education opportunities;
- Identify low performers and design a tailored policy strategy;
- Provide targeted support to disadvantaged schools and/or families;
- Offer special programmes for immigrant, minority-language and rural students;
- Tackle gender stereotypes and assist single-parent families;
- Reduce inequalities in access to early education and limit the use of student sorting. ■

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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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A celebration of apprentices in Scotland

Natasha Levanti, ACE Group Communications Executive celebrates the rising number of apprentices in Scotland which has reached a five-year high...

The Scottish Build Apprenticeship and Training Council (SBATC) as well as the [Construction Industry Training Board](#) (CITB) have both released figures around the [Scottish Apprenticeship Week](#) (29 February – 4 March) that reveal an increase in the number of apprentices in Scotland for construction and building.

Also revealed by the [SNP](#) is the upcoming achievement of the new apprentice numbers promised in the 2007 manifesto, which further drive to ensure more apprenticeship positions are created in Scotland.

Construction Industry Training Board (CITB) has revealed that the number of Scottish apprentices registered in construction has reached a five year high, with 1876 apprentices hired during 2015. This 32% increase in the number of construction apprentices from 2011 (1422) is a positive sign for the continued drive towards increased apprenticeship opportunities from both the public and private sector. Given the February 2016 CITB prediction that Scotland will need over 21,000 new skilled workers – and the larger UK wide skills gap, with the required engineering estimate to be 1.82 million jobs over 10 years – the push for apprentices within construction is well-founded.

The [Scottish Build Apprenticeship and Training Council](#) (SBATC) subsequently released on 29 February that the number of building apprentices registered in Scotland has risen by 8% to a total of 1683 apprentices registered in building during 2015.

Compared to years past, the 2015 Scottish building apprenticeship registrations is 29% higher than the number of registrations in 2012, which was 1299. However, within this it must be noted that 2012 marked a 15 year low for Scottish apprenticeships in the building



Natasha Levanti,
Group Communications
Executive

industry, making it of vital importance that increased opportunities are continued to be seen. Scottish building apprentice registrations must increase by 39% in order to see registration numbers akin to 2007 – a peak year when 2,700 Scottish apprentices were registered within building. Again this solidifies the need for private and public efforts to increase the number of apprenticeships in Scotland.

The Scottish government is very much aware of the need to increase apprenticeship numbers in Scotland, taking the opportunity during Scottish Apprenticeship Week 2016 (29 Feb – 4 March) to say that their 2007 manifesto apprenticeship targets are in close proximity, with the expectation that these will be reached shortly.

The SNP took office in 2007 under a manifesto that set forth a goal to deliver a total of 200,000 apprentice positions for Scotland, at a rate of approximately 25,000 positions per year.

This week the SNP has reported that 186,855 individuals have been able to secure a 'modern apprenticeship (MA)'. With only 13,145 registrations to be secured prior to the 2007 Manifesto target, this positive



progress for Scottish apprentices is to be celebrated during Scottish Apprenticeship Week 2016. The widely used MA employment programme, partially funded by Skills Development Scotland (SDS), is intended to provide work-based learning for a variety of industries, including engineering, building and construction amongst others.

However, considering the hard hit apprenticeship numbers took during and after 2008, as well as the predicted skills gap for skilled workers, further efforts must be made.

As of yet, it appears that the Scottish government is highly aware of this, with the proposition that the goal set for apprenticeship registration be increased to 30,000 per year by 2021.

The government is also working to counter the misconceptions that apprenticeships are only for school leavers, which was revealed in recent survey from Scottish gas. To highlight that apprenticeships are worthwhile training programmes for all ages and assist not only in establishing a career but also in switching career focuses, as well as to reveal contributions apprentices make to Scotland, the Scottish minister for housing & welfare, Margaret Burgess MSP, helped launch the Scottish Federation of Housing Associations' (SFHA) Apprentice Challenge on 29 February geared

towards video diaries of apprenticeships. The winning video diaries from this competition fully expected to reveal benefits of apprenticeships will be shown at the Scottish Federation of Housing Associations' Conference in June.

It is only through efforts, big and small, of public and private stakeholders that the number of quality apprentices in Scotland will be raised to fulfil the skills gap, as well as overturn the misconceptions present, allowing Scotland and potential Scottish apprentices to fully benefit from apprenticeship opportunities.

The Association for Consultancy and Engineering (ACE), through the support of the Technician Apprenticeship Consortium (TAC), is highly cognisant that apprenticeships

are a key tool for our industry to overcome the looming skills gap of 1.82 million skilled jobs over the next ten years across the UK, including Scotland. For Scottish Apprenticeship Week, as well as for National Apprenticeship Week (14-18 March) ACE and TAC will continue to highlight the benefits of apprentices for future progress. ■

Want to participate in highlighting apprentices? Contact consult@acenet.co.uk



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Ljubljana – European Green Capital 2016

The European Green Capital team outline why Ljubljana is the first and only European green capital in central and south eastern Europe...

Ljubljana is a city that will surprise you and exceed your expectations. It is unique – small by surface area, but huge in its hospitality and quality of life. On 275 m² you will find all the characteristics of big metropolises and at the same time, you will be fascinated by its greenery, cleanness, safety, and friendliness of its 287,000 residents. In the last decade, numerous sustainable changes have happened, and this is one of the reasons why the European Commission awarded Ljubljana with the title of European Green Capital 2016. According to the jury, Ljubljana is the city that made the biggest change in the field of sustainability in the shortest period of time.

Since 2007, when we introduced the Vision Ljubljana 2025, we set out to ensure that our city becomes a sustainable and ideal city by 2025. In the Vision, the concept of sustainable development and urban planning are closely intertwined. In the last 9 years we have successfully implemented more than 1,700 projects that are in line with the Vision.

Representatives of various world cities we meet, often see Ljubljana as an example of good practice, pointing out its determination and courage to implement sustainable mobility projects in the city centre, where we established an ecological zone by closing it to motorised vehicles and opening it to pedestrians and cyclists. We completely transformed the main artery in the centre with altered traffic regime and the creation of shared space dedicated only to pedestrians, cyclists and public transport. Now, on the main road, there are no private motorised vehicles, and the refurbished city walkway is lined with young ash trees attracting butterflies and bees.

The city has become revitalised with new energy; it has become not only an ecological zone but it is a big living



Image: © A. Rebec

room for diverse social, cultural, sporting and other events where people can meet and enjoy.

However, one of the major challenges was to change the established habits of residents, to make a shift in their mind-sets in order to allow a better quality of life and a sustainable future. For this reason, we cooperate and communicate with numerous stakeholders, especially with those that are the most affected by the change. Sustainable strategies are carefully formu-



lated, and projects are thoughtfully carried out in the cooperation with numerous local, regional and national stakeholders. Participation in the process is not limited only to experts or certain stakeholder groups but is wide and open to all.

According to the jury, Ljubljana successfully combines 2 things: we are protecting and preserving the recognisable green identity of the city and actively transforming areas that not too long ago were not green or environmentally sustainable.

We have a large share of green surfaces. Almost 3/4 of the city's surface is covered with green areas. There are 4 nature parks in Ljubljana. Among them the Ljubljana Marsh Nature Park – Natura 2000 areas represent more than 16% of the city's surface. The park is also listed in the UNESCO World Heritage List. Forests cover 46% of the entire area of Ljubljana and reach right into the city centre. 20% of Ljubljana's area has a nature protection status. We have also revitalised a large number of degraded areas and brownfields and created 80 acres of new parks.

Furthermore, we are continuing to offer sustainable mobility options to our residents and visitors, such as building park & ride facilities, greening our public transport bus fleet and prolonging the travel routes into neighbouring municipalities, expanding the network of the bike-sharing system BicikeLJ and encouraging electrical mobility.

Ljubljana is the capital that has already exceeded the EU's recycling targets for 2020 by 10%. We rank first in separately collected waste in Europe and we are also the first European capital to be part of the Zero Waste Europe network. Our regional centre for waste management has the most advanced system of processing mixed and organic waste in Europe. It will manage waste for one-third of the country while creating new green jobs.

The main water source for Ljubljana and its outskirts is groundwater from 2 different ecosystems: Ljubljana Marsh and Ljubljansko Field. Water is of outstanding quality, and there is no need for technical treatment. This proves that the city's development has been closely



Image: © V. Hoffmann

tied up to sustainable measures for the protection of water sources.

The city carries out a number of actions, campaigns and events to encourage its residents towards more green lifestyles. It has become a yearly tradition to conduct a month-long spring cleaning campaign For a More Beautiful Ljubljana as well as the Sustainable Energy Week and the twice-awarded European Mobility Week. We decided that every member of our so-called 'large city family', which comprises more than 12000 colleagues in the city administration along with public companies and institutions, should plant their own tree. Tree planting campaign has been launched last year and it will be completed this year.

Even though we have not only met, but even exceed some important goals, one can always find room for improvement and further development. At the moment, we are implementing over 90 projects and each one of them is "green". We will continue to restore degraded areas and nurture the established green ones. To fight climate change, we will, through various measures, reduce CO₂ emissions by 30% by 2020 in addition to balancing the distribution of mobility; so by the end of

the decade, one-third of all journeys will be made by public transport, one-third by foot and bicycle, and one-third by car. Additionally, we will reduce water loss and preserve clean drinking water, which must remain a public good, accessible to all.

We are very proud and honoured to be the seventh European city that won the prestigious title of European Green Capital. In 2016, every month is dedicated to different sustainable topic and we are carrying out numerous daily activities with different stakeholders to raise awareness among citizens on green issues and encourage them to make Ljubljana even more green, clean, hospitable and friendly. We would like to invite readers to visit Ljubljana and experience our city first hand. ■

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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 Sustainable Renovation project Coordinated by the Danish energy specialist com-



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

pany 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 opposite:

<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 and schools. The benefit here will be much lower total costs due to the avoidance of large amounts of duct work, but the



School facade in Copenhagen with window integrated heat recovery ventilation

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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Strengthening partnerships between cities

Hella Dunger-Löper Member of the European Committee of the Regions (COR) outlines the core principles that should shape the EU's new Urban Agenda...

A wall once ran through my city. When it came down, two halves had to be connected, neglected areas restored, new communities created, a shared direction agreed. Berlin is not, of course, alone in needing re-integration. Belfast has achieved that. In Cyprus, efforts to foster contacts between the ethnic Greek and ethnic Turk parts of Nicosia encourage the hope that, sometime soon, the island's divisions will end.

Berlin took away from that extraordinary post-1989 period 2 core principles. Firstly, participation is crucial: residents need to be engaged in shaping the city, just as local and regional government and national policy-makers must be. Secondly, participation is only possible if cities' administrations are open and transparent. If they are to develop the city, all those involved need to be able to see what is going on at any point.

These principles are backed by my peers across Europe: on 8 April, the European Committee of the Regions, the EU's assembly of local and regional politicians, adopted an opinion drafted by me that said that these are 2 of the 3 principles that should underpin the EU's new Urban Agenda.

They backed it because they recognise that the relationship (and understanding) of state and society, of citizens and community is shifting significantly. Sometimes in the past – and still in some places – cities were viewed almost as passive objects, to be worked upon by urban planners and engineers. Now, cities are promoting more participation by residents; they realise that they need to coordinate more with the local, regional, national, and European levels; and they are collaborating more with other cities. With the internet, participation is easier. Coordination is more important, because complex global challenges such as climate

change need agreements between member states and action by local government. Networks of cities and regions have developed, making collaboration easier. Increasingly, there is also a realisation – as the Committee of the Regions argues – that social cohesion needs to be reinforced in the face of growing inequality and other pressures.

For example, the arrival of a large number of refugees in Europe makes inclusive policies and an integrated approach even more important. In Berlin, one well-known project is the 'neighbourhood mothers' programme, through which women with a migrant background support other migrants in everyday life in areas where, for instance, the role of social workers is limited because of language barriers and trust issues. Integration requires this type of imagination and hard work at the local level. It also requires support from the regional, national and European level.

The EU's new Urban Agenda, which ministers will endorse in Amsterdam, is a recognition of this shift by local governments towards a more inclusive approach. It is also a response to criticism that the EU needs to take a more integrated approach to issues affecting cities. The EU has no urban policy – urban policy is determined by national governments. Yet around 70% of legislation agreed by EU member states – on, for example, transport – require some implementation at the regional or municipal level. In the absence of an EU urban policy, urban issues have been addressed in a fragmented, sometimes incoherent way. The Pact of Amsterdam will set specific priorities and some working methods, including a strengthening of partnerships between cities.

This is good. There is no attempt to suggest a one-size-fits-all solution. The Pact promotes a bottom-up



*Hella Dunger-Löper,
Member representing the
Party of European Socialists*

approach. There is no threat to Member States' power to determine urban policy. It will enable a state and a city to discover what other states and cities are planning, and they should be able to work together more easily. Crucially, the aim is to 'urban-proof' EU policies, so that European institutions take urban issues into account as a matter of course from the beginning of the legislative process.

But 'urban-proofing' and implementation require more political commitment. The EU's member states agreed to an urban action plan in 2000 (in Lille), identified documents that could act as common ground for urban development policies in 2004 (the Rotterdam Urban Acquis), and in 2009 agreed to start integrating sustainability strategies into national, regional, and local development policies (the Leipzig Charter). We now need to work more on implementation, which is what the Pact of Amsterdam encourages. But the pact should be binding – that is the third principle that the CoR is calling for.

The EU's Urban Agenda is, in effect, an attempt to improve the quality of life in Europe's cities. But it is

also crucial to the health of our societies. The EU's approach could also help cities across the globe that face bigger challenges with fewer resources. This year, the UN will hold its biggest gathering in 20 years, Habitat III, on sustainable urban policies. The Pact of Amsterdam is, therefore, the right message at a big moment for the world's cities. ■

Hella Dunger-Löper is the state secretary of the Land of Berlin, with responsibility for European affairs. She is a member of the European Committee of the Regions (CoR), representing the Party of European Socialists, and is the author of the CoR's "Concrete steps for implementing the EU Urban Agenda".

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Hella Dunger-Löper
Member representing the Party of
European Socialists

European Committee of the Regions (CoR)
<http://cor.europa.eu/en/Pages/home.aspx>

Corrosion rate of steel in carbonated concrete made with modern binders

Concrete and reinforced/pre-stressed 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

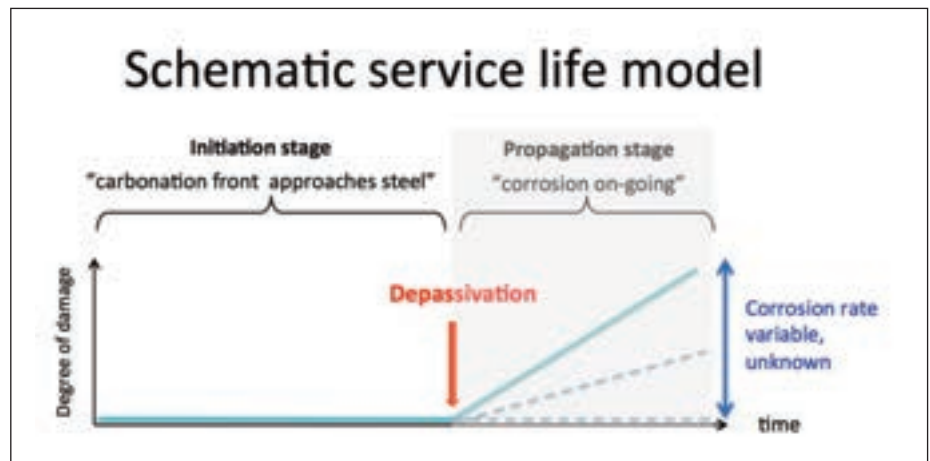


Fig. 1: Service life model of a reinforced concrete structure exposed to carbonation. At the end of the initiation period the steel is depassivated and corrosion can start

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,



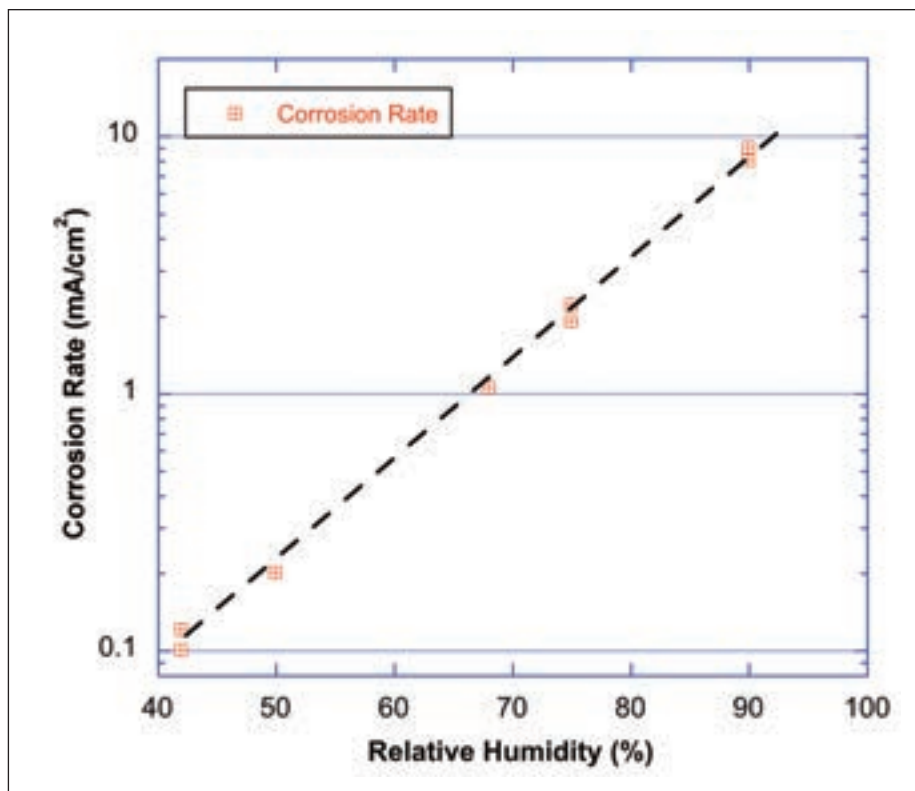


Fig. 2: Influence of relative humidity on the corrosion rate of steel in carbonated OPC mortar adapted from C.L. Page et al. 4

thus the reaction of CO_2 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 outmost 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.

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Varberg takes responsibility – again

For the coastal city of Varberg, Sweden, 2015 was the year when the community united in a joint effort to take responsibility for peace and human rights – just as they did at an international peace summit held there one hundred years before. The municipality has an active role to play and views the project as an extension of the work towards its vision of developing the city of Varberg as the Swedish West Coast's creative hotspot, with the help of local residents.

As the 100th anniversary of a significant peace summit approached, here in Varberg we chose a different way to celebrate. The result was the VARBERG CALLING for Peace project, with the aim of engaging and involving residents in actively working for peace and a sustainable society. The basic idea is to draw attention to the local and international history of peace, and in doing so combine the forces of Varberg's administrative bodies, organisations, civil society and local residents to increase awareness of the important perspectives that are vital for peace and a sustainable future. It is also important to encourage participation in order to highlight issues of democracy, human rights, cultural understanding and sustainable environment, and to examine them in greater detail. Also for there to be a legacy once the project has ended, which can be built on and will provide support for future development.

Photo: Mimmi Persson



Greater awareness of the age in which we are living and a common educational perspective on our history provide the conditions for future creativity, innovation and action. We believe that the big, universal human issues can unite many, both organisations and individuals.

Thinking globally and taking into consideration situation analysis and environmental and resource perspectives cannot be restricted to municipal or national borders. VARBERG CALLING for Peace is an opportunity, therefore, for Varberg municipality to take a forward-looking, general approach to sustainable development in a project that involves local residents. Engagement on humanitarian issues and the all-pervading problems we now face in the world around us may also increase interest in important issues at local level. The project therefore represents a step towards the realisation of Varberg's plan: Vision 2025 "Swedish West Coast's creative hotspot" and a sustainable future.

Christina Josefsson
Head of the Culture and Leisure department
The City of Varberg

Come to Varberg. Share our vision.

Inspiring people to create everyday peace



**VARBERG
CALLING
for Peace**

The city's local education centre, Campus Varberg, is today the largest vocational college in the Halland region and is one of Sweden's leading providers of vocational education. The core values at Campus Varberg include knowledge, innovation and creativity, and it was not long before it became involved in the VARBERG CALLING for Peace project.

At the college's events and management course a number of students are running their own projects as part of VARBERG CALLING for Peace. Here they tell us about the solid peace work they have done, which has given them valuable experiences.

"We are studying on a three-year events and management course and during February and March we studied a course in 'project-based development work'," explains Lina Rundbom, one of the students.

"During the course, we had the opportunity to choose from a number of assignments to work on and we five chose 'VARBERG CALLING'. We had to examine and communicate the questions 'What do you stand for?' and 'How can you get strangers to talk to one another?' to the general public."

The assignment came from the two process managers for VARBERG CALLING for Peace, Malin Bellman and Jon Liinason.

"They gave us some good advice before we started. 'Don't think – just do it and see what happens!' they said. So we did. We tried out our ideas on people using quick and easy prototype tests, with the results leading to new ideas."

One of the prototype tests involved leaving a bicycle in the entrance to the city's galleria. The girls left the bicycle "right in the way" and stood a few metres away to see how people reacted. Contrary to what you might expect, most people did not seem particularly irritated. It gave some people something to talk about as they wondered why the bicycle was there. Another was the mobile "everyday peace cycle café". Loaded up with coffee and pastries, the bicycle was pushed around to various parts of the city, offering coffee and cakes for free.

They asked the people they met how we can create everyday peace. Smile at someone you don't know, pick up litter, and hold open the door for someone were some of the suggestions.

"It really doesn't need to be any more difficult than that," says Lina. "Everyone can do something. The cool thing was seeing how our own positive energy clearly spread to those people we were talking to."

Annette Wenklo

varberg

varberg.se

Indoor Positioning Systems – We know where you are

Jim Sinopoli, Managing Principal at Smart Buildings LLC highlights
the benefits for Indoor Positioning Systems...

Studies have found that people spend 80-90% of their time indoors, so it's no surprise that one of the most promising technologies for buildings is Indoor Positioning Systems (IPS). An IPS simply locates objects and people in a building and provides location dependent information and data to occupants to assist in finding their way. It has much more potential, such as providing valuable information to businesses and building owners, security and life safety aspects.

The most popular approach to the architecture of the IPS is "Bluetooth Beaconing", although Wi-Fi can be used, it is not as accurate as Bluetooth. Bluetooth was created in 1994 to essentially replace short cables. Today every smartphone is Bluetooth enabled and we're all familiar with using it to connect ear buds, headsets, printers, game consoles, keyboards, etc. It is the Bluetooth capabilities of smartphones together with the beacons that can provide the location of the smartphone users. The use of Bluetooth beacon have an accuracy around 0.3 meters (1 foot), with no latency. The IPS system will use a variety of methods to identify the location of a personal or object including triangulation, signal fingerprinting and direct association.

Large national and international companies have formed the In-Location Alliance for indoor positioning systems to standardise and commercialise the technology. The alliance includes large multi-national companies such as Nokia, Samsung, Qualcomm, Sony and dozens of other companies.

Some of the companies involved in IPS are high tech companies motivated to extend their existing outdoor mapping applications to the indoor environment where GPS doesn't work well due to signal attenuation. In addition to extending their mapping applications and advertising revenue the companies have an

opportunity to create a treasure trove of data that will assist businesses, primarily retail, in identifying customers and product placement.

One of the key metrics for building management is data on how occupants are using building spaces. That may include when and where building occupants enter and exit a building, what building spaces occupants inhabit, what time or day they occupy the area, duration of occupancy, etc. Such data can be used to optimise the building operations, correlating the occupant data to building systems, energy consumption, space utilisation, and even utilising the data for renovations of existing buildings or design of new buildings. IPS could also be part of addressing life safety events, for example locating people for safety and security purposes in an emergency.

IPS technology can be used for almost any size building but appears to be particularly well-suited for large commercial buildings, educational campuses, malls, airports and museums.

Some of the applications involve real time location of personnel such as doctors, supervisors, technicians, or tracking team members and assets on missions in dark or crowded locations. Some companies have also used IPS to identify occupancy and adjust energy management systems based on where people are gathered.

IPS has many uses such as life safety and security, providing an innovative way to locate and communicate with people inside buildings during emergency situations. The United States Federal Communications Commission (FCC) is looking at indoor positioning to enhance emergency response as well. FCC has suggested a current baseline for indoor positioning for use in emergency response. One of the concerns is



determining vertical location in a multilevel building. An FCC report concludes: "While the location positioning platforms tested provided a relatively high level of yield, as well as improved accuracy performance, the results clearly indicate additional development is required".

It is worth noting that over 70% of all emergency calls come from mobile phones. The indoor positioning system can also be used in conjunction with an Access Control System to trigger an alarm notification if a worker or asset enters or leaves certain predefined zones.

Many deployments of indoor positioning systems use multiple technologies; Wi-Fi and Bluetooth BLE. Such installations strive for more precise and exact locations. Multiple technologies also provide some resiliency and reliability in the system, and the use of multiple technologies may allow for compatibility with a larger spectrum of support for user smartphone and tablet devices.

Given the high profile incidents that are occurring with growing frequency in shopping malls, office buildings,

schools and even government facilities, hybrid IPS technologies combining Wi-Fi and beacons offer the best methodology available to protect individuals, reduce injuries and prevent loss of life. Indoor Positioning Systems do not work without indoor maps. Building owners will need to survey their area and incorporate the maps into the facility's app.

We track and locate people and objects outdoors in real-time via GPS; IPS provides for similar tracking indoors. In the near future it may be that there will be few places on Earth where we can't be tracked and identified. ■

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Indoor location and IoT for smarter and more inclusive buildings

We spend the vast majority of our time in indoor spaces, be this at home, at work, or while travelling. Despite most of us being used to location-based services (LBS), for instance to find the nearest point of interest, this experience is essentially limited to outdoor spaces since GPS-based location becomes of limited use, when locating the position of objects or people within indoor scenarios.

In recent years, several indoor location solutions have reached technical maturity, opening up unprecedented “smart building” scenarios including, but not limited to, personal mobility, facility management, retail, etc.

How i-locate has addressed existing barriers

Today, the indoor location-based services market is very fragmented with several corporates, SMEs and start-ups developing specialised solutions based on a variety of different technologies (Bluetooth, Ultra Wide Band, geomagnetism, Li-Fi, etc.). The three main barriers which have traditionally limited widespread adoption of these technologies are: the lack of online services capable to support the creation and sharing of indoor maps as open data, the lack of technological ecosystems leveraging on indoor mapping data, and limited availability of dedicated standards for indoor location based services. These three obstacles have been targeted by i-locate (www.i-locate.eu), a project co-funded by the European Commission, which has developed an online service to create and share (as open data) indoor

maps and a software ecosystem for indoor location based on open standards.

The resulting technologies have been used to create “smart” building scenarios within publically accessible buildings (e.g. city halls, hospitals, universities, etc.), by leveraging on indoor location of objects and people. The technology is being piloted for 12 months in 14 locations across 8 countries, addressing several scenarios selected for their social and economic relevance, with the involvement of real downstream users including, operators from hospitals, public officers, and citizens, etc.

Indoor location as the driver for smarter buildings

Although indoor location technologies have proved to be an enabler for smarter buildings in domains such as industry, retail, health, etc., their benefit for scenarios related to the ageing population has been still largely unexploited.

However, indoor location, used in conjunction with technologies of the Internet of Things (IoT), can be a very effective leverage to the creation of smarter buildings, specifically designed to promote more “independent living” for older people by monitoring, adapting and responding to the needs of an ageing population.

The extent of the impact, in both social and economic terms, of having smart buildings designed for ageing people becomes clear if we analyse evolution of demographics. Our fast ageing population may threaten sustainability of healthcare financing, with an

increasingly smaller share of population providing the resources for a larger group of elderly people who will generate increasing costs.

Particularly critical is the rising Long-Term Care (LTC) expenditure as frailties, chronicity or multi-morbidity significantly rise with age, especially in the very old (+80), the fastest growing age group, straining an already challenged healthcare model (their costs are set to increase from 1.8% of GDP in 2013 to 3.4% in 2060).

Such a demographical evolution clearly requires new health-care and assistance paradigms based on old people staying in their homes as long as possible and it calls for smarter buildings specifically designed to account for the requirements of older people.

“Imagine an old person, living in a seniors home, that wakes up from bed at night and falls on her way to the toilet. The accident could be discovered only after hours. To limit risks, today, beds are fitted with barriers, which -however- affect seniors’ dignity and autonomy. Future smart buildings will be able to detect the danger, turn on the lights and immediately send an alert to caregivers, granting the old person the freedom she would enjoy at home. Smart and high-accuracy location technologies capable to understand dangerous situations and -if needed- react, are an essential component of such a smarter building.”

The achievements of the UNCAP project

The aforementioned scenario depicts the typically used case addressed by

UNCAP “Ubiquitous iNteroperable Care for Ageing People”, a project co-funded by the European Commission that, in line with modern literature, fosters a non-pharmacologic approach where “smarter buildings” become part of a wider strategy to help old people maintain dignity, autonomy, and a qualitative good level of life for a longer period.

This is done through the development of an IT ecosystem for AAL, capable to transform a private or nursing home into a “smart building”. This would specifically be designed for older people, to help them live as independently and as long as possible, while reducing dependence from other people to perform Activities of Daily Living (ADL), e.g. to find the container of the medicines.

The underling principle is to leverage on interoperable access to biosensors (based on Internet of Things – IoT), to indoor location technologies (based on the aforementioned i-locate platform) and home automation systems, to create added-value services capable to ensure active monitoring and prediction of incidents of their guests, adapting to gradual deterioration of patients’ cognitive, physical, and social functions. Examples of such integrated vision includes services to monitor physical movements and clinical parameters, to promote exercise and training (both at a physical, emotional and cognitive level), to support ADL, to detect when an old person with cognitive impairment leaves their room at night, or to turn on the lights if the person starts a night wandering episode or -worse- if he/she falls to the floor.

Emergence of new services models

At policy level, such a technological convergence should be exploited to promote social and organisational

changes, as well as new service models beyond the simple care domain, which can leverage on a more autonomous ageing population living within smart buildings.

Policies should promote not only collection and access to health information but they should promote the transformation of existing houses into smart buildings that facilitate self-empowerment of old people and, most notably, their families. Self-empowerment will promote proactive involvement of elderly people, and their families, in turn facilitating better dialogue with clinical staff, bringing to a generally improved care system.

Barriers and obstacles and framework conditions

The most significant barriers that need to be overcome to promote such a radical change, include:

- Lack of common policies across EU, which are often not developed nor harmonised, to promote transformation of existing buildings into smart spaces;
- Fragmentation of markets at national level, as well as fragmentation of provision/ reimbursement schemas that could be applied to re-fitting of existing buildings;
- Very complex value chains and lack of synergies across public and private stakeholders;
- Undefined boundaries and responsibility structures and clarification of liability issues connected to smart buildings as part of more comprehensive health and care systems.

The lack of high-level standards (more than low-level standards for hardware communication), is perhaps the most urgent barriers to overcome, and it is

associated to the risk of emergence of de facto standards from companies that can take benefit of such a fragmentation. As highlighted by European Innovation Partnership on Active and Healthy Ageing (EIP on AHA), most solutions are based on single provider design and therefore cannot be adapted or adopted to different technologies. The lack of interoperability is one of the key barriers to increasing competition, it does not allow synergising between different systems, it may cause market dominance by major vendors preventing true competition (especially by SMEs) and -ultimately- it increases costs.

A grand challenge and a major economic opportunity

To conclude, if we consider that, in Europe alone, people aged 65+ possess wealth and revenues worth over €3,000 billion, it becomes clear that, if properly exploited, such a major change in demographics will create a significant market opportunity around smart buildings for the “silver economy”.

Acknowledgements

Both i-locate and UNCAP are coordinated by Dr Giuseppe Conti, CTO of Trilogis, an Italian SME specialising in geospatial solutions and CTO of Nively, a French start-up spin-off of both i-locate and UNCAP, specialising in location-based Ambient Assisted Living solutions targeted to elderly persons.

i-locate and UNCAP are co-funded respectively by the ICT-PSP and Horizon 2020 Framework Programmes of the European Union.



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Engineering happiness in our cities

Simon Price, Ramboll Liveable Cities Director looks at how engineering and infrastructure in our cities can lead to happiness...

Cities are where most of us live, not just in the UK but across the world. Every city is different, characterised by its geographical position, its history of development and its population. But in an ever increasingly connected world and with the increased mobility of individuals, and indeed whole populations, cities are in competition with each other for success.

Increasingly it is recognised that for a city to thrive it must engender a sense of wellbeing within its citizens, a sense of happiness. Happiness is considered to provide a better indicator of human welfare than does income, poverty, education, health and good government measured separately ([World Happiness Report](#)).

For many years, the role of engineering within cities was simply seen as the means to provide the core infrastructure required to support urban life. To meet the basic needs of energy, water and waste services, transport etc. More recently though the concept of place making has emerged, but has often been interpreted by design professionals, including engineers, as 'place' being defined by some particular sort of infrastructure, a square, a cultural facility perhaps; often to address perceived needs with little recourse to an area's population.

Exploring issues of human wellbeing and happiness means we too can draw on the work of other disciplines and studies. For example the [New Economics Foundation \(NEF\)](#) – The Five Ways to Well Being. This can provide engineers and planners with new insights into how to support the frame conditions for happiness through good planning and design.

The Ramboll concept of the 'liveable' city is an approach that builds on the ideas which underpin the



findings of the NEF and others and combines this with expertise to design and deliver urban infrastructure. We recognise that engineering has a key role to play in creating the opportunity for wellbeing and happiness. This approach has underpinned much of the recent development within Copenhagen.

Copenhagen, named as the European Green capital in 2014 already has an established reputation as one of the most liveable cities in world. It is recognised for how green solutions have both benefited sustainability and growth. It is the world's best city for cyclists with in excess of 40% of commuters choosing to use bikes over their cars and has the ambition for all to be in a 15 minute walking distance of a beach or a park. With over a million people linked to a multi fuel district



heating system, the city has the ambition to be CO₂ neutral by 2025.

Through being a more attractive city to live and work in, the city has turned around a situation of population decline to one of growth resulting in the need for new housing districts. Nordhaven, situated just 4km from the centre of Copenhagen, will provide housing and workspace for over 40,000 people as it is developed over the next 40-50 years. This new urban district will eventually reuse over 500 acres of old port facilities but rather than being all designed in one go, much of the early effort went into establishing the overall vision for the development, that is the framework which will guide all future development across the 40-50 year period. The vision was broken down into 6 supporting elements all considered to be supportive of sustainability and happiness. The elements are: islets and canals, CO₂ friendliness, the 5 minute city, the blue green city, an intelligent grid, and identity and history.

Considering these 6 elements the first development quarter nearest to Copenhagen has already been planned, and construction is underway. The design of this quarter carries many of the influences of the existing city to create the feel of a natural extension to something which is familiar, and not of an isolated project. Scale has been an important consideration

since it is known that people feel more inspired by their environment when it offers great variety. To support this approach, building plots have been limited in size and the network of streets limits individual street lengths with an emphasis on the concept of 5 minute mobility, which means the goal of making all service facilities reachable within a 5 minute walk. Therefore housing and workplaces throughout the district will all be within a convenient distance of public transport, bicycle paths, green areas, public institutions and commercial facilities. All will be connected to the district heating system and linked into the wider cycle and public transport networks.

Will good planning and engineering design provide the conditions for happiness for the populace of Nordhaven? Well time will tell, but it seems arriving citizens of Copenhagen are recognising the value of a vision driven by liveability with all the apartments already been sold ahead of schedule. ■

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BIM, IoT, big data: A vision for a data enabled built environment

The building information modelling (BIM) journey is underway and accelerating across the globe. Those now wishing to tender for UK Government funded projects are required to demonstrate their ability to work with and provide information from a BIM-enabled environment.

Some companies will now be thinking that they can rest a while having achieved 'level 2'. However, the reality is that level 2 was not intended as the destination; it is the departure point to fuel the journey towards data, information, knowledge and wisdom. While significant value can be achieved at level 2 it is evident that significantly more value is to be found by going beyond level 2 and managing the information at a data level.

However, it is my belief that some companies are now on the wrong track, driven by software vendors who are selling what they have, based on where they came from, rather than what the industry truly needs to drive efficiency. The belief that a document-centric approach will work effectively in the future is fundamentally flawed. Of course documents are still required, at least for the foreseeable future, but it is a data-centric approach that is required to better expose and access the information required to achieve more.

Truly data driven platforms

The key question is, how else can we move towards a true data driven information platform that can be linked at object level and is ready to

be used in the 'big data' world without the accessibility to information that is currently locked away in files?

The most forward thinking companies are already using data-enabled collaboration and are moving quickly towards working with objects i.e. construction elements like slabs, columns, beams, windows, pumps, valves, etc., and focusing on the processes for gathering information attributes across the information lifecycle in a database, rather than trying to abuse 3D design files to store lots of detailed descriptive attribute data.

The result is building a fuller representation of the asset by federating the data from multiple models, storing it in a database, and then enriching the information as the project progresses. These companies are now reaping big rewards of increasing efficiency and quality of project outcomes. Some of the outcomes and ROI's have been significantly better than anyone predicted.

Extracting value from information

The dawn of 'big data' is rapidly drawing nearer for the built environment. Technologies that take feeds of data from a myriad of sensors connected by the internet – the so called 'Internet of Things' or IoT – brings us into a highly connected world. The technology is available now to deliver masses of data, but as an industry we still need to figure out how to extract value from the information and resulting intelligence that big data and IoT is able to provide.

Big data is all about using this vast array of data sources to identify and analyse trends. This is quite different from 'analytics'. I have a simple view that analytics is looking for information when you know the question. Big data is about analysing data and trends looking to provide answers to questions you should or could have asked.

From a construction industry perspective, we need to apply this thinking to how we design and use our built environment, and how it could automatically react to changing conditions.

Picturing a data enabled environment

Imagine an emergency situation in an inner city high street where a fire breaks out. It is important to protect life and contain the environment to stop the fire spreading. By monitoring fire detection equipment and temperatures within spaces linked to a 3D building model it is possible to assess the extent of the fire and determine the best escape paths. Access to detailed building information can provide rich information on possible danger and safety areas, fire containment strategies and rescue planning.

Now bring into the scenario anonymous cellular data feeds, linked to the building model which can indicate the location or concentration of people in the building or in other dangerous areas.

Then consider the weather. If it's windy, sending an emergency code to sensors to close air vents and seal the building may help bring the fire under control

BIG DATA

and stop the fire and smoke from spreading. Anonymous cellular device feeds can also inform the emergency services on the dangers of predicted debris areas based on structural information and weather conditions. Traffic systems can automatically place signals on red to avoid traffic entering the area, and corridors opened up to assist first responder access.

An effective response

Analysing trends from simulations on real time and historic data, adding in such things as detailed building models, GIS information, weather and transportation feeds, movement of people, and so on, can bring intelligence and inform us on how situations can be prevented or responded to more effectively in the future.

This kind of approach is already starting to happen in small steps through the UK's efforts to smooth out traffic flow by introducing 'smart motorways'.

However to move forward I would

suggest that we need to have a full physical and functional representation of our built assets at an object, or element level. We cannot achieve what is required in the future with the information being locked away in 3D models and document management systems. This kind of scenario calls for a data-enabled collaborative environment that can share detailed attribute information, in context from a database platform.

Making headway

Intelligent clients are already starting to consider how they can use information to drive better decisions. The supply chain also need to focus on their systems and processes so that they can meet the growing need to share a data driven, object-based information model which contains the full physical and functional characteristics of the asset.

There are companies making real headway with a data-centric information platform that sits on a database. I am currently working with one of the

leading companies, Clearbox Limited www.clearboxbim.com in the UK, who are committed to driving forward a data-driven information environment. Over the past two years the BIMXtra cloud based solution has been used on over 500 projects, and provides a real insight into analytics and Big Data and the journey in front of us.

Contact me with views and comments at: steve.dunwell@elev8consult.com



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Training – the first step to competency

Association for Specialist Fire Protection CEO Wilf Butcher explains why competency is important for the specification, installation and maintenance of passive fire protection...

Within the fire sector world, one of the most common 'buzz words' you are currently likely to hear is 'competency'.

The dictionary offers a range of explanations to define the meaning of competency, not least of which is 'the capacity to testify in a court of law'. A sobering thought, as without doubt, the penalty for proven 'incompetence' can be very severe. One only has to be aware of the number of heavy fines, and indeed custodial sentences brought about through incompetent fire risk assessments under the Regulatory Reform (Fire Safety) Order 2005 to understand the importance of competency in achieving a given objective.

In relation to fire safety, competency can only be assured by a combination of education, training and experience, starting with the design concept and progressing through specification, the main contractor tendering process, installation, inspection and finally the onward management for the life of a building.

In other words, fire protection is a cradle to grave process, specified, installed and managed by many different professions, all of whom should have, in varying degrees, an appropriate knowledge and understanding of the functionality of the fire protection measures installed and its surrounding structure.

Improving competency

Over the last 20 years, the Association for Specialist Fire Protection (ASFP) has promoted both product and installer third party certification as a vital means of demonstrating competency in the quality of product selection and the installation of appropriate fire protection systems. Such a UKAS accredited process offers:

- Supporting evidence of the quality of the product or service for the architect, specifier, contractor, building control authority, end-user, responsible person and any other stakeholders;
- Assures the quality of the product or service independently of the supplier.

Third party certification is encouraged by authorities such as DCLG (AD-B), Scottish Government, Local Authority Building Control, the fire services and many others key bodies, and is encouraged by all fire protection trade associations. In fact, it is mandatory for all ASFP contracting members to hold and maintain third party certification to become and maintain ASFP membership.

Whilst the third party certification approach is now widespread within the 'specialist installer' sector of the fire community, the ASFP has long been aware that a considerable element of the workforce currently installing passive fire protection is doing so as a secondary activity, which may be outside of its core construction competencies. These contractors therefore cannot be considered as 'specialist' operators. As a result, there is an identifiable 'under skilling' of essential elements of the construction industry workforce, all of which would benefit from having an appropriate understanding of passive fire protection.

Industry wide training

Given the above, the ASFP, has now taken the next important step. Working in partnership with the Fire Protection Association (FPA) and part funded by CITB (the Industry Training Board for the construction industry), the ASFP has now developed an industry wide

training scheme which encapsulates in one syllabus the necessary awareness training to assist in improving capabilities during the installation process.

This comprehensive awareness training programme is offered in two parts:

Core Module

This 2-day core module introduces attendees to essential fire safety concepts, explaining the need for a holistic approach to fire safety in which all types of fire protection system, both passive and active, have a role to play. The core module:

- Outlines the legal, standard and other code-driven requirements for passive fire protection installations;
- Identifies the role of passive protection to ensure the safety of buildings and their occupants;
- Develops an understanding of the responsibilities of those involved in the process including the designer, specifier, distributor, installer and end user;
- Presents some of the common problems and issues caused by building alterations and potential solutions;
- Explains the principles of fire science and the role of fire engineering.

Pathway Modules

For those wishing to progress their understanding of the passive fire protection process in more detail, the ASFP and FPA have developed a number of specific 'Pathway' modules in each of the passive fire protection disciplines.

Each of these modules combine both theoretical and practical application to reinforce the required awareness for the installation of passive fire protection, and can act as a springboard to assist in the process of onward development to an NVQ in passive fire protection.

Reaching a wider audience

This new training scheme has been designed to significantly improve overall standards of passive fire protection specification, inspection and installation within the construction sector, and in the process will enable an

up-skilling of the existing workforce by creating a recognised and measurable industry benchmark.

Further analysis of the passive fire protection sector has identified that there are a number of other groups that should be better advised and trained in appropriate passive fire protection awareness. These include but are not limited to:

- Site supervisors;
- Inspectors of fire systems e.g. the fire services;
- Approved inspectors and building control officers;
- Fire risk assessors;
- Facilities managers.

It is essential that adequate knowledge is communicated throughout the industry to ensure necessary up-skilling of the existing workforce and to reach those within the process who are not familiar with passive fire protection practice to enable them to achieve a minimum level of competency.

The ASFP's Passive Fire Protection Awareness Training Programme is a first step in an important process which aims to raise levels of competency throughout the construction sector and improve standards of passive fire protection specification, inspection and installation. Ignore it at your peril. ■

For further information on ASFP training, seminars and technical guidance visit www.asfp.org.uk; or to book a place on the Core module visit http://www.thefpa.co.uk/training/training-courses_detail.introduction-to-passive-fire-protection.html

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HEADLINES LIKE THESE...

A London hotel has had to pay more than £260,000 in fines and costs in what is believed to be the first jury trial of a case under the Regulatory Reform (Fire Safety) Order 2005

The former owners of a Wolverhampton Hotel have been fined almost £44,000 following 11 breaches of fire safety

A landlord has been jailed for four months and ordered to pay £10,000 costs after pleading guilty to three offences under the Regulatory Reform (Fire Safety) Order 2005

...ARE BECOMING
ALL TOO FAMILIAR

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WITH YOUR FIRE
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COMPANIES NEAR YOU

**FIRE SAFETY LEGISLATION IS NOW BEING SERIOUSLY
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Adequate Fire Protection starts with a comprehensive and competent fire risk assessment.

That's why BAFE developed a scheme for the certification of companies who provide fire risk assessment services.

BAFE scheme 'Life Safety Fire Risk Assessment' (SP205) ensures that UKAS accredited certification bodies can assess staff and procedures, so that property owners

can be sure that the provider that they use meets appropriate standards.

BAFE is the independent third party approvals organisation, which ensures quality for the fire protection industry and provides the vital reassurance that the services being bought or specified are effective and reliable.

Don't leave everything to chance.
Make sure that your suppliers are certified and registered with BAFE at WWW.BAFE.ORG.UK



PROMOTING QUALITY IN FIRE SAFETY

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The circular economy – an investment with a triple win

Karmenu Vella, EU Commissioner for the Environment highlights why Europe needs a circular economy...

Everyone who looks closely at the economic and environmental realities of the world today agrees that the 'take, make, use and throw away' economy is the model of the past. In an age where the global population grows by 200,000 every day, these ways of thinking are no longer sustainable.

“The circular economy will also be on the agenda at Green Week, Europe’s biggest annual event on environment policy, which will take place from 30 May to 3 June.”

What Europe needs is a positive vision for economic development. We need a new model, where we use resources more efficiently to boost Europe’s competitiveness. A model that retains precious resources in the production chain, and exploits the economic value they contain to the full. What we need, in short, is a more circular economy.

In a circular model, products are designed to be used for as long as possible, easily repaired and, once they reach the end of their lives, recycled or disposed of effectively. This brings major environmental benefits, as resources are used efficiently and waste is reduced. But the economic opportunities are just as big.

Studies show that a shift towards a circular economy could bring savings of €600bn for EU businesses, and reduce greenhouse gas emissions by 2 to 4% every year. There is also significant employment potential with low, medium and high-skill jobs in eco-design, engineering, waste sorting and recycling, and in new services based on renting or sharing products. A circular economy promotes innovative technologies that give European companies a competitive edge, and it benefits consumers, who enjoy more durable and innovative products.



The European Commission presented a package on the circular economy in December 2015 showing how this future can be achieved, with a legislative proposal on waste and an Action Plan for the economy.

The waste proposal acknowledges a hard truth: waste in the EU could be better managed. Only 36% is effectively recycled, and 37% is sent for disposal, wasting precious resources that the EU cannot afford to lose. Recycling rates reach 80% in some countries, while in others they languish below 5% (the UK recycled 45% of its municipal waste in 2014, which is above the EU average of 43%). What we propose is a plan for raising that average, while still taking into account the differences between Member States.

Food waste is an area of particular concern. The UN Sustainable Development Goals adopted last September include a target to halve food waste by 2030. The Commission is committed to helping EU Member States deliver on this target.

The circular economy is not just about recycling. It's about the whole lifecycle of products. It's about incorporating sustainability into products from the outset – rethinking design, rethinking production processes, giving better choices to consumers, and changing existing business models.

The UK already has a number of champions in this area. On a recent visit to Scotland I saw how Kalopsia, a textile company in Edinburgh, is putting the circular economy into action. Their “Facility Space” is a communal area that encourages fashion and textile designers to work more sustainably by sharing skills and ideas, using machines that would otherwise lie idle, and utilising offcuts and waste.

The Bay, a fish and chip shop in North East Scotland, is another beacon – a small company that takes care of resources at all stages of their activities. They monitor their electricity, gas and water use, reduce food waste, recycle extensively and minimise their carbon footprint. Their efforts took them to the shortlist in the European Commission's 2014-2015 [European Business Awards for the Environment](#).

These trends are very real, but they need more support. This is why I was delighted to hear about Scotland's ambitious plans for a more circular economy. We are looking forward to working with Scotland to help “[Make Things Last](#)” and turn a circular economy into a reality.

Europe is home to many energy-efficient, low-carbon and resource-efficient technologies, and many small and medium enterprises are ready to make the shift. But these investments are sometimes perceived as risky.

EU finance can help. To reinforce circular economy-related innovation and attract investors, the EU is

mobilising European Structural and Investments Funds, its flagship Research and Innovation Programme Horizon 2020, and working closely with the European Investment Bank. The ‘Industry 2020 in the Circular Economy’ initiative will grant over €650m to innovative demonstration projects.

One major support and funding tool is the European Fund for Strategic Investments (EFSI). This can help raise private finance, especially in areas where commercial banking is still hesitant to get involved.

But we need to do more. We need to channel private sector funding towards these new opportunities. In the coming months a series of initiatives are planned to help businesses and consumers continue to move towards a circular economy. The circular economy will also be on the agenda at Green Week, Europe's biggest annual event on environment policy, which will take place from 30 May to 3 June. Focusing on the theme ‘Investing for a greener future’, discussions will zoom in on opportunities and challenges of green finance.

“The circular economy is not just about recycling. It's about the whole lifecycle of products.”

With the circular economy we are looking at a triple win. Society can win through job creation, savings for businesses and lower carbon emissions. It's a major opportunity – let's make sure we grasp it. ■

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European Commission

http://ec.europa.eu/commission/2014-2019/vella_en

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A paradigm shift to sustainable financing

MEP Sirpa Pietikäinen highlights progress already made towards a circular economy, as well as, what more needs to be done...

Traditionally, we are used to thinking about ecology and economy as 2 different worlds. This thinking is premised on the assumption of unlimited natural resources, a world with such abundant resources that the end to those resources doesn't figure in traditional models of economic thought. Neither do the negative external costs such as the ones posed by climate change.

However, the fact is that physical limits to growth exist. It has been forecast that global demand for resources will triple by 2050. Currently we already consume some 1.5 planets' worth of resources every year. Following the estimates, we would need some 4 planets full of resources to satisfy the demand by 2050 under business as usual. Estimations vary, but it is clear that under business as usual, we are also set to exceed the 2 degree Celsius global warming, a limit set by the global community.

Taking into account these facts, it is clear that the current Cartesian worldview can no longer apply. What is needed is a true paradigm shift, one with a holistic approach. When the physical limits to growth are factored in, the whole basis of our economic thinking changes: the way we measure the success and viability of companies or countries, the way we value assets – the list goes on.

A lot of work has already gone into developing resource accounting methodologies, in organisations such as United Nations Environment Programme (UNEP) or OECD. The parameters are there; what is needed now is to put this work into practice. A set of indicators that most parties can globally agree to, needs to be chosen, and applied to different countries and sectors. A concerted international effort is required to bring this forth and the Financial Stability

Board can and should play a central role to promote this effort. Another important aspect is the fact that these indicators need to be binding, to ensure comparability.

This set of agreed-upon accounting rules should subsequently be applied across the whole financial system, to measure the situation of national and global accounts much the same way the GDP currently does. By the same token, credit ratings as well as capital requirements rules must take these sustainability parameters into account.

The financial system is the bloodline feeding our societies, which is why it needs to be at the forefront of the paradigm shift. If the incentives of the financial sector run counter to the goal of building more resource efficient societies and combatting climate change, the latter efforts are destined to fail. ■



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Moving beyond waste management towards a green economy

Hans Bruyninckx, Executive Director of the European Environment Agency outlines why we need to facilitate a transition towards a circular, green economy by moving beyond waste policies and focusing on eco-design, innovation and investments...

Our current resource use is not sustainable and is putting pressure on our planet. Research can foster not only innovation in production, but also in business models and financing mechanisms.

The European Commission proposed on 2 December 2015 a new legislative package on circular economy. The package covers different stages of a product's extended lifecycle from production and consumption to waste management and the market for secondary raw materials. The proposed actions are designed to benefit both the environment and the economy, and extract the maximum value and use from all raw materials, products and waste, fostering energy savings and reducing greenhouse gas emissions.

Over the last decades, legislation to protect the environment has evolved from issue-specific responses to more integrated and systemic responses. The circular economy package is one of the latest examples of such integrated policy responses and is certainly a significant step towards the European Union's objective of 'living well within the planet's ecological limits'.

Our European environment: State and Outlook 2015 report (SOER2015) underlines the sustainability challenge we are facing today. We are consuming and extracting more resources, both in Europe and in the world, than our planet can replace at any given time. On the one hand, economic activities contribute to human well-being and poverty reduction. On the other, they pollute the environment, warm the planet, damage human health, while weakening the planet's capacity to provide for us. Climate change and population growth projection add to the urgency for comprehensive and immediate action.

Although no country has achieved so far both 'living



well' and within its natural means, there are some encouraging signs. The European Union has started to break the link between economic growth and consumption of energy and materials. Europeans are recycling a larger share of their municipal waste and sending less to landfills. Eco-industries (e.g. working on renewable energy, waste water treatment, air pollution control, etc.) have grown considerably over the last decade and created jobs despite the recent recession.

Reducing dependence on raw materials

A circular economy strives to reduce the 'inflow' of new resources, especially non-renewable resources, to use, re-use and valorise the resources in the economy as much as possible, and to minimise the 'outflow' of emissions and waste.

The message is clear: potential reductions in waste could generate substantial gains for the economy and human health. Keeping already extracted resources in use would not only reduce dependence on raw materials (domestically extracted or imported), but also boost competitiveness while reducing environmental

pressures. A preliminary analysis by the EEA shows that European countries are already taking action to improve their resource efficiency, mainly due to economic concerns linked to resource dependency.

“The proposed actions are designed to benefit both the environment and the economy, and extract the maximum value and use from all raw materials, products and waste, fostering energy savings and reducing greenhouse gas emissions.”

Waste prevention, recycling and better waste management in general are all certainly crucial to minimise the flows into and out of the economy. However, closing the material loop is not sufficient to prevent further impacts on the environment, human health and well-being. Circular economy approaches need to go beyond waste management, and facilitate a transition to green economy. We need to re-think the way we produce, consume and dispose of products.

Unlocking the eco-design potential

To start with, eco-design is essential for increasing recycling potential and extending the lifetime of products. We can design products in a way that they can be easily repaired, have only their broken pieces replaced and have their components easily sorted for optimal recycling.

We also need to consider health and environmental aspects of the materials we use in our products. Eco-design could equally help replace materials with high environmental impacts with better alternatives. For example, it is clear that exposure to hazardous chemicals is a serious health concern. We can adopt clean materials cycles to prevent human exposure to hazardous substances and to protect ecosystems from chemical pollution.

Similarly, bio-based materials, such as wood, crops or fibres, can be used for a wide range of products and energy needs. Apart from providing an alternative to fossil-based products, bio-based materials are also renewable, biodegradable and compostable. However,

a potential to shift to bio-based materials should be analysed in view of associated ecosystem and health impacts. There are for example limits to forest exploitation and burning wood for energy could worsen air quality.

Investments to foster innovation

Eco-innovation and research promoting innovative solutions are essential for a shift to a circular economy. Innovation is not only limited to production processes. New business models could be encouraged and supported. There are already many examples of innovative solutions providing services rather than selling products: you don't for example need to own a car to meet your transport needs. Such collaborative business models focusing on service provision could benefit from new financing mechanisms, since investment and profit follow a different pattern in time.

Public funds across Europe are already supporting eco-innovation but they can play an even stronger role than they do today. Investments in infrastructure, research and cities could all be geared towards facilitating the transition to a green economy. A strong commitment to sustainability backed by a clear financial and regulatory framework sends the right signal to all stakeholders.

It is clear that moving towards a green, circular economy will benefit some groups and sectors, while putting pressure on others. Policy makers will need to take into account equity considerations, both within Europe and globally, and offer support measures to facilitate and steer the socio-economic transition needed. ■

EEA Editorial published in the issue no. 2016/1 of the EEA newsletter, March 2016.

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De-Icing sewage treatment – a clever combination

Ms. Caterina Talerico and Mr. Dirk Kauffeld from Zurich Airport Ltd detail how the airport is using new methods to treat the sewage from the de-icing of planes...

Aircraft operating areas and aircraft itself have to be kept free of ice and snow for safe flight operations also during winter-time. Mechanical clearance is therefore not sufficient. However, use of conventional de-icing salts is not acceptable due to their corrosive effects on aircraft. On these grounds, operating areas are cleared mechanically at snowfall before chemical de-icing agents are applied. Additionally, the formation of ice at the wings and engines of aircraft must be prevented and the aircraft needs to be cleared from adherent snow and ice. For this purpose, the organic compound Propylene Glycol, for certain applications diluted with hot water, is applied by specialised vehicles. Depending on the weather conditions and the respective size of the aircraft, 200 to 500 liters of Propylene Glycol are needed for a single de-icing of an airplane. During the application, already more than one third of the agent drips off.

As a result of the de-icing and the dilution of precipitation, a large amount of sewage incurs on the operating areas during winter, which is contaminated with de-icing agents. A direct discharge of this sewage containing organic compound into local water courses would cause an impairment of the ecological system. The consequences would be the growth of fungi, an increase of silting and the decrease of the oxygen content. This is why these kinds of sewages are treated at Zurich Airport.

The active treatment system for de-icing sewage is the result of a long-time evaluation phase at the Airport. The system today involves chemical and physical methods as well as natural degradation processes. Depending on the concentration of carbon, the sewage is treated through a different process. A specifically developed control system delivers the data basis for adequate decisions. This system automatically



evaluates all measured parameters such as carbon concentration, filling level of storage ponds or ground-water level.

“During the past 15 years, Zurich Airport invested more than 100 million in total to develop and construct the whole drainage and treatment system. Today, the catchment area comprises 57% of the airport’s operational areas, which contains all substantial sources of de-icing sewage.”

Highly concentrated sewage, which incurs on the de-icing pads, is collected in an extensive channel system and is led to the distillation plant of Zurich Airport. There it is distilled and afterwards recycled by the chemical industry. Two plants treat all highly concentrated sewage from Zurich Airport.

Medium concentrated sewage is led to the spray irrigation system. This is a method specifically developed for Zurich Airport and it was actually copied from nature. Sprinklers spray the sewage on suitable grass land. The organic compound contained in the sewage is degenerated during the infiltration process by ways



of microbial activity in the top 60-90cm of the soil. The cleaned waste water is led through the drainage system into the Glatt river. The performance of this system is 99%. The idea of this procedure is based on the fact that always a considerable amount of the de-icing fluid, dropping from aircraft during take-off, has been dispersed into the fields without contaminating the groundwater.

“The active treatment system for de-icing sewage is the result of a long-time evaluation phase at the Airport. The system today involves chemical and physical methods as well as natural degradation processes.”

Low contaminated de-icing sewage is led through retention filter ponds. These are particular soil filters which are also used for treatment of sewage from roads. Storm water from the operating areas is also discharged in these ponds during summer.

The complex drainage system of Zurich Airport and the treatment of de-icing sewage in particular, enable the airport to capture and treat 95% of the carbon load in waste water. This is a substantial share to the

protection of the water quality of the Glatt river, which is the main receiving water course at Zurich Airport.

During the past 15 years, Zurich Airport invested more than 100 million in total to develop and construct the whole drainage and treatment system. Today, the catchment area comprises 57% of the airport's operational areas, which contains all substantial sources of de-icing sewage. The volume of subterranean storage ponds is 10'000 m³ and retention filter ponds have an extent of 6 hectares. The spray irrigation system extends on an area of 45 hectares of grassland. ■

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Project Leader Environmental Protection

Mr. Dirk Kauffeld
Head Water and Waste Management,
Airfield Maintenance

Zurich Airport Ltd
www.zurich-airport.com

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

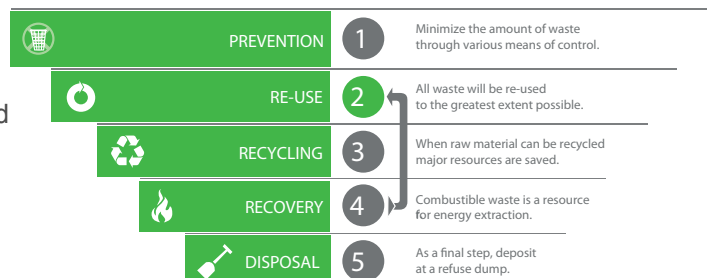
whereby we purify and concentrate used glycol so that it can be re-used. In this manner, we will save the earth's resources since glycol is extracted from crude oil and is a non-renewable resource. In addition, glycol is a scarce commodity since demand is consistently higher than the supply.

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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Organising climate action in Germany

Barbara Hendricks, Federal Minister for the Environment outlines how the German government is committed to reducing greenhouse gases through their Climate Action Programme 2020...

Climate change is one of the biggest global challenges of the 21st century. The United Nations Climate Change Conference in Paris in December 2015 has proven that the international community is serious about preventing serious damage by acting jointly and ambitiously. It is a milestone agreement that, for the first time, binds all countries to a clear target: to limit global warming to well below 2 degree Celsius, above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 degree Celsius.

“I am convinced that climate action will boost modernisation and innovation of our economy. Billions of investments are going to be made anyway in the next decades – together we need to steer them in the right direction.”

The key to success in this endeavor is implementation on the ground based on ambitious national contributions and efforts in line with the common objective. Germany and the European Union will continue to take the lead by undertaking ambitious economy-wide absolute emission reduction targets.

Already in 2007, the German government set itself the goal to reduce greenhouse gas emissions by at least 40% by 2020, compared to 1990. This is an important milestone towards the long-term objective of Germany and the European Union to reduce emissions by 80 to 95% by 2050 compared to 1990.

The German target for 2020 is more ambitious than the overall EU target. With a broad mix of instruments, ranging from the EU wide emissions trading system and other market based instruments, to regulations and incentives through funding programmes as well as,



*Barbara Hendricks,
Federal Minister for
Environment*

targeted information, Germany has already achieved a reduction of about 27% by 2014, compared to 1990. Important pillars of this success are improved energy efficiency in all sectors as well as growth of renewable energy supply.

However, projections published in 2013 show that with measures adopted and implemented so far Germany would achieve a reduction of around 32 to 35% by 2020. To achieve the remaining 5 to 8 percentage points, the German government adopted the Climate Action Programme 2020 in December 2014: A broad package of about 100 additional measures to be implemented to close the gap for the 2020 target with efforts in all sectors – ranging from energy supply, housing, transport, and industry to agriculture and the waste management sector.

A key element of the process to develop this action programme was a broad participation process, involving key actors that need to be on board to achieve the ambitious climate targets: Not only government agencies and ministries, but also the federal

states, local authority associations and a broad range of business and civil society groups were invited to submit proposals to help close the climate mitigation gap. Within 2 months more than 700 proposals were submitted and then compiled in clusters of comparable measures and quantified. This formed the basis of the inter-ministerial discussions leading to the agreed package of additional measures.

The programme aims to address the potentials identified in all sectors without setting any sector-specific targets. It comprises 9 key components and lists the contribution each component can make to close the mitigation gap. The National Action Plan on Energy Efficiency (NAPE) is one example. It was adopted to increase energy efficiency in buildings, as well as to present energy-saving as a business opportunity and to support individual responsibility for energy efficiency. Other components are a reform of the emissions trade, a climate-friendly building and housing strategy, climate action measures in the transport sector, in the industry sector (non-energy related emissions), in the waste management sector, as well as in the agriculture sector.

All these measures need to be implemented ambitiously and swiftly. To ensure this actually happens, the government follows 2 main strategies: Transparency and participation.

Transparency: Since 1990, emissions have already been lowered in all sectors, but by varying degrees. It is important to keep track and monitor progress of implementation, as well as emissions trends and expected mitigation contributions of different measures. An annual climate action report adopted by cabinet ensures that all these aspects are monitored and ultimately, the emission development is on the right path.

Participation: The success of climate change action depends to a great degree on whether the individual measures secure popular support and how many people and different parts of society actively participate in this endeavor. Therefore, the government

has established a Climate Action Alliance involving all stakeholder groups as well as federal states and local governments. This Alliance meets twice a year. Groups are encouraged to develop initiatives and discuss them in this alliance.

Beyond 2020, the German government is also working on a Climate Action Plan 2050 in the light of the Paris Agreement. We intend to adopt this Plan in summer and to update it regularly to monitor if the adopted measures are effective or if they need modification. The Climate Action Plan will develop concrete guiding principles for individual fields of action for 2050, outline transformative paths for all sectors, look at critical path dependencies and present interdependencies between different fields of action. And finally, it will specify concrete reduction steps and measures for the 2030 interim target in particular.

I am convinced that climate action will boost modernisation and innovation of our economy. Billions of investments are going to be made in the next decades – together we need to steer them in the right direction. This will involve change in many areas. My job is to organise this structural development in a way that is climate friendly and socially balanced. The earlier we begin to do this, the greater are our chances to succeed in a global economy geared towards climate neutrality in this century. ■

You can find the Climate Action Plan here: http://www.bmub.bund.de/fileadmin/Daten_BMU/Pool/Broschueren/aktionsprogramm_klimaschutz_2020_broschuere_en_bf.pdf

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Barbara Hendricks

German Federal Minister for Environment

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Climate Service Center Germany (GERICS) – COP21 and the role of climate services

After the dust has settled on COP21 – and now that the Paris Agreement is open for signature – it remains the case that the agreement represents a very important step forward in relation to global climate change mitigation, as well as adaptation to the impacts of climate change. For the first time, an international climate agreement has a goal to not just hold global warming below 2°C, but also critically specifies this goal as holding global warming well below 2°C. In addition, the agreement contains a clear aspiration to limit warming to 1.5°C. Furthermore, the Paris Agreement specifies that anthropogenic greenhouse gas emissions and removals have to balance in the 2nd half of the century.

However, let's not forget that based on the current INDCs (Intended Nationally Determined Contributions) we are not even on track for 2°C, let alone 1.5°C. On the contrary, the national mitigation contributions would most probably lead to a median warming of around 2.7°C by 2100. On the one hand, this means that a majority of national governments need to enhance their mitigation contributions in order to achieve this main Paris Agreement's purpose. On the other, we have to recognise that we are living in a changing climate and that impacts of climate change are already visible today. This is why it was important, that besides mitigation also adaptation was prominently addressed in the Paris Agreement.



What are climate services?

Based on the “European Research and Innovation Roadmap for Climate Services”, the term climate services has a broad meaning, which covers “the transformation of climate-related data – together with other relevant information – into customised products such as projections, trends, economic analysis, assessments (including technology assessment), counselling on best practices, development and evaluation of solutions, and any other service in relation to climate that may be of use for the society at large. As such, these services include data, information and knowledge that support adaptation, mitigation and disaster risk management”.

Climate services for adaptation

This is the point where an institution like the Climate Service Center Germany (GERICS) comes into play, with its mission to offer products and services in a scientifically sound manner to help decision makers in a range of different organisations from government, to administration and business, adapt to climate change and variability. GERICS works at the interface between science and society, and as such its work is characterised as being highly inter- and transdisciplinary in nature. The institution was initiated in 2009 and has become a well-established and influential player in the climate services arena both within Germany and internationally. As such, GERICS has strong connections with major scientific

research organisations across the world, and is equally well connected in a number of business and administration networks.

In developing prototypical climate service products, the focus is on the development of products which can enable and assist the decision making process, and so are duly highly practice oriented. GERICS has a number of different resources at its disposal for developing products, not only the in-house scientific expertise, but also through scientific networks, and has access to high-performance computing for complex model simulations. The user specific knowledge transfer through an iterative approach ensures that products are tailored specifically to the users' needs. Moreover, as part



of its commitment to quality assurance, GERICS undertakes a critical evaluation of the products, by assessing the impact they have on decision making.

Impacts under a global +2°C warming

One activity of GERICS which was highly linked to the Paris Agreement and also influenced the debate at COP21, was the participation in and the coordination of the four-year EU-project IMPACT2C (www.impact2c.eu), with 29 partner institutions. In this project a team of researchers from twelve European and four Asian and African countries identified and quantified the impacts and most appropriate response strategies of a 2°C global warming for Europe and selected vulnerable regions in other parts of the world.

“Even under global warming of only two degrees, society will have to find ways to adapt”

(Prof. Dr. Daniela Jacob, Director of GERICS and Project Coordinator of IMPACT2C)

The key findings, summarised in the [IMPACT2C web-atlas](#), indicate that +2°C global warming will have major impacts on the environment, society and the economy across the project case studies. According to most new climate scenarios, we will hit 2°C warming before mid-century. If we continue in the direction of a high emission scenario, 2°C will be reached around 2040 and even under a stabilisation scenario, 2°C will be reached before 2050. Therefore a follow up activity led by GERICS will now take a more detailed look at the impacts under 1.5°C, referring also to the Paris Agreement.

Decarbonisation, adaptation and critical infrastructure

Particularly since COP21 it has become even more apparent that responding to climate change involves both mitigation to address the causes and adaptation as a response to the changes. Hence a main current activity at GERICS is focusing on the energy

sector and other critical infrastructure, and analysing how climate change might influence the transformation to a low-carbon-society. Critical infrastructure is of particular importance since failure or functional impairment can have immediate and high impacts on numerous economic sectors, and society as a whole.

Climatic changes are also of relevance for the energy sector in Germany. The German “Energiewende” – as a role model for decarbonisation – is characterised by an increasing share of decentralised small-scale renewable energy sources feeding directly into the regional distribution grids. This triggers the need for grids and other infrastructure projects. Due to the long life expectancy of investments, the planning of such infrastructure should consider the potential impact of changes in regional climatic conditions on the necessary requirements. First results show that mainly the system grid infrastructure has to be designed such that it is adapted to future climatic conditions, since a maladaptation may lead to deadweight losses, either due to stranded investments, or due to losses resulting from recurring outages.



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Let the fish see the plate

Providing enough food for a growing population is one of the most challenging questions in our time. Blue growth is the key to a sustainable future, as The Norwegian Minister of Fisheries Per Sandberg explains...

Two billion extra people are expected to live on earth by 2050. Food production must rise by 70%. At the same time, the UN claims we are about to reach the limit for agriculture. Finding new ways to produce food is crucial. Furthermore, in order to be sustainable, we have to use energy and fresh water more efficiently in our food production.

Seafood is good for the environment and great for your health. Fish either drink water or use energy to keep warm, which gives seafood a high rank regarding sustainability. In most countries in the world, even in Norway, people will benefit from increasing their seafood consumption. It is a great resource not only when it comes to proteins and omega 3 fat, but also containing essential minerals. Fish is good for your heart and brain.

Oceans, seas and inland waters cover almost three quarters of the world's surface. However, our marine areas are generally under-utilised. Today less than 5% of the food comes from the sea. In other words, there is a huge potential for food production.

To bring more fish to the food tables of the world, we have to implement better fisheries management and increase the aquaculture production.

We have to harvest wild resources carefully in order to secure seafood as a renewable resource. Globally, overfishing is still a challenge. Our fish resources shouldn't be mismanaged or wasted and it certainly shouldn't be plundered by illegal vessels. Discarding of fish is part of the challenge. Around 8% of all catches are discarded every year. Throwing away food this way is simply not acceptable anymore. In Norway, a ban on discard was first established in 1987. We strongly welcome the EU ban on discard which is now being phased in.

The history of agriculture is more than 10,000 years old, turning mankind from hunters to farmers. Now we have to prepare for the next revolution. We must use the oceans as farmers, not only as hunters. The amount of wild fish is limited, and the resources are by no means sufficient to meet the demand for food.

“The potential for growth in Norway is considered by scientists to be fivefold within the next 30 years. Norway's long coastline with clear and cold waters provides perfect conditions for aquaculture.”

The farming industry, however, must be developed in a sustainable way. The footprint on the environment must be at an acceptable level. We have to overcome challenges such as disease and escape. In addition, increasing the farming industry also increases the demand for new resources for fish-feed. A lot of promising research is ongoing around the world. Norwegian researchers are at the moment collaborating with Dutch colleagues in building an insect-farm. The insects eat waste which means the factory is renewable in its own way, turning waste into a feed. So far, the results are promising. Fish that eat insects is both healthy and tasty.

Norway may be a small country, but when it comes to seafood we play a big role. Norway is not only the biggest supplier of seafood to Europe, we are also the world's second largest exporter of seafood bringing 36 million plates of fish to more than 140 countries every day of the year. Being the world largest producer of farmed salmon, Norway is prepared to develop the aquaculture in a sustainable way.

Firstly, we are developing systems that allow us to regulate the industry according to the limits of nature. These days, Norway is in the process of implementing



a new system for further growth in the Norwegian aquaculture industry. It is a “traffic light system” where environmental impact is the determining factor for future growth in the salmon farming industry.

Secondly, we must encourage the industry to further innovation. We have recently announced special licenses for innovation projects. This gives the incentive to develop and commercialise new, more environmentally sustainable technology paving the way for future growth.

The potential for growth in Norway is considered by scientists to be fivefold within the next 30 years. Norway’s long coastline with clear and cold waters provides perfect conditions for aquaculture. To be able to reach the potential for growth, however, we need to expand our knowledge and technology.

There is a Chinese saying: If you give a man a fish he will be satisfied for the rest of the day. If you teach him to fish, he will be satisfied every day. Being a small country, Norway alone will never be able to feed the world’s growing population with fish. What we can do, however, is provide our experience and knowledge and with that contribute to the planet’s food production.

For Norway this is not only a challenge, it is also an opportunity. As we are now facing a shift from a petroleum-based to a knowledge-based economy, we must create new knowledge-based jobs and contribute to the necessary shift in the economy. Actually, knowledge of the oil industry can contribute to the blue growth, for example in developing off-shore sea-farms.

Fish should not only be put on the Norwegian government’s plate. Providing sustainable food should be on the menu for decision-makers all over the world. The opportunities swimming in our oceans will not be realised by themselves. We must seize the opportunities through cooperation and interaction between government, researchers, commercial actors and industry. Together we must welcome and encourage innovation. ■

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Tracking harp seals

Dr Martin Biuw, Senior Scientist at Akvaplan-Niva AS highlights how research is key to track the diet of harp seals...

Harp seals are major fish and zooplankton consumers in the Arctic marine food web.

But how much food does a harp seal need to sustain itself, grow and ultimately gather sufficient reserves to reproduce successfully? Can we develop smart animal-borne instruments that can track changes in energy expenditure, body condition and ultimately diet in free-ranging harp seals and other organisms? Under the leadership of Akvaplan-niva AS in Tromsø, researchers from Norway, Japan, UK and the US have joined forces to develop instrumentation and on-board processing approaches to achieve just this. COEXIST – Condition and Energy Expenditure Estimates from free-ranging seals, was funded by the Norwegian Research Council to develop methods to provide better management advice for a key Arctic marine predator. Once the concept has been successfully applied to harp seals, it can be extended to other species of seals, and potentially other marine predators.

For the past 4 decades, animal-borne instruments have revolutionised the study of free-ranging marine organisms, but the information provided thus far has been mostly limited to where animals go, both geographically across ocean basins and vertically throughout the water column. To better understand why animals go where they go, and how their feeding

Image: © Michael Poltermann



success may be affected by environmental conditions and potential competition with fisheries and other human activities, approaches are needed that allow us to monitor not only their food consumption but also what animals do with the food resources they obtain. How much of the ingested energy goes toward maintaining vital body functions and body activity? How much is allocated to growth? And, how much can be stored as energy reserves in preparation for reproduction? While some of these questions will remain elusive in the short term, others can now be addressed thanks to the use of smart sensors such as accelerometers and small cameras, together with advanced data processing approaches.

Accelerometers have found broad industrial use for measuring the acceleration of objects relative to their

surroundings. In addition to being vital components in, for instance, inertial navigation and image stabilisation systems, they are now also included in consumer electronics such as smartphones and training watches to allow everyday functionality such as screen autorotation and step counting etc. When deployed on marine organisms, accelerometer data loggers can continuously detect and record swimming movements and body orientation, which may in turn tell us something about both energy expenditure and body condition. Since acceleration has to be measured at very high frequency, sending these data via low bandwidth satellite telemetry channels is not possible. In order for accelerometry data to become a useful tool for long-ranging marine organisms that cannot be recaptured once instruments have been deployed, these high-frequency

data must be drastically compressed into simple indexes of body condition and energy expenditure. The aim of COEXIST is to develop such data compression algorithms that can be implemented on board the satellite linked animal-borne instruments.

“To better understand why animals go where they go, and how their feeding success may be affected by environmental conditions and potential competition with fisheries and other human activities, approaches are needed that allow us to monitor not only their food consumption but also what animals do with the food resources they obtain.”

COEXIST researchers built a state-of-the-art experimental facility at an old fish farm outside Tromsø. Using a modified salmon pen where access to the sea surface is limited to a small moon pool covered by a Perspex dome, researchers can use so-called open-flow respirometer to monitor the energy expenditure by measuring O_2 consumption and CO_2 production when a seal is at the surface inside the dome. By fitting an accelerometer data logger to the seal, the true energy expenditure can then be related to the swimming activity of the seal during dives. The relationship between these measures can then be turned into an algorithm that can use on-board accelerometer on free-ranging seals to estimate their energy expenditure.

But, how can we estimate if, when and where seals find sufficient food to also accumulate on-board energy reserves in their blubber? Because fat is much less denser than water, while remaining body tissues are denser than

water, the body condition of a seal (i.e. its fat content) directly affects its body density and therefore buoyancy. This will in turn affect the swimming activity of a seal on descent and ascent in a predictable way. In simple terms, a fat seal will have to swim hard on the way down in order to overcome the buoyant force of the low-density fats, while it can glide on its return to the surface. Conversely, a skinny seal can glide effortlessly on descent but will have to swim very actively on ascent back to the surface. These patterns can be monitored by the on-board accelerometer. By fitting floats, weights or neutral blocks to seals in the experimental facility, COEXIST researchers can modify the buoyancy to simulate different body conditions, and this relationship can then be used to fine-tune an on-board algorithm that can provide estimates of changes in body condition.

COEXIST is coming to a close at the end of this year, but the researchers plan to continue and extend their studies by developing approaches to monitor the diet of seals. Attaching miniature cameras to the seals allows researchers to see the prey that seals encounter and ingest. Specific patterns in the acceleration data can be used to trigger the camera when seals chase prey, thereby optimising power and memory requirements of the instruments. But again, entire images cannot be relayed via the low bandwidth of available satellite relay systems. Instead, on-board processing using advanced object identification algorithms may present a solution. To train such advanced algorithms to recognise fish and zooplankton is no mean feat. It will require extensive image libraries of potential prey species, and the captive facility used

in the COEXIST project can again be used to conduct controlled feeding trials. This has already been initiated during COEXIST, and will be continued in a future project, in order to extend the capability of animal-borne instruments.

Together, estimates of energy expenditure and body condition can be used to track the energy budgets of free-ranging seals over their entire at-sea feeding periods, indirectly providing an estimate of their food requirements. In combination with prey recognition from animal-borne cameras, we will also be able to partition the energy/food requirement between different prey species. Once we scale up these detailed results from a small number of individuals, to an entire seal population, we can gain a better understanding of the prey requirements and prey preference of harp seals, and therefore provide improved management advice for this species and ultimately other marine top predators.



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Protecting tropical forests worldwide

Vidar Helgesen, Norwegian Minister of Climate and Environment answers Adjacent Governments questions about how Norway is contributing to sustainable development by reducing deforestations in the worlds tropical forests...

As part of their International Climate and Forest Initiative (NICFI), Norway has pledged up to 3 billion NOK a year to help save the world's tropical forests and improve the lives of those who live off and near them. Deforestation of tropical forests accounts for approximately 11% of global greenhouse gas emissions and as part of the NICFI, Norway aims to support efforts to reduce emissions. Here Vidar Helgesen, the Norwegian Minister of Climate and Environment answers Adjacent Government's questions about the Initiative and its goals...

What are the aims of the Norwegian Climate and Forest Initiative?

Reducing Emissions from Deforestation and Forest Degradation (REDD+), our aims are: Firstly, that REDD+ as part of the Paris-agreement will be an effective measure of reducing emissions from forests; secondly, to contribute to large scale emission reductions from deforestation in selected countries; and thirdly to contribute to the protection of natural forests. As an overarching goal, our support should contribute to sustainable development. This is also a prerequisite for countries to succeed in reducing deforestation.

In cooperation with several developed and developing countries, Norway is taking action in order to demonstrate that paying for carbon stored in tropical trees is feasible. Paying developing countries to fight tropical deforestation may provide up to a quarter of the climate change mitigation needed by 2030, while contributing to green growth, increasing resilience to climate change, fighting poverty and protecting invaluable biodiversity.

How important are programmes such as this to help protect and preserve natural environments?

We support one of the most important actions to pro-

Image: © Elisabeth Brinch Sand



tect some of the world's largest forests that contribute to regulate the climate and global rainfall patterns: reducing tropical deforestation. This is a global responsibility. And it is absolutely necessary if we are to reduce greenhouse gas emissions fast enough to avert the most serious consequences.

Worldwide, approximately 1.6 billion people depend directly or indirectly on tropical forests for their livelihoods. These forests are home to more than half of the world's land based species and store enormous amounts of carbon.



Vidar Helgesen, Norwegian Minister of Climate and Environment

How important is it to protect tropical forests in order to reduce greenhouse gas emissions?

Brazil illustrates the importance of preventing deforestation in order to reduce greenhouse emissions: In 10 years Brazil reduced deforestation in the Amazon by nearly 80%. We estimate that this has spared the atmosphere for over 4 billion tons of CO₂, more than 4 times Germany's annual greenhouse gas emissions.

How will Norway work with partnership countries in order to achieve its goals for the Initiative?

Governments of major tropical forest countries are witnessing the consequences of deforestation and are committed to combat it. How we work with partnerships varies widely from country to country. What the partnerships have in common is that these countries show a political will to protect the forests. National ownership is crucial. In our partnerships, national governments are in charge of the efforts to combat deforestation. Deforestation has many different causes, so we also emphasise that a cross-sectoral approach is needed. Most notable so far are the commitments and actions of Brazil, Colombia, Guyana and Ethiopia.

Brazil has delivered impressive results when it comes to reducing deforestation in the Brazilian Amazon and

consequently also CO₂-emissions. Norway has paid Brazil 6.5 billion NOK for these results.

How does the government aim to implement the Initiative and ensure goals are met?

We have a broad approach. We work with forest country governments, other donor governments, the private sector, academia, civil society and indigenous people. With a growing population both globally and in many tropical forest countries, pressure on forested areas for conversion to agricultural lands and food production is increasing. Through our REDD+ programmes we support measures such as land use planning and more sustainable agricultural practices to increase agricultural efficiency. In short: We work to promote sustainable production and protect the forest at the same time.

“In cooperation with several developed and developing countries, Norway is taking action in order to demonstrate that paying for carbon stored in tropical trees is feasible. Paying developing countries to fight tropical deforestation may provide up to a quarter of the climate change mitigation needed by 2030, while contributing to green growth, increasing resilience to climate change, fighting poverty and protecting invaluable biodiversity.”

Four commodities represent approximately 50% of global tropical deforestation today; palm oil, beef, soy and paper. This means that positive commitments and actions by private companies are necessary to reform past practices. By paying countries for results in terms of reduced emissions from deforestation and forest degradation we aim to strengthen the financial and political incentives to keep the forests standing, and do so in a way that benefits the people living in and of the forests. This is the essence of REDD+. ■

Vidar Helgesen

Minister of Climate and Environment

Ministry of Climate and Environment – Norway
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From spruce to beech forests – fundamental ecosystem transformation driven by climate

Beech has a wide distribution in Europe, but reaches its northern boundary in South-East Norway. With future climate change, it is expected that the beech will expand northwards, probably at the cost of spruce. Beech in other words have the potential to get a far greater distribution than today. One can already see that regrowth of beech is establishing rapidly in older spruce stands at its northern brim in Norway. At the same time, spruce is expected to struggle under the climatic conditions expected in this area in the future.

The dominant tree species and their impact on ecosystems above and below ground has great importance for future climate, through their potential for binding CO₂. Previous



Fresh beech leaves (Photo: Christian Strømme).



Which of the neighbors is better suited for future growing conditions? (Photo: Line Nybakken)

studies, mostly done in temperate forests, suggest that CO₂ sequestered is somewhat larger in coniferous forests compared with broadleaf forests. Beech forests, however, are assumed to have a potential approximate to what we find for conifers. As the deciduous forests also have a higher albedo than the dark coniferous forests, the effect of more beech forests in boreal regions may have a counteracting effect on climatic warming. We need more knowledge about both the capability for adaption, both of beech and spruce, about how the two tree species affect decomposition and thus CO₂ storage below ground. To understand this, we also need more knowledge about the historical emergence and distribution of beech in Norway, and not least about how likely the projected future expansion is. These are some of the aspects we cover in our ongoing project "From spruce to beech forests – fundamental ecosystem transformation driven by climate change".

The climatic potential of beech

Using climate chamber and field experiments we try to define the climatic potential of the Norwegian beech provenances by studying i.e. winter dormancy stability and frost resistance, growth and carbon allocation. Investigations of spring bud break from field and greenhouse indicate that bud break dates of European beech at its northern distribution brim are mainly governed by temperature, in contrast to the Central European populations that are regulated also by day length. This means that warming in the north will give earlier bud break in spring, with increased risk of spring frost damage of shoot tips.

In a comparative study of 81 pairs of neighboring old spruce and beech trees, we show that both species already struggle with increasing temperature and decreasing precipitation. The effect is, however, strongest for spruce, indicating that beech is handling the new climate regime better in this region.

Decomposers and belowground C

The community of fungi, small animals and bacteria living below ground, is decisive for both how fast nutrients from litter is released for the next generation and how much carbon is stored over longer time periods. How this community is composed is in turn largely decided by what trees are dominating above ground. We see that spruce litter decompose quicker than that of beech. This may be related to another finding, namely that the biomass of fungi is greater under spruce. On the other hand, beech litter release its nitrogen faster, and may therefore provide better growing conditions. Interestingly, the societies of fungi and bacteria under the two tree species are very different, which means that the diversity below ground change will alter with a shift in dominating tree species.

With beech at its northern distribution limit in Norway, these studies provide valuable information about adaption potential in a long-lived species under climate change, as well as the effect of an expansion on an ecosystem level. At the same time, information on the outcome of the competition and interplay between beech and spruce will be important for future forestry in the region.



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Using large carnivore research to inform wildlife management policies in Norway

John D C Linnell, Norwegian Institute for Nature Research

Conflicts associated with the recovery of populations of wolves, bears, lynx and wolverines in Norway during the last 30 years have motivated intensive research projects. The results have led to an in-depth understanding of many aspects of these species ecology's, and of the conflicts they cause with people. The extent to which these results have influenced policy sheds a lot of light on the complexity of the science – policy interface.

The recovery of large carnivores to Norway, in recent years can be viewed as a success for conservation. However, it has also been associated with very many conflicts, especially associated with the killing of sheep and domestic reindeer.

To better address these conflicts there has been a massive investment in research on large carnivores since the mid 1990's, in both Norway and neighbouring Sweden. A large part of this has focused on the ecology of these species. One of the main tools used has been to equip individuals with collars carrying a GPS unit which allows researchers to follow their movements. This makes it possible to study how it lives, and dies, how much it moves, which habitats it lives in, when it reproduces, how it interacts with other species, and what it eats. Another powerful method in the modern wildlife researcher's tool-kit is to extract DNA from hair or scats. If

scats are collected over many years and large areas it is also possible to follow the movement, family relationships and survival of these animals. We are also increasingly using automatic camera-traps. These cameras can now work for months at a time without supervision. For lynx this method is especially useful as individuals can be recognised from their coat patterns.

During the last 20 years we, and our colleagues in Sweden, have deployed these methods across large parts of Scandinavia, from the alpine tundra of the north, through the boreal coniferous forests to the more urbanised mixed forest-farmland areas around the southern cities. The result of this massive research effort has been an explosion of knowledge about these secretive and previously poorly understood animals. We now have insights into how they live their lives, moving across enormous areas of forest and tundra, and navigating the diversity of human activities and structures that dominate all landscapes, even in Scandinavia. A key finding has been that that the modern Scandinavian landscape constitutes potential habitat for these species despite the intensity of human land-uses like forestry, hunting and livestock grazing. This research effort has made it possible to not only produce applied knowledge for wildlife management, but also to address many fundamental ecological and evolutionary questions. Over 600

scientific papers have been produced during the last 20 years documenting many of the smallest details of these species' otherwise secret lives! Some of these articles have even appeared in top journals like Nature and Science.

Social science methods have also been used to understand the deeper nature of the conflicts which they cause. These studies have revealed how rural people's reactions to the return of these species are very mixed. In many ways the large carnivores have become symbols (and scapegoats) for a range of other underlying social and economic issues that are bringing unwanted change to rural lives and livelihoods.

The motivation for initiating this research was to help improve their management and reduce conflicts, so it is important to consider how the research has been used to inform policy. One of the greatest successes has been in using research results to design effective monitoring systems so that we now have an incredible level of detailed knowledge about how the populations develop over time, and how they respond to different management measures. Research results have been used to set more realistic levels of compensation payments for livestock that are lost while grazing during summer. Results have also been used to justify changes in the reindeer herding system that should both increase its sustainability



and lower losses to predators. However, much less progress has been made in adapting modes of sheep husbandry to production systems that are compatible with the presence of large carnivores. As a result, Norway practices exceptionally restrictive policies (compared to all other European countries) concerning how many large carnivores should be permitted to live in the country. In essence, the system continues to focus most of its efforts on managing the predators rather than managing the livestock.

This underlines several aspects related to integrating science into policy. Firstly, it shows how poorly the different sectors (in this case environment and agriculture) coordinate their policies. Secondly, it illustrates how conserving controversial wildlife species can come into conflict with some of the economic interests and fundamental values, held by rural people who are being asked to share their landscape with these predators. This creates what is called a “wicked problem” in

wildlife management, where conflicts are so fundamental that it may be impossible to find consensus solutions. Our insights into the nature of conflicts would never have been possible without combining both natural science and social science perspectives. Thirdly, it reveals the clear limits to how far science can be integrated into policy. Science can be used to inform the public and decision makers about the state of the situation on the ground and the outcome of alternative policies. But when it comes to it, making decisions about conservation goals, it is a political decision concerning many competing interests, which will be prioritised. Therefore, the extent to which large carnivores will be able to return to large parts of Norway (and Europe) will be limited by the vagaries of public opinion and political power struggles than by the ecological potential, which is considerable.

Further information

Scandinavian Lynx Project <http://scandlynx.nina.no/>

Camera trapping in Norway <http://viltkamera.nina.no/>

Scandinavian Wolf Project <http://www.slu.se/skandulv>

Scandinavian Brown Bear Project <http://bearproject.info/>

Large Carnivore Initiative for Europe <http://www.lcie.org/>

European Commissions Large Carnivore Initiative http://ec.europa.eu/environment/nature/conservation/species/carnivores/index_en.htm



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A new Sustainable Development Strategy for Switzerland

Daniel Dubas, Head of the Sustainable Development Section at the Federal Office for Spatial Development outlines the Federal Council's Sustainable Development Strategy and its aims...

In Switzerland, sustainable development is a constitutional obligation. To ensure that the country continuously meets this obligation, the Swiss Federal Council (government) recently renewed its Sustainable Development Strategy for 2016–2019 as a part of its legislative planning. This federal strategy has existed since 1997, and renewed every 4 years. Its primary aim is to ensure coherent sustainable development policies on a national level. The strategy focuses on coordinating various activities of the federal administration, but many other public and private actors also use it as a point of reference for their own policies and activities. Sustainable development is not considered a separate policy field, but a cross-cutting issue that needs to be integrated into all policies while respecting economic efficiency, social solidarity and economic responsibility, as well as minimising trade-offs.

In recent decades, much has been achieved in Switzerland with regard to this. Social security systems are constantly reinforced, for instance, and water and air quality have been improved quite substantially, while retaining excellent conditions for the economy. However, there is still much ground to be covered on the path to sustainable development. Considerable challenges remain, for example, with regard to demographic opportunities, the development of spatial and transport infrastructure, climate change, and social cohesion.

Guidelines for the Federal Council's sustainability policy are defined in its strategy, of which the central element is an action plan that focuses primarily on domestic issues. However, the strategy also shows how Switzerland is strengthening its international engagement. For every policy field, the action plan includes a long-term vision, medium-term goals (2030) and actions for the current legislative period. It is structured as follows:

- Consumption and production;
- Urban development, mobility and infrastructure;
- Energy and climate;
- Natural resources;
- Economic and financial systems;
- Education, research and innovation;
- Social security;
- Social cohesion and gender equality;
- Health.

One interesting thematic example of measures set out in the action plan is sustainable construction, which has been included since 2008. In this case, a predefined work schedule has enabled the government to create a joint public and private network for sustainable construction as well as a new standard for sustainable buildings in Switzerland.

In September 2015, the international community reached a major agreement at the United Nations' special summit in New York by adopting the universal 2030 agenda for sustainable development. For the first time in history, all heads of state agreed on a series of global sustainable development goals (SDGs), which are to be achieved by the international community by 2030. All states – in the global north as well as in the south have been called upon to implement the SDGs both at home and abroad. For Switzerland, which played a very active role in the negotiation process, one of the challenges will be to align its federal Sustainable Development



Strategy with this international agenda even further, whilst also involving public and private actors in this process. Although the 2030 Agenda is not legally binding, it provides an important implementation framework for the federal government.

To ensure that the 2030 Agenda is implemented coherently, it is especially important that domestic and international policies be well coordinated. It should be bear in mind, for example, that more than two-thirds of the environmental impact of consumption is generated in countries other than Switzerland. One principal focus of the country's foreign policy is on international cooperation. Indeed, Switzerland strongly supports partner countries in implementing coherent sustainable development policies, especially within the 2030 Agenda, thus helping less developed countries to implement their own actions and making it possible to measure any progress made. Furthermore, Switzerland, as a member of international organisations, is committed to supporting well-coordinated and consistent policies.

Sustainable development can be achieved, but only if all societal actors contribute towards implementing it. Shared objectives on which most societal actors agree are therefore of great importance. Close collaboration with the other federal state levels, as well as civil society, economic actors and the research community are required. The Swiss Confederation will maintain its

efforts to support the sub-national and local levels in implementing the 2030 Agenda, as well as sustainable development programmes and projects. Examples of this include the Sustainable Development Forum – a tried and tested platform for exchange and networking between different national levels – and the sustainable development promotion programme.

By adopting its Sustainable Development Strategy for 2016–2019, the Federal Council has taken an important step towards implementing the 2030 Agenda at a comparatively early stage. However, the real work is only just beginning. All actors in Switzerland are called upon to exploit this opportunity and to contribute by their actions towards achieving their common goals.

Daniel Dubas studied Political Science and Urban Planning. Since 2013, he has been Head of the Sustainable Development Section at the Federal Office for Spatial Development, which coordinates sustainable development within the federal administration in Switzerland. ■

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Capacity Building and Twinning for Climate Observing Systems (CATCOS) in Central Asia

Analysing glaciers to fight impact of climate change...

Climate change remains at the top of the global agenda with a priority for action. In current climate debates the problem of relations between industrial societies emitting greenhouse gases and societies that are impacted by the result of the atmospheric warming are often complex. There exists a strong disparity between industrialised nations and victims of climate change that most lack the capacity to influence its outcomes. The problem is that developing and emerging countries can lose a lot due to the consequences of climate change but often they do not possess neither the capacity nor the political will to make significant contributions to its mitigation. Many of those nations are confronted with poverty, corruption and conflicts and climate change is therefore not on their priority list. However, human caused atmospheric warming is a global problem and requires global solutions. One of the current biggest deficits faced in climate related science is a lack of sufficient data from less developed parts of the world.

At this point, the project Capacity Building and Twinning for Climate Observing Systems (CATCOS) is one of many projects helping to build up sustainably long-term monitoring. Funded by the Swiss Agency for Development and Cooperation (SDC) and coordinated by the Federal Office of Meteorology and Climatology (MeteoSwiss), a broad association of

Image: © Martina Barandun, University of Fribourg



Abramov glacier, Pamir Alay range, Kyrgyzstan. The photo is showing a glaciologist carrying a Heucke steam drill equipment to install stakes to measure ice melt of the glacier. Abramov glacier is part of the Global Terrestrial Network for Glaciers run by the World Glacier Monitoring Service. For the glacier a rich past data set from 1968 to 1998 on glacier mass balance measurements exists and the measurements are resumed in 2012 and continued until present

Swiss and international institutions is aiming to fill gaps in the Global Climate Observing System (GCOS).

The project is very ambitious, as many observation networks on the entire globe have large gaps in a spatial, as well as, temporal extent. The CATCOS project is covering observations on atmospheric essential climate variables (ECVs) such as, greenhouse gases and aerosols, and on terrestrial variables like glaciers.

Scientists from the University of Fribourg, Department of Geosciences are coordinating efforts for the monitoring of glaciers in the Central Asian nations Kyrgyzstan and Uzbekistan. The re-establishing of former glacier

monitoring network is based on new monitoring strategies. It is important that the project tries to ensure a sustainable development of the monitoring activities in the years to come.

Countries in Central Asia are especially vulnerable to climate change, because runoff during the dry summer months is mainly dependent on the vast glacierised areas in the mountain ranges of the Tien Shan and Pamir. The Tien Shan mountain glaciers cover around 12,400 km² from which about 7,400 km² are located within Kyrgyzstan. In the Pamir mountain glaciers cover an area of around 12,100 km². Of this area approximately 1,900 km² are situated in Kyrgyzstan. These Central Asian

glaciers are suffering from rising air temperatures. Ultimately, enhanced melting will lead in the coming decades to an increased runoff in spring and summer and will often cause natural hazards such as flooding which carries a high potential to destroy settlements and disrupt agriculture. In a later stage of this century runoff in the dry summer month will continuously decrease because of strongly decreased ice volumes. Therefore, reduced runoff patterns will affect local communities, agriculture and ecosystems.

Kyrgyz glaciers whose long-term monitoring programmes had collapsed after the breakdown of the Soviet Union, have been selected by our team as reference glaciers. The historical data has been re-analysed and is used as a foundation for the new established monitoring strategy. Measuring the glaciological mass balance is a well-established conventional method that refers to point measurements documenting snow accumulation or ice ablation on the glacier surface. When analysing glacier-wide point measurements, researchers are able to assess whether a glacier is losing or gaining mass. New methods are additionally applied including remote sensing observations on satellite and camera images and the measurements of meteorological components with automatic weather stations. The combination of all these technologies, allows us to gain an in depth understanding of the processes and enables us to develop models that can better predict the fate of the Central Asian glaciers.

Phase 1 of CATCOS finished in early 2014. This project period focused primarily on the re-establishment of the glacier measurements and first

components of capacity building, with limited focus on ensuring the sustainability of the project. The current phase 2 is aiming for the preparation of local scientists to take over the monitoring activities independently. It is important to ensure that the monitoring efforts do not come to such an abrupt halt like in the past. The local partners are being provided with good field training, as well as, data analysis and how to transfer the data to the international archives. More and more, they should independently organise the field measurements and afterwards analyse and work with the collected data.

During the 2nd phase of the project, we have been able to train promising Kyrgyz students during time spent at our department. As well as the experience to work in an international environment they have learned how to compute mass balance analysis for Kyrgyz Glaciers with different methods. One of the outcomes is a publication, submitted to an international journal and the preparation of articles for Kyrgyz journals. For us, this represented an important success in our efforts to increase regional researcher's capacity

Of course, high-quality publications are an important step in developing a local scientific community. However, the objective of this project is to produce high-quality data that serves as Kyrgyzstan's contribution to GCOS. This means that the data needs to be sent to the international data centres, which in this case, the World Glacier Monitoring Service, located at the University of Zurich, Switzerland. Gathering all collected data at this centre allows a better global picture of climate change impact on mountain glaciers and will enable estimates of related changes such as global sea

level rise, regional water cycle, and local hazard situations.

We have been able to estimate some trends from the data collected in the recent past. Unfortunately it is not good news for the 'health' of the glaciers. Abramov glacier in the Pamir-Alay range is one of the four key glaciers we have investigated so far in the project. The glacier has clearly undergone considerable mass loss which is not an exception, as results from other glaciers show similar tendencies.

The work being undertaken by our group and our Central Asian colleagues will have profound impacts. With the gathered information, efforts to mitigate – or at the very least adapt to – the oncoming effects of climate change is a starting point to take better action in the concerned regions. The need for international cooperation to overcome this global threat was clearly pointed out at the recent Conference of the Parties (COP21) in Paris in December 2015. Our efforts are a just a small part of the action to establish the required database necessary for mitigation and adaptation measures.



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Transforming the agricultural model

At the 2016 Forum for the Future of Agriculture, EU Commissioner for Rural Development Phil Hogan outlines how the EU is stepping up its role in sustainable development...

I wish to make the case that the European Union is stepping up to the plate, both at home and abroad, when it comes to taking a leadership role in sustainable development.

Agenda 2030 is universal. This means that our commitments under the Sustainable Development Goals (or SDGs) apply to both our external and internal policies. I also want to make it clear that sustainable agriculture is central to this leadership.

Today I want to confirm the integration of sustainable development goals into the Common Agricultural Policy, into our agricultural research and innovation policy, and into our agri-food trade policy.

The Sustainable Development Goals (SDGs) and the Paris Climate Agreement have given us a clear roadmap for sustainable development in the years to come. However, without meaningful implementation on the ground, these goals will remain aspirational in nature.

To achieve real progress, there needs to be a prominent role for sustainable agriculture policy. Indeed, we are witnessing an increasing focus on agriculture policy in all international fora addressing global sustainability.

Among the Sustainable Development Goals there are particular priority areas for agriculture – notably the zero hunger target by 2030 in SDG 2. In SDG 12, there is an emphasis on the sustainable use of resources and climate action through responsible consumption and production.

Climate action is the priority of SDG 13, while “life on land” – in other words how we manage forests, tackle land degradation, and stop biodiversity loss – is the focus of SDG 15. We are all familiar with the challenges underpinning these goals:

As global population growth continues to accelerate, the world needs to produce more and better food. In the 21st Century, with our knowledge, our wealth and our technology, no-one should have to experience systematic hunger.

But that same population growth will put even greater pressure on our environment and resources. So the way we think about food, and the way we produce food, has to adapt accordingly.

We know the world possesses enough available land, water, and people to make this happen. We already have much of the technology and know-how to tackle both hunger and climate change. We already produce enough to feed the world, but we waste or lose upwards of 30% of our production.

So the challenge is a political one: can we organise ourselves to make zero hunger a reality? It is a very substantial challenge and responsibility: resting in part on the shoulders of everyone in this room.

As EU Commissioner for Agriculture and Rural Development, I am responsible for the Common Agricultural Policy – still today the only EU policy fully funded and administered from Brussels.

The CAP has changed to reflect a changing world, and I firmly believe it has evolved for the better. I'd like to present you with an overview of what the CAP is currently doing to help Europe meet its SDG commitments.

I'd also like to show you where we can aim to be even more ambitious. It is true that in the past, the CAP did not have a strong emphasis on sustainable development. However, the reformed CAP has a positive story to tell, both at home and in the developing world.



EU Commissioner for Rural Development Phil Hogan

The objectives of the CAP are fixed by the EU Treaties and have not changed since 1958. The policy, however, has changed tremendously. Traditionally, the CAP was a very inward-looking and protectionist policy. Today, the CAP continues to guarantee a decent livelihood for our farmers and agribusinesses, and can be summarised in 3 key aims:

Viable food production contributing to food security;
The sustainable use of resources; And balanced territorial development of our rural areas.

But the policy has also become far more outward-looking and is truly plugged into the global economy. This means that European farmers and agri-businesses are competing in international markets to sell our products. And it means a more global outlook and a more nuanced understanding of the policy's impact on other parts of the world.

In line with the aims of SDG 2, the CAP contributes to –
Correct and prevent trade restrictions and distortions

in global markets, due to its increased market orientation; It also prioritises sustainable food production systems and resilient agricultural practices to improve the ecological performance of EU agriculture; This is beneficial for Europe's contribution to other SDGs, be it in terms of enhancing the sustainable management and efficient use of natural resources (as in SDG 12), or combating climate change and its impacts (as in SDGs 13 and 15).

And thanks to its rural development policy, the CAP can be considered as a role model for keeping lives and livelihoods in rural areas. We aim to support sustainable rural communities by providing them with the economic opportunities and social and cultural cohesion they need.

The CAP is now more aligned with other EU policies, in particular agricultural trade and research. This means a continuing focus on healthy and quality products without hampering Europe's very open access for agricultural products from developing countries. We also

provide a wealth of opportunities for third countries to adopt out best practice and benefit from knowledge spill-over. Let's look at the climate and environmental dimension. While moving towards a stronger market orientation, we have reoriented the CAP to improve the environmental performance of EU agriculture and to contribute to the provision of public goods not remunerated by the markets. In the 2014-2020 period, 30% of CAP funding supporting farmers' incomes is spent on environmental and resource friendly production methods ("greening").

And nearly half of the EU-budget for rural development programmes is spent on a series of measures benefiting the environment or the fight against climate change. In addition, the European Union is a committed leader in the area of climate action. This was clearly demonstrated at the COP21 Climate Change Conference. Implementing the Paris Agreement on the ground will be difficult, but it is a commitment that the EU embraces. And we have already come a long way. Greenhouse gas emissions from agriculture have dropped by 24% since 1990.

Agriculture and forestry must continue delivering on the EU's ambitious pledge to reduce greenhouse gas emissions even further. And I'm happy to remind you that the farming sector is already contributing a growing share of the EU's total output of renewable energy, with almost 10 % provided in 2012. In the same year, forestry contributed with 47%. This is very promising for the road ahead. We will also continue to work closely with our developing country partners to assist them wherever possible in meeting their own SDG targets. We have strong links at multiple levels, including in international fora.

Sharing expertise and addressing problems together is the smartest way of achieving these ambitions. But we mustn't take our eye off the bottom line, either. These challenges will only be solved with significant investment, from both public and private sources.

The reality is that in today's squeezed global economy, aid budgets are under pressure. Needs far outweigh capacity. Development aid and emergency assistance are still at the forefront of our efforts. And the private sector has the resources to transform the agricultural

economy of developing countries. Under SDG2, there is an onus on all parties to "make markets work". This means galvanising responsible private investment in developing countries, promoting smart, sustainable and profitable farming practices.

I'm proud to say that the EU is already making real progress on this front. - Just before World Food Day last year, we launched a process to reach out to EU agribusinesses and persuade them to invest in African agricultural growth. The Addis Ababa Action Agenda, which provides a blueprint for implementing the SDGs, makes it clear that developing countries have the primary responsibility for their own development.

In the coming years, we will continue to persuade EU agribusinesses to enter partnerships with African and developing country farmers' organisations to provide responsible investments. Ladies, and gentlemen, the CAP is now attuned to its political responsibilities when it comes to sustainable development. European agricultural policy is assuming leadership in implementing the relevant SDGs. This leadership will evolve and deepen in the coming years, working on its own steam and in tandem with other EU and international policies. In conclusion, the European Commission's commitment is this: we must continue on this path and we will do so. We will honour our commitments, and add to them where possible.

We are ready to lead from the front. ■

Speech by Commissioner Hogan – 2016 Forum for the Future of Agriculture 22nd March – Brussels – <http://ec.europa.eu/agriculture/commissioner-speeches/pdf/hogan-ffa-22-03-2016.pdf>

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Phil Hogan

EU Commissioner for Rural Development

European Commission

http://ec.europa.eu/commission/2014-2019/hogan_en

www.twitter.com/PhilHoganEU

Soil organic carbon – the most precious substance on the planet

By Arwyn Jones and Emanuele Lugato

When the Italian astronomer Galileo Galilei wrote 400 years ago, *“What greater stupidity can be imagined than that of calling jewels, silver, and gold ‘precious,’ and earth and soil ‘base?’”*, he was highlighting the undervalued role of soil in sustaining human well-being. Unfortunately, political establishments and society at large, still continue to disregard the importance and true value of life-critical functions provided by soil. As the keystone resource for agriculture, soils also mitigate flood events, provide resilience during droughts, buffer the effects of pollutants and preserve cultural heritage, while regulating global nutrient cycles and climate processes¹. With increased attention on biofuels, soil is even viewed in some quarters as a component of the energy sector.

Soils generate an abundance of valuable products and services for human well-being, also from a broader environmental perspective, and as the basis of economies. Yet the fact that soils perform many, if not all, of these functions simultaneously, albeit with different levels of efficiency, is due mainly to the presence, quantity and quality of soil organic carbon (SOC).

Soil is a biological entity, which distinguishes it from rocks, comprising organisms, plant and animal residues (some synthesised or exuded, others at various stages of decay). During



decomposition, organic residues are converted into several carbon (C) products (about 58% of the mass of organic matter is C). These compounds, depending on their chemical composition, degradation pathway and soil characteristics, can be stabilised by different mechanisms. Therefore, in soils we can find carbon pools with turnover rates ranging from centuries to months or days.

A remarkable property of these organic carbon (OC) substances is their ability to enhance plant growth either by facilitating the exchange of nutrients (mostly metal cations) between the soil and the plant, or through aggregate formation which in turn enhances soil aeration, rootability

and water holding capacity. Soils with low levels of OC are unable to perform these functions effectively; many agronomists consider soils with less than 1% SOC to be a precursor of desertification.

Levels of SOC, and the exchange between different pools, is governed by climate, soil characteristics, vegetation and the diversity of soil organisms. Anthropogenic activities, such as land take (urbanisation, infrastructure development), land use change (deforestation, abandonment) and intensive arable agriculture can have a major impact on natural SOC levels. The harvesting of crops results in a net export of C from the soil to ‘market’. Repetitive tillage results in

disturbance of the C pools and its removal through mineralisation or erosion. Overgrazing or the use of crop residues for fuel, animal bedding or feed, also lower SOC content. Unless replaced by other sources, such as manure, OC levels in the soil will gradually decrease. Low SOC content is a trigger for decreased soil fertility, increased susceptibility to erosion and compaction, reduced resilience to droughts and pollution events, higher and more sudden flood peaks. The Status of the World's Soil Resources report² noted that 45% of soils in Europe have low or very low SOC content; while particularly evident in many southern countries, this occurs also in parts of France, United Kingdom, Germany and Belgium.

In parallel, the draining of peat (the most carbon-rich soil) and the associated loss of SOC has major consequences. Most European Union (EU) countries have lost 50-90% of their natural peatlands – the Netherlands has lost virtually all natural peatlands, Ireland has lost 93% of its raised bogs, most natural peatlands in Finland are impacted by drainage for forestry³. Locally, these represent a loss of habitat and natural water management; globally, emissions of CO₂ from extensive areas of drained peat contributes to global warming.

It's worth reflecting on the fact that the soils of the EU store 73-79 billion tonnes of C⁴, equivalent to almost 50 times the annual greenhouse gas emissions of the EU. In this context, there is increasing realisation that soils are a significant component of the global climate system. This aspect was given a global platform during the recent UNFCCC COP in Paris through a French initiative, "*4 pour mille*"⁵,

which aims to significantly offset global carbon emissions by increasing SOC levels annually by 0.4% through changes in land management. Researchers have shown that several agricultural practices can be used to raise SOC stocks⁶ – these range from the conversion of cultivated land to grass or woodlands and the restoration of peatlands, to the use of green manure crops, optimising rotation patterns to provide a 'pulse' of organic matter, retaining and incorporating crop residues, reduced tillage, and increasing crop biomass.

Modelling carried out by the JRC⁷ showed that the adoption of such practices in the soils of the EU is generally effective, leading to an increased rate of carbon sequestration without significant impact on production and markets. Results can be improved by using combining measures (e.g. residue management with cover crops). However, the research highlights that there is no single 'silver bullet' that can be applied everywhere, as local effectiveness reflects limitations imposed by climate, soil conditions and actual agricultural practices. Critically, the research shows that the impacts of such practices are effective only over short to medium timescales, after which a 'saturation' level is reached. While supportive of the concept, the research also indicates that achieving the targets of the *4 pour mille* initiative may be challenging throughout the EU given current cropping patterns and land management policies; nevertheless, there may be possibilities at local scales. However, any increase in SOC levels is beneficial to soil functions; even if sequestration rates decrease from a peak, soils will have helped offset the impacts of climate

change while alternative solutions to curb emissions are implemented.

We hope that this article has convinced you of the true value of soil organic carbon and, given its inherent role in our present and future well-being, should be treasured as the most precious substance on the planet.

Please visit:

<http://esdac.jrc.ec.europa.eu/themes/soil-organic-carbon-content>

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The hurdles of biological control of the red imported fire ant: Part 2

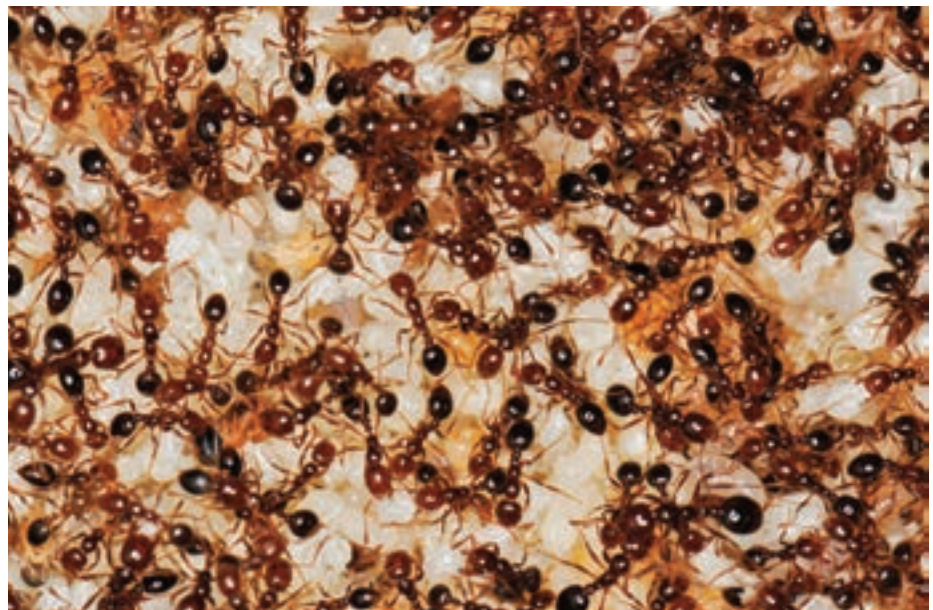
M Guadalupe Rojas, Brad Elliott, Jian Chen, Michael Grodowitz, Margaret Allen, and Juan A Morales-Ramos...

Biological control relies on the use of natural enemies – including predators, parasites, and pathogens – to reduce and manage pest populations. This can be an ecologically benign alternative to pesticides for reducing agricultural losses due to arthropod pests.

One of the most important disadvantages of the use of chemical pesticides is that many pest species develop resistance in a relatively short period of time. Although developing resistance to the attack of natural enemies is much more complicated, the use of biological control is not totally immune to the impact of evolving defence mechanisms in the target pest species. Fire ants as social insects have developed efficient defence mechanisms against predators and diseases affecting the colony (Rojas, et. al. 2016).

Fire Ant Antimicrobials

Fire ants, including both *Solenopsis invicta* (red imported fire ant) and *S. richteri* (black imported fire ant) and their hybrid, construct elaborate underground nests which can extend 2 to 3 m in depth. The underground habitat harbours, among others, entomopathogenic fungi such as *Metarhizium anisopliae* and *Beauveria bassiana*. It is not hard to conceive that red imported fire ants must have experienced a great selection pressure from those pathogens.



Red Imported Fire ant workers and brood

A range of defence strategies have evolved for countering infectious diseases in social insects (Schlüns and Crozier 2009), including “social immunity” (Cremer et al. 2007). Antimicrobial agents are a crucial component in social immunity, including substances obtained from the environment (Lenoir et al. 1999; Christie et al. 2003), gland secretions (Baracchi et al. 2012) and body exudates (Rosengaus et al. 1998).

Behaviours such as self- and mutual-grooming have been recognised for some time as important antimicrobial strategies in ants, as well as removal of dead individuals – or necrophoresis – from the nest (Diez et al. 2014). Recently, Wang et. al. 2015 reported that some nest volatiles of the red imported fire ant have antimicrobial

properties and that the germination rate of *B. bassiana* GHA spores was significantly reduced after exposure to these nest volatiles within an artificial ant nest. Thus, fumigation may be a component of ant social immunity.

Active inclusion of antimicrobial plant resins into nest materials affording protection from microbes has also been documented (Schlüns and Crozier 2009). Probably the most studied antimicrobial strategy is the secretion of various antimicrobial compounds through various glands, most importantly the poison gland in fire ants. As early as 1958, Blum et al. (1958) documented antimicrobial properties of fire ant venom, and Vander Meer and Morel (1995) reported that queens deposit a queen-specific piperidine



Red Imported Fire ant queen and sister

venom alkaloid on eggs as they pass out of the vulva and are pushed across the sting.

Hundreds of manuscripts on fire ant venom chemistry detailing various components, antimicrobial properties, and behaviours associated with venom dispersal (incorporation in nest materials, among others) have been published (Vander Meer 2012). However, the biosynthesis of fire ant venom components can be disrupted. For instance, ingestion of boric acid by fire ant workers had a detrimental effect on the venom chemistry, reducing the concentration of some alkaloids in the fire ant venom including piperidine (Rojas, et. al. 2011).

Disrupting the fire ant venom chemistry may also impact social immunity by reducing its antimicrobial properties. Current research on fire ant biological control focuses on finding plant chemicals or natural products that disrupt social immunity. Most of the known plant-derived toxic compounds induce different levels of physiological disruption when used

at sub-lethal concentrations. Such products can be combined with spores of entomopathogens such as *Metarhizium* or *Beauveria* to improve their virulence.

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index.php



Providing data to manage soils sustainably

Dr Andrew Tye, Soil Scientist & Process Geochemist at the British Geological Survey looks at soil management and how it can help ensure sustainability for future generations...

Society in the past has generally paid scant regard to its soils. However, as global population increases, pressures on the land we use to feed and house ourselves become greater. In recent years the role soils play in nearly every aspect of our lives becomes more apparent and the need to consider their sustainability becomes a key issue for policy and decision makers. Functions of soils include supporting food and fibre production (including biomass), holding and filtering water, holding and transforming chemicals, sustaining biodiversity and genetic resources and providing a platform for construction. Yet soils are a finite resource; it takes up to 1000 years to produce 2.5cm of top soil through the process of rock weathering. Therefore the management of soils to ensure their sustainability for future generations is of utmost importance.

Making decisions regarding soil management requires an appreciation of the function required from the soil as well as understanding how a soil's properties relate to this function. Many soil properties are related to the rock type from which the soil has been formed. Decisions relating to the sustainable management of soil require both data but also a sense of scale. As with so many things in life, a development in one area can lead to fresh problems being created. This is also true of soils but can have large impacts. For example, modern agricultural techniques, particularly involving large and heavy equipment have been used successfully to increase food production in the UK, but have also damaged the physical structure of our soils. This has led to poor drainage properties, which has been suggested, was a contributory factor to recent floods in some areas of the country. This demonstrates that for



successful sustainable management, soils need to be considered from the pore to landscape or catchment scale. This requires good quality data upon which to base decisions.

The UK has significant datasets that can contribute to many aspects of sustainable soils management. These datasets range from soil maps which classify soil types and how they change at a range of scales (1:250000 – 1:10000), soil parent material maps which link soils to geology as well as datasets of soil properties, geohazards and geochemistry. Much of this information is available via the NERC funded UK Soils Observatory (www.ukso.org) that is hosted by the British Geological Survey (BGS). This site holds soils data from a range of Institutions including the BGS, Forest Research, the Centre of Ecology and Hydrology, Cranfield University, Rothamsted Research, Agri-Food and Biosciences Institute, and the James Hutton Institute as well as Higher Education Establishments. The information in the UKSO brings national soil data together and makes it accessible in line with government policy. A key aim is that policy makers, scientists and engineers will develop new collaborations, and use this data to understand how future development and environmental change may affect a soils ability to sustain the diverse functions we require of it. Using this data will also allow

predictive modelling of society's impacts on soils on the wider landscape.

The objective of the UKSO is to give simple, free access to data for non-profit making use and to facilitate its licensing for commercial use for wealth creation. The UKSO project will acquire new data, harmonise licensing and develop accessibility software to ensure data interoperability to improve the clarity and ease-of-use of our national and regional soil data resources. For example data can be viewed through the UKSO map viewer (<http://www.ukso.org/mapviewer.html>) which can work with any desktop, laptop, tablet or mobile device with web access. In addition, the UKSO project works alongside the mySoil smartphone app (www.bgs.ac.uk/mysoil), which enables UK and European soil information to be examined in the palm of a hand, and crowd-sources soil data from around the world. ■

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IUSS launches the International Decade of Soils (2015-2024)

Following the International Year of Soils 2015, the International Union of Soil Sciences has proclaimed the International Decade of Soils to increase the momentum of raising awareness of the importance of soil for life...

The International Union of Soil Sciences (IUSS) is the global union of soil scientists and the umbrella of all national soil science societies. The IUSS was founded as the International Society of Soil Science (ISSS) on 19th May 1924 in Rome and became a scientific union member of the International Council for Science (ICSU) in 1993. The objectives of the IUSS are to promote all branches of soil science, and to support all soil scientists across the world in the pursuit of their activities. In addition, the IUSS aims to put soils and soil science on the global agenda.

In the 'Vienna Soil Declaration' of Dec. 7, 2015, the IUSS identified the key roles played by soils in addressing the major resource, environmental, health and social problems which humanity is currently facing. The worldwide responsibility for conserving soils, their properties and functions as environmental keystones requires an improved knowledge and understanding that soils are the basis for microbial, plant and animal life, as well as a major reservoir of biodiversity, antibiotics for human health and a gene reserve.

Soil filters water, critical for supplying drinking water and other water resources, stores water for the use by plants and acts as a buffer to prevent rapid run off. Soil stores and releases plant nutrients and is able to trans-



form many compounds including pollutants.

Soil is the basis for most of the food produced globally, is necessary for the production of biomass such as wood, fibre and energy crops, capture carbon and can help mitigate climate change.

Given this situation, the IUSS believes that it is incumbent on IUSS members to not only maintain the level of activity generated in IYS 2015, but to increase the momentum and the extent of our contributions on these issues as we move towards the Centenary of the IUSS formation in 2024.

The Executive Committee and the Council of the IUSS will play a pivotal

role in setting overall objectives and directions during this period. However, it is essential that not only all IUSS Divisions, Commissions, Working Groups, National, Regional and individual Members, but also experts of related fields of expertise accept the challenge to undertake activities to ensure that the significance of soils in maintaining a healthy life and environment remain continually at the forefront of political and scientific planning and decision making.

The International Decade of Soils shall thus be a continuation of the efforts made during the International Year of the Soils 2015. It will be marked by a number of activities on the national and international levels. IUSS plans to play a key role in education, dissemi-

nation of information, issuing informative press statements on key issues, co-ordinating activities across the world through our National Members (e.g. World Soils Day) and maintaining a historical record and collecting personal biographies. Furthermore, a public outreach campaign is envisaged to show the emotional and cultural relevance of soils to reach the general public and other target groups.

As a first step, a logo was designed:



The logo design describes a healthy soil profile. The logo is made up of ten lines – each representing one year in the international decade of soils. Each line also represents a decade of IUSS, leading up to the organisation's centenary in 2024. The brown of the soil horizons in the logo is darker towards the top and gradually becomes lighter further down, demonstrating a soil organic matter content declining with depth. A green plant sprouts out of the soil – demonstrating soil as the origin of life itself. Earthworms symbolise the vitality of soil life.

Secondly, the Vienna Soil Declaration was translated into Spanish and Portuguese. Its key messages will be used for dissemination purposes. And, last but not least, upon the initiative of the Latin American Society for Soil Science (SLCS), the first outreach campaign via social media was launched in which the global soil science community is invited to participate. In the framework of a project called Thus are Soils of my Nation® a 'Soil's Friends Virtual Network' will be created to generate public awareness of the need to preserve soil.

Partnerships will be forged with other international organisations (e.g. IAEA, CGIAR, UNEP, Worldbank, WWF, and Friends of the Earth) who could help propagate IDS messages and support us in our endeavours. Furthermore, interested media (National Geographic, Discover etc.) may help us to reach the general public and companies who share the same values, as well as others who wish to propagate IUSS IDS messages through their own channels by becoming "soil ambassadors"; all working together with potential sponsors, who would benefit from publicly showing their interest in protecting soil etc.

With regard to education, the main focus of our activities will be on school age children (who will be teenagers and young adults in 10 years' time). Some young children's books already exist; we could assist with their translation into other languages. Web-based material needs to be developed (together with teachers notes) that would target several age groups (including adults). When this material has been developed it could again be translated into other languages. Another idea was to create a soil jigsaw which would allow every person doing the jigsaw to make their own world of soils.

The IUSS will act as an independent, reliable source of information about soils and their role in key areas affecting humanity, such as: food production, food security, climate change, carbon sequestration, nuclear contamination, etc.

Following the very successful publication of Soil Matters – solutions under foot ¹, a series of books on new and upcoming soil related topics is planned. The next book in this series will be on urban soils and shall be published by the end of 2016.

Soil is essential to human life. Soil around the world is being degraded and too few people know about it. To preserve the soils in which we grow our food, long-term, we need to do everything we can to educate people and to raise awareness of how important soils are. Experts, decision-makers, politicians and the general public – we all need to work together. Play your part! Please send your activities, ideas and suggestions for how to promote soil awareness to iuss@umweltbundesamt.at.

If you want to be informed about our activities, please subscribe to our monthly newsletter called IUSS Alert.

¹ Edited by Stephen Nortcliff on behalf of the IUSS, Nov. 2015, Catena Verlag, GeoEcology Essays. 160 pages, ISBN 978-3-923381-63-0. The book can be ordered from: iuss@umweltbundesamt.at



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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
North Carolina State University

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.

Following on from COP21

At the public session of the Environment Council in March, EU Commissioner for Climate Action and Energy, Miguel Arias Cañete delivers a follow up speech to COP21...

It is a pleasure to address you today following the adoption of the Commission's Communication on the Paris Agreement and its implications for EU climate and energy policy.

I would like to thank Minister Dijksma and the Presidency for preparing their headline reading of the Paris Agreement which is also important for today's discussion.

We have already reflected on the historic achievement of Paris and the opportunity the global low carbon transition presents. But much work lies ahead. In our Communication adopted, we set out our initial reflections on implementing the Paris Agreement in the EU. Our message is clear: the EU needs to continue to show global leadership.

Long-term goal

The Paris Agreement includes a long-term goal to put the world on track to limit global warming to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C.

It also contains a dynamic mechanism to review ambition over time. The 2018 facilitative dialogue presents a first opportunity to assess collective efforts in achieving the long-term goal before the first global stocktake in 2023.

The special report by the Intergovernmental Panel on Climate Change on the specific policy implications of a 1.5°C goal will be critical in informing those discussions. The EU will provide input into the work that will be undertaken internationally for that purpose.

Along with other Parties, the EU is also invited to communicate by 2020, its mid-century long-term low emission development strategies. To facilitate the

preparation of these strategies, and the political debate in the Parliament and Council, the Commission will prepare an in-depth analysis of the economic and social transformations required for this purpose.

In this context, some argue that the EU needs to raise its level of ambition already today. Let me give you my view:

The EU 2030 target is an ambitious contribution to the Paris Agreement, as part of a global effort, and in comparison to other Parties contributions. This is because:

- It is consistent with what science requires. Reducing our emissions by at least 40% by 2030 is in line, in the medium term, with the Paris Agreement's goals;
- It is the most ambitious form of mitigation target. It is an economy wide cap, binding in European law, and accountable down to each tonne;
- It will require a significant transformation of the European economy. In the energy sector, transport, buildings, agriculture. In fact this concerns all sectors. It will not be easy, but we are determined to deliver;
- And importantly, it is designed as a first step in a roadmap towards a low carbon economy. As I just mentioned, the EU will prepare, by 2020, a mid-century low emissions development strategy, that will enable the EU to lead the global transformation towards climate neutrality.

2030 climate and energy framework

Coming back to the Paris Agreement, a key element is the legally binding obligation on all Parties to pursue domestic mitigation efforts necessary to achieve their emission reduction targets.

The EU was the first major economy to submit its intended nationally determined contribution (INDC) on 6 March 2015 which reflects the European Council Conclusions of October 2014 on the 2030 climate and energy framework.

We must live up to our commitments made in Paris and implement swiftly the EU's climate and energy framework, as agreed by the EU leaders in October 2014.

The Commission began the process of implementation even before the Paris Conference with its proposal to revise the EU emissions trading system (ETS).

As a next step the Commission is currently preparing proposals for the non-ETS sectors, including on effort sharing and land use, land use change and forestry, as well as a new governance mechanism to streamline planning and reporting requirements for the post-2020 period. This will also cover energy policy, with the revision of the energy efficiency and renewable energy directives as well as our work on the electricity market design scheduled for autumn.

Low carbon transition

The Paris Agreement has sent a clear signal to stakeholders and investors that the global transition to a low-carbon economy and clean energy is here to stay.

We should reflect for a moment that being in the lead on the drive towards a low carbon economy is a clear opportunity for our economy, for jobs and growth here in Europe.

To support this transition, we need an enabling framework to a real long term transition to a low carbon economy, in particular by delivering on the Energy Union.

With the scope of needed investments, it is clear that shifting and scaling up private investment is essential. EU funds, such as the European Fund for Strategic Investments, will play an important role to mobilise the markets.

Indeed the EU as a whole is well placed to exploit these new opportunities. I believe that with our strong track

record and continued focus on innovation, Europe is on the right track.

Climate Diplomacy

The Paris Agreement was without a doubt a great success for EU climate diplomacy. The EU spoke with a unified voice which was crucial in the lead-up to Paris and in developing the High Ambition Coalition – the alliance of countries that fought for a high level of ambition – which shaped the successful outcome.

We must maintain this momentum in all international fora including the G7 and G20, not least because of the critical negotiations in the International Civil Aviation Organization (ICAO) later this year as well as further talks on the Montreal Protocol, both of which provide a good opportunity to scale up the level of ambition in the pre-2020 period. We must also ensure tangible progress on many of the left-overs from Paris before the Marrakech conference.

As a first step I welcome the Conclusions adopted by the Foreign Affairs Council on 15 February, which recognise that climate action is a major strategic foreign policy challenge in a range of areas with implications in development aid and cooperation, trade and security.

We should continue to support developing countries in the implementation of their national climate action plans, with such support programmes to be rolled out as of this year. In that regard, we (the EU and the Member States) should deliver on our commitment to scale up the mobilisation of climate finance in order to contribute our share of the €100bn per year by 2020. ■

Taken from a speech on the EU Commissioners website – http://europa.eu/rapid/press-release_SPEECH-16-586_en.htm

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Miguel Arias Cañete
EU Commissioner for Climate Action and Energy
European Commission
http://ec.europa.eu/commission/2014-2019/arias-canete_en

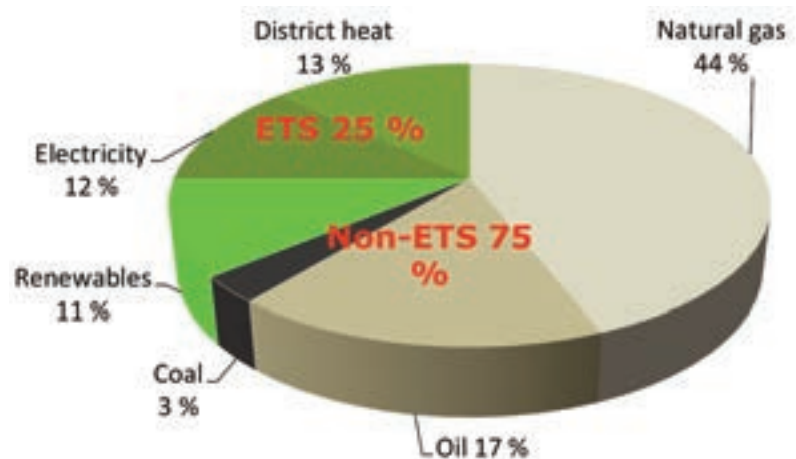
Space heating – the blind spot of the EU energy and climate policy

Pertti Salminen, Director, EU Affairs and Antti Kohopää, Adviser of District heating at Finnish Energy highlight the benefits of district heating

Heat consumption of residential, commercial and public buildings is about 30% of all energy use in the EU. Heat demand is mainly satisfied by individual fossil gas, oil and coal boilers, with total market share of 64%, in addition the share of biomass is 11%. Heating is the key sector concerning emissions reduction, together with traffic.

Some 25% of heating is based on electric and district heating which are in the EU emissions trading scheme (EU ETS). However, the rest of residential, commercial and public buildings heating has slipped outside of it, the most effective policy instrument to reduce CO₂ emissions. Today, these individual heating appliances in buildings emit more than 600 million tons of CO₂ annually, whereas the total emissions from the ETS sector are now some 1,880 million tons of CO₂.

So far, actions at the EU level to limit the emissions of the non-ETS sector have been weak. Introduction of a binding cap and financial instruments to limit these emissions have not been a real topic in the EU. For many reasons, now would be the right time to start a debate on what kind of policy instruments EU should have to reduce the emissions of the non-ETS sector. For example, could the extension of the EU ETS to cover the heating sector deliver cost-efficient CO₂ reductions?



Heating of residential, commercial and service buildings covers appx. 30 % of final energy consumption in the EU. Source: Eurostat.

All heating should be incorporated into to the emissions trading system

In the heating market different solutions should compete with each other. This means that customers should have the option to choose their heating solution. Therefore it is crucial that EU-wide energy policy does not distort the competition in heating.

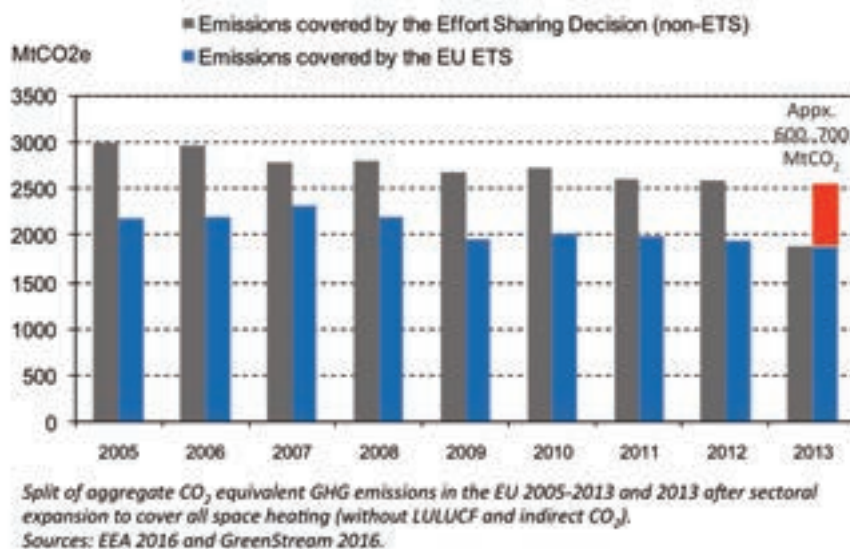
Unfortunately, existing policies are distortive. The EU emissions trading system is a good example of distortion between different heating solutions. District and electric heating are covered by EU ETS and these products have the cost burden of the ETS. At the same time and in the same market gas, oil and smaller amounts of coal used in individual boilers are not covered by the EU ETS. These products have no cost burden and therefore they have a competitive advantage.

In some cases this may cause carbon leakage from the ETS sector to non-ETS sectors. Direction should be opposite. Customers should replace individual boilers to use less carbon intensive solutions like district heating, as well as electricity where that is feasible. Biomass is also a heating option in many member states, too.

The share of emissions covered by the EU ETS was 42% in 2013. After sectoral expansion of the ETS to cover all space heating, the share of the EU ETS would be 56-58% of the total GHG emissions.

Renewable energy and CO₂ reductions could be done on behalf of the customers

The widespread use of district heating in urban areas in some EU member states, like Denmark, Netherland and Finland, is a concrete and a good



example on how to change or at least how to create an opportunity to change large parts of the buildings from house-specific fossil heating to a carbon neutral future. During the past four years, the share of renewables in district heating has increased from 18% to 35% in Finland. Finnish Energy has estimated that the share could be above 50% in 2030.

Furthermore, over 70% of all district heat in Finland is produced in combined heat and power plants. CHP reduces one third of the CO₂ emissions compared to the dominant technology producing the same amount of heat and electricity in separate utilities.

Existing or new customers do not need to invest in renewable energy sources in heating because district heating companies do it for them. The EU heating and cooling communication is a very welcome strategy. It emphasises the need for this kind of consumer based holistic and systemic approach.

The national effort sharing of emissions is a major political, technological and funding challenge

Almost all EU member states will have huge difficulties to achieve targeted

emissions reduction in the non-ETS sector while emissions of the ETS sector will be reduced as agreed, for sure. In the future the problem is growing larger year, by year. Expanding the ETS to cover house-specific oil, gas and coal heating would make reaching the greenhouse targets much more cost-efficient and confident.

On the other hand extension of the EU ETS would improve the functioning of the emissions trading market. There would be more actors, more tradable allowances and more subjects for emissions reduction.

More incomes for member states

Possible extension of the emissions trading scheme would bring more emissions under the scheme and it would change the amount of auctioned emission allowances, and increase the price of allowances. This would increase the revenue of the auctioning and incomes to the member states.

In the long run, state economy should not be based on emission pricing because the target is to reduce emissions and therefore, base of incomes will dry up, but in the short term this could and will have a positive impact.

Need for further information and actions

Today, EU and all member states have economic instruments like taxes, building regulations, regulated energy prices, as well as, capacity and support mechanisms which all are incentives for heavy renewable investments without market based thinking or the overall advantage of the society. This is weakening the competitiveness of district heating, as well as electricity towards alternative solutions. Before any new legislative proposals, these policies should be analysed in the perspective of the heating market. Europe should make an analysis at the EU level.

On the other hand, our knowledge about the heating sector is still incomplete, even thinking about the statistics, which should be one of the key bases for all political decisions. We would need thorough analysis from where and how much emissions are caused by the non-ETS heating sector and what kind of emissions reduction policies exists. It would be important to know the price of emissions reduction in the heating sector, and why existing policies are not delivering emissions reduction.



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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



Portion of mural by Jonathon Cruz in Iqaluit, Nunavut

in a more acute and profound manner. 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

Image: © Anna Bunce 2013

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 pro-

gramming 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 | Nasivik 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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A call for speed, focus and results

At the high level 'Global Action Day' which opened the World Future Energy Summit in Abu Dhabi, Ms Marie-José Nadeau, Chair of The World Energy Council, addressed the plenary session...

The role of cooperative action in supporting the future of global energy and boosting innovation. The session explored the future of the global energy industry as nations seek to transition to a low carbon economy while maintaining economic growth and supplying energy to growing populations.

The Paris Agreement is only a starting point for governments and the energy industry. The Agreement will not stabilise the climate, but the collective efforts of 195 countries who have published their Intended Nationally Determined Contributions, INDCs, will go a long way to achieving success.

Countries must now do what they said they would do, and deliver on their INDCs and report in a transparent

mode to their national stakeholders as well as to the international community.

The findings of the World Energy Council's Scenarios for 2050 on current trends, total energy demand is set to increase, with fossil fuels remaining the dominant energy source, supplying roughly between a quarter and a third of the global primary energy mix.

Nations cannot suddenly force each other to stop emitting greenhouses gases, because fossil fuels are fundamental to the way that many economies work. However, with new technologies coming on stream, the share of renewables is set to record its highest rate of growth reaching between 20% and 30% of the global energy mix by the year 2050.

There is the need for sustainable energy policies that balance the need for de-carbonisation on the one hand, and the need to ensure energy security and to alleviate energy poverty on the other hand.

As the global economy continues to experience difficult times, balancing the Trilemma is not going to be an easy task. But the Paris Agreement does offer a range of mechanisms and a roadmap to achieving goals.

Countries have pledged more money to help the poorest and more vulnerable countries adapt to the effects of climate change. The Agreement requires a flow of \$100bn a year from developed countries to developing ones by 2020 – a total which is to be reconsidered in 2025. There is also the basis for new carbon pricing mechanisms.

In presenting the results of the World Energy Council's survey of 1000 energy leaders from across the globe on what they perceived as the top priorities the energy industry must also play its part. There are 5 key actions that the survey highlighted:

- Trade and technology transfer;
- Carbon pricing;
- Address the costs that may accompany commitments to targets, particularly relevant for developing economies;
- Better management of demand and energy efficiency programmes;
- RD&D investment in key areas such as electricity storage, smart grids, high efficiency combustion engines, fuel cells and batteries, new renewable technologies and advanced biofuels.

However, it has to be recognised that at the moment the energy sector is facing disruptive change. The deep dive of the price of crude oil is badly hurting both the industry and resource dependent countries. In the electricity sector, the combined effects of de-carbonisation, digitalisation and decentralisation is forcing a profound transformation of the industry.



*Marie-José Nadeau,
Chair of The World
Energy Council*

Furthermore, rates of returns and earnings are deteriorating which is leading to a reconfiguration of businesses with subsequent impacts on jobs, assets, operation budgets and Capex. But, even against this turbulent background, positive transformation is occurring in the energy sector.

On a positive note, it is encouraging to see that countries want to reduce the risks posed by climate change and know that they will have to find a way of working together. The real question now is for governments – will policymakers embrace the much needed policy decisions at the pace that they themselves called for in Paris?

What is needed is speed, focus and results so that when the first opportunity in 2018 comes to take stock, we can see real progress being made.

Footnote: Marie-José Nadeau was appointed Member to the Order of Canada in the country's 2016 New Year's Honors List in recognition of her outstanding lifetime achievements in the energy sector. It is one of the country's highest civilian honors. ■

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Marie-José Nadeau
Chair

World Energy Council – For sustainable energy
www.worldenergy.org

Success story on mineral carbonation of CO₂

Pushing academic research towards industrial scale through advanced modelling and piloting

At Aalto University's Department of Energy Technology, Professor Mika Järvinen's Energy Engineering and Environmental Protection research group is conducting pioneering research on biomass combustion, carbon (CO₂) capture and storage (CCS) by mineral carbonation, circulating fluidised bed gasification of waste, and advanced modelling of industrial processes, mainly for energy and metallurgical applications. To foster good industrial collaboration, the group carries out laboratory, pilot and full-scale research to avoid problems in scale-up and provide sustainable and economically feasible solutions for companies.

In 2011 the Aalto University Foundation, together with Abo Akademi University and SSAB (formerly Ruukki) Raahe Works, successfully secured a patent for a technique that produces precipitated calcium carbonate (PCC) from alkaline by-products. This CCS approach aims to reduce CO₂ emissions by using alkaline industrial waste materials and flue gas rich in CO₂ to produce a valuable PCC that is marketable to paper, pharmaceutical or plastics industries, (see the above figure 1). The conventional production of this PCC requires limestone to be mined, transported and subjected to a very energy intensive calcination processes that also emits CO₂. However, by substituting limestone with industrial Ca-rich wastes (e.g. steel slag) our

method reduces waste, saves energy and reduces CO₂ emissions.

Almost 1500 Mt of steel is manufactured globally every year producing 2700 Mt CO₂ corresponding 6.7% of anthropogenic emissions. In addition to the direct and indirect emissions of CO₂, the production of steel also annually generates about 400 Mt of a solid by-product known as slag. Slag is formed from species in pig iron such as Si, Mn, Mg, some Fe and also valuable Cr that are oxidised during steelmaking. One major component in slag formation is CaO that is fed to the top of the slag to remove silicon and sulfur and improve flowability. CaO is produced in the lime kiln by heating the lime stone up to 1100 °C.

There are several different types of slag produced at different stages of the steelmaking process. Basic oxygen steel converter slag is very well suited for a Slag2PCC process as it contains a large amount of free calcium that can be effectively extracted, with annual slag availability being 135 Mt. Steelmaking slag finds applications in road construction as well as the cement industry, however, about 13% is unusable for these purposes and is generally landfilled. Figure 2 presents the simplified principle of our Slag2PCC process implemented to steelmaking.

Steelmaking requires calcium oxide CaO that is produced from CaCO₃. In

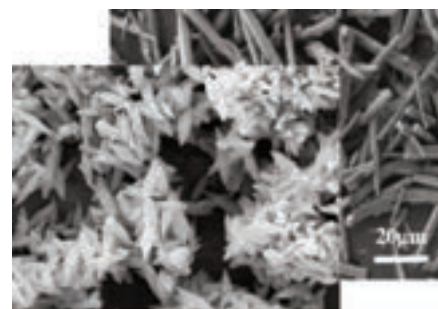


Figure 1

our process, a water solution of an ammonium salt is used to extract calcium from the steelmaking slag. The resulting Ca-rich solution is bubbled with CO₂ gas which reacts to form PCC, precipitated calcium carbonate.

The quality of synthetic PCC generally surpasses that of even the highest quality natural ground PCC as the process can be tailored and controlled to produce a wide variety of PCC products with very high purity and different crystal properties. For this reason PCC can be sold at a higher price. The global consumption of PCC increased from 10 Mt in 2004 to 14 Mt in 2011 and is expected to continue to grow. There are many requirements for the PCC properties including particle size, purity, brightness and crystal morphology, and these vary depending on the application.

Current research challenges and main developments

There could be a significant surplus of PCC available if all steel converter slag production in the world would be utilised by our process. As one exam-

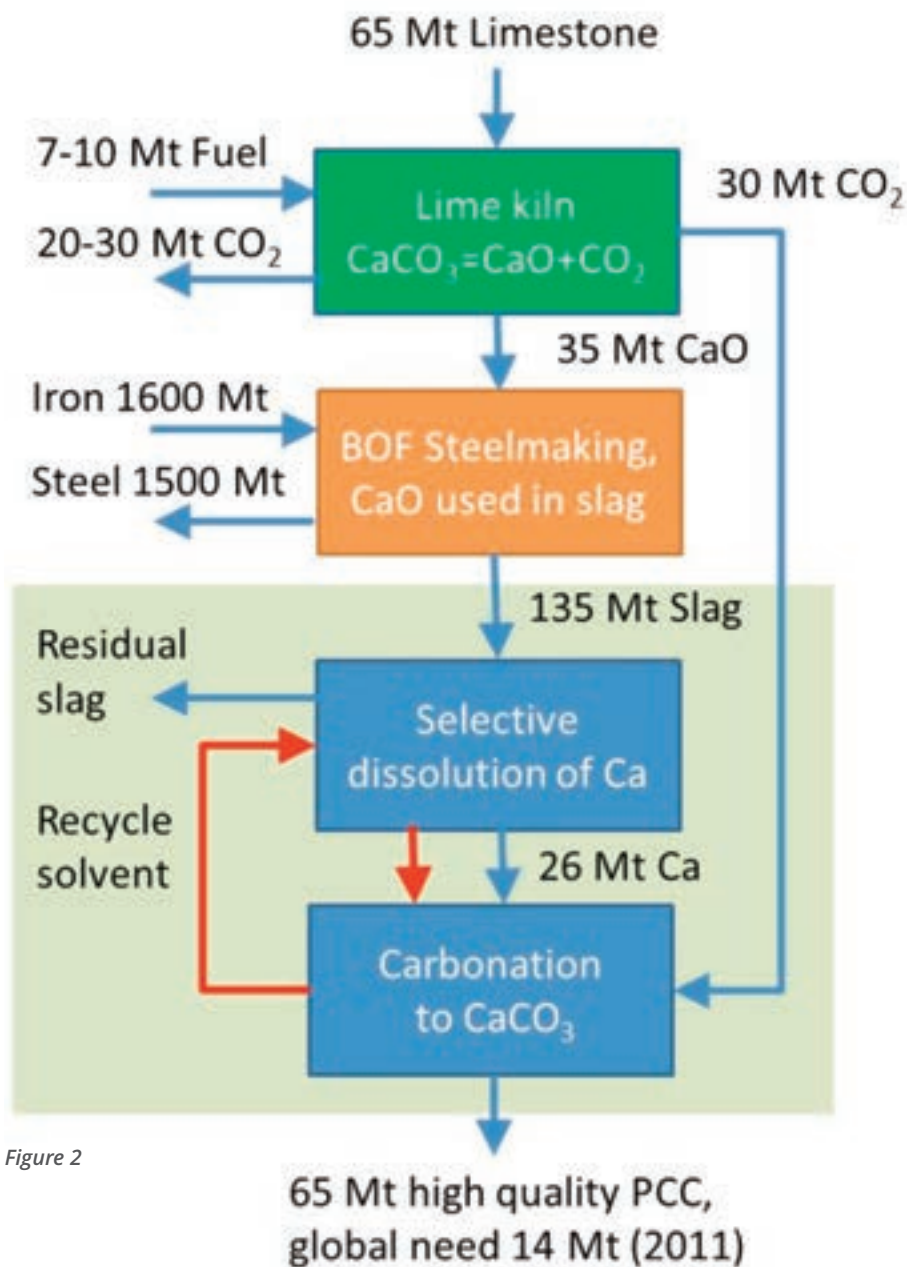


Figure 2

ple, our synthetic PCC could partly replace the limestone used in the production of steel, reducing the need for mining. PCC could be sold at a higher price as a commodity chemical to several other industries. We are also able to bind most CO₂ emissions, 30 Mt, related to calcium treatment in the steel mill. If the lime kiln is heated by biofuels, the process would be mostly CO₂ neutral. The global annual emissions from the blast furnace in

iron making are in the order of 2600 Mt, being far too large for Slag2PCC process to be applicable. The slag from blast furnace is also not suitable for our process and is already mainly used the cement industry. The biggest benefit from our process is in the reduced need of virgin lime stone required for steel converters.

The feasibility of PCC production from steel making slag has been success-

fully demonstrated by our pilot plant, launched in 2014, both on batch and continuous modes. We can successfully produce high quality PCC of rhombohedral calcite and aragonite of various sizes. We have recently published results showing that by applying ultrasonic extraction, extraction efficiency can be significantly increased (Said et al. Enhancement of calcium dissolution from steel slag by ultrasound, Chemical Engineering and Processing 89 (2015) 1–8). We are also currently working on developing alternative PCC products based on the particular advantages of the Slag2PCC process for potential high value niche applications. Recovery of the ammonium salt solvent and effectiveness of the filtering are still critical aspects of the process and how to best achieve this at minimal energy cost is a major challenge.



Mika Järvinen and Arshe Said

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Call for action for UK energy

Our national identity, not just energy security, hangs in the balance while decisions over Hinkley Point C and Swansea Tidal Lagoon are delayed, explains Dr. Nelson Ogunshakin OBE, chief executive of Association for Consultancy and Engineering (ACE)...

The professional consultancy and engineering sector, which is at the forefront of capital project development, is going from strength to strength at the moment. The government has taken impressively clear action to improve British critical infrastructure as HS2, the Crossrail projects, Tideway tunnel and the Northern Powerhouse agenda surge ahead. However, indications that decisions pertaining to the energy sector are faltering may relegate what could be an infrastructure boom to a flash in the pan.

Two longstanding UK energy generation projects have recently looked increasingly beleaguered, a show of form that must be reversed if the UK is to remain energy secure in terms of baseload capacity. Both Swansea Bay Tidal Lagoon and Hinkley Point C are facing delays in decisions to fund the projects amid fears that they will be too costly to justify expenditure. I would argue, however, that these projects will not only contribute to the invaluable instrumental goal of energy security, but also have a symbolic value that is just as important to UKPLC.

Swansea Bay Tidal Lagoon is a genuinely ground-breaking project that is going unduly cold at the moment. Once heralded as a key point in the energy plan laid out in the Conservative's 2015 manifesto, Prime Minister David Cameron's enthusiasm for the project is now said to be 'reducing'. Indeed, just last week, it was announced that an independent review would be launched into the feasibility and practicality of tidal lagoon energy in the UK – perhaps an existential threat to the project.

In spite of these challenges, I remain hopeful for the prospects of the project. The scheme already has planning permission, an intelligently laid out supply chain and £200m from equity sponsors, not to mention huge

local, national and international support. Indeed, the project has recently agreed to a strike price that rivals new nuclear plants, proving its competitiveness.

Importantly, what is at stake here is not simply the £1bn facility, but the entire legacy of the UK's tidal energy generation. If tidal energy in the UK was a housing development, Swansea is but a marketing suite; it is designed to prove the efficacy of this kind of project so that larger projects (benefitting from economies of scale) can be rolled out along the West coast, providing clean energy for millions. Swansea Bay Tidal Lagoon represents a modern Britain – green, decentralised and enterprising – and I would encourage the government to push past the current sticking points so that construction can begin. It is the thin end of a green energy generating wedge that we must support to secure Britain's energy and make a statement about the country we can become.

The decision to begin work on Hinkley Point C is the second deliberation to dither. Indeed, dithering has characterised this process for some time; back in 2007, Vincent de Rivaz, EDF's boss in the UK, said that the British would be cooking turkeys using Hinkley power by Christmas 2017, for example. Indeed, the largely state-owned French energy giant is under financial pressure and is struggling to finance the £18bn project, even with China's state nuclear firm CGN picking up the slack and taking on a third of the costs.

Despite all this, Hinkley Point C represents a good opportunity for the UK to meet its energy needs. In 2013 the site received planning permission and a strike price was agreed, which would make it competitive with other low carbon generation methods. Over the 60 years the plant would operate, it would save the UK 600 million tonnes of CO₂ all the while producing 7%

Swansea Bay Tidal Lagoon is a genuinely ground-breaking project that is going unduly cold at the moment. Once heralded as a key point in the energy plan laid out in the Conservative's 2015 manifesto, Prime Minister David Cameron's enthusiasm for the project is now said to be 'reducing'.



of the UK's generation needs. Even before the facility formally begins producing electricity, the construction process will create 25,000 new jobs.

Beyond the stats, Hinkley Point C symbolises an opportunity to embrace our stated values of openness and internationalism with expertise and capital from around the world coalescing in the UK to produce something that would make a real impact. Hinkley Point C gives the UK the chance to reframe nuclear energy post-Fukushima as not only safe but an essential ingredient to a healthy mix of energy generation in the UK. Here the UK can boldly push ahead with nuclear power – proving it is open to businesses and world leading, even in the event of a crisis. What is clear is that these projects, although they have measurable outputs, creating jobs, promoting investment and providing electricity, also have important softer impacts that change the way others think of us and, perhaps most importantly, how we think about ourselves.

All good professional engineers and consultants understand that the results of their work mean more than just projects' instrumental outputs. How we solve the critical problem of energy security is more than just about avoiding blackouts. Rather, going ahead with these projects would contribute to indicating that the UK is a progressive, green and outward looking nation, the country we always aspire to be. If we embrace innovation and enterprise in this instance it enables us to retain the fantastic position we are currently in – any decisions to the contrary might mean we lose our spark. ■

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Smarter homes: How to save money and cut emissions

Russell Bowes outlines how the implementation of smart technologies can impact the way our homes are built and heated...

The home of the future is almost here. A phrase which has become a little overused in the past few decades. The difference in using it at the start of 2016 is that in a very real way, our homes are already becoming homes of the future. Smart, connected devices are permeating every room in our homes and almost every aspect of our daily lives. What makes this revolution much more muted than one might have expected is both the gradual rollout of new technology and the non-invasiveness of it.

Disruptive technologies are affecting and changing every aspect of our homes from the way they are built, using natural cement churned produced by bacteria or constructed from fungi, to how we interact with and control our homes through connected devices. Cloud computing, energy and water saving technologies are becoming ubiquitous across every room in the home and will become standard in the future.

Perhaps the most disruptive concept driving the adoption and application of new, smarter home technologies is what is known as 'the internet of things' (IoT). The internet of things is not a new idea. The concept has been around for several decades. At its most fundamental it is a simple idea. What if your fridge could tell when you run out of milk or when the butter was past its use-by date and could notify you and order more butter or milk? Pretty useful, and that is the IoT at a day-to-day level. Within the UK the most common application of this technology has so far been in home heating and energy usage.

In part this is due to the government's aggressive rollout of smart meters which allow you to control every aspect of your heating from your mobile phone, at home or remotely. 'Smarter' devices can also control heating and lighting to work with natural light levels, warmth and weather and even shut off or switch on

heating and lighting when you are away from home.

These and other technologies will combine to help consumers to better monitor their energy usage through connected heating systems, appliances and smartphone applications. This monitoring via apps and smarter, self-controlling technology will push down energy usage by making our use of heating and lighting much more focused. Imagine a world where your fridge freezer, washing machine and boiler can all switch off for peak energy price periods - whilst still keeping your food fresh, water hot enough to shower and getting your clothes clean.

More intelligent and thus lower energy usage will ultimately result in lower energy bills and in the end lower emissions.

As I mentioned earlier, smarter technology is also pervading how homes are being designed and built. Traditional house building with bricks and mortar is a carbon intensive process. New homes may use building materials such as natural cement created by bacteria and the reintroduction of straw-bale panels as a super insulator.

Roofs will also become smarter utilising super reflective tiles in warmer climates and bio solar roofs in moderate climates. These will combine habitats for pollinators alongside energy-generating panels and self-cleaning finishes. These technologies will help to lower mains energy usage with more homes generating a greater proportion of their energy through smart and green technologies. The follow on from this is a lowering of energy bills and carbon emissions from people living in these homes.

Perhaps for the next few years the area we will see the greatest progress and uptake of smart technology and



the internet of things is in home heating controls. Smart thermostats and heating controls give you almost immediate insight into your energy usage via smartphone apps. This is information which you can use to reduce your energy usage and bills whilst making your life a little more comfortable.

With devices such as NEST and competitors you can switch your heating and lighting off when you leave in the morning safe in the knowledge that should the temperature drop or it get dark before you get home both your heating and lighting will come on in time for you to come back to a warm and welcoming home, without having wasted energy heating empty rooms and lighting an empty house. Intelligent thermostats will know how long it takes for your home to reach and maintain a specified temperature and will switch on at the optimum time to reach it.

As these devices are connected to the cloud and to your smartphone they can also be location activated, switching off as you leave and switching on as you return home without you having to pre-program timers. The major benefit of both of these is a reduction in overall energy usage, bills and carbon emissions.

Other applications of this type of connected technology which are just around the corner include the instinct vacuum cleaner - a dog like vacuum which will patrol your home using 3D mapping, smart toilets which recognise you and can analyse and monitor your excrement shedding light on the state of your health and microbiome. Bathrooms will also become smarter with gadgets such as Water Pebbles, a water activated shower timer to save water, and thus heating and energy wastage. The bedroom will also see the introduction of smart mattresses which track sleeping patterns, breathing and heart rate. Some may also prompt couples when they haven't been intimate in a little while. ■

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Power on Connections – Self-service for ICPs is great news for customers

Finally, following years of lobbying, Ofgem has introduced legislative changes that will alter the face of competition in electricity connections forever, finally creating a truly competitive and open market that will offer customers improved service and reduced costs.

These changes have the potential to revolutionise the customer experience by allowing far more customer centric Independent Connection Providers (ICPs) to deliver an end to end connection service to customers without any reliance upon the DNO.

Self-service for ICPs

The new Competition in Connections Code of Practice was formally approved by Ofgem on 16 July 2015. The objectives of the Code of Practice can be summarised as follows:

Distribution Network Operators (DNOs) must, as far as reasonably practicable, minimise their involvement in the provision of new connections by ICPs to their customers.

Should an ICP require a service from the DNO to enable it to provide connections for its customer(s) then the DNO must provide the service on an equivalent basis as it would to its own connections business.

Finally, DNOs must work to harmonise their processes and procedures relating to competition in connections in line with industry best practice thereby allowing ICPs to freely and easily operate across DNO boundaries.

Legally enforceable

The Code of Practice becomes legally enforceable through the new Electricity Distribution Standard License Condition 52 that came into force on 30th October 2015. The license mandates that the DNO must adhere to their Code of Practice which shall be published and maintained through regular review. In addition to the Incentive on Customer Engagement (ICE) that came into place at the beginning of the latest Electricity Distribution Price Control (ED1), the Code of Practice is a further incentive on DNOs to take a more positive and proactive approach towards competition in connections.

When Ofgem completed their review of the electricity connections market in 2014, they concluded that the most appropriate way to further develop the market was to remove the DNO from the critical path of their competitors that are offering connection services to their own customers. As a result, the Code of Practice has a strong focus on DNOs empowering their competitors to undertake previously non-contestable activities themselves much like the gas connections market which has successfully operated for the last 10 to 15 years.

Ofgem set out these minimum requirements which have now been incorporated into the Code of Practice. This means that ICPs in future will be able to liaise directly with their perspective customers to obtain all of the necessary information to:

- undertake the study of the distribution

network to determine the most appropriate point of connection;

- complete the design for the network extension and any required reinforcement; and
- carry out all of the works including the final connection and network reinforcement.

Further changes are currently being made to the Code of Practice to make the processes for self-determination of point of connections to, and design approval of DNO adoptable networks more definitive. These will come into force this summer and are built upon the outcome of stakeholder consultation by the DNOs.

“Finally, DNOs must work to harmonise their processes and procedures relating to competition in connections in line with industry best practice thereby allowing ICPs to freely and easily operate across DNO boundaries.”

Power On, like many ICPs has built its business on a commitment to, and proven track record of delivering first class customer service in the provision of connections. Unlike DNOs, who need to focus on their wider statutory obligations to ensure they can keep the lights on, the sole focus of the ICP is to deliver connections in a timely and cost effective manner.

The challenge that now lies ahead is bringing all of this into business as usual. DNOs must give ICPs the same level of



access to their network information as their own equivalent connections business or service providers.

For many DNOs this will require changes to their IT systems and processes. Many DNOs are still running pilot or proof of concept schemes to ensure the seamless transition to this new way of working.

Power on has, in many instances been the first ICP, alongside its BUUK sister company GTC to carry out these self service activities. We have also assisted DNOs to understand the requirements of the detailed processes for Self Determination of POCs, Self-Approval of Designs and Self Connection including the associated operational activities.

It is recognised that not all ICPs will be able to move at the same pace so it

also important that where the ICP does require a service from the DNO that the service level provided by the DNO is to the same standard that is offered to its own business.

Power On has built its business on a commitment to, and proven track record of delivering first class customer service in the provision of connections.

Next Steps...

In addition to the change proposal currently going through the governance process of the Code of Practice which are expected to receive backing from Ofgem, it is anticipated that future change proposals may look to mandate that DNOs provide IDNO customers with emergency response services and the ability to trade unmetered supply inventories under the DNOs MPAN.

Such changes will help support the development of IDNO networks; which in itself promotes competition in connections as many ICPs construct assets for adoption by IDNOs.

Proposed changes will be tested against the objectives of the Code of Practice. Where a proposed change is shown to have the potential to better meet the objectives of the Code, a working group will be established by the Code governance panel to take the proposal forward. The working group will be tasked with creating a Change Report for presentation to Ofgem for their decision on where or not to direct the DNOs to update the Code of Practice with the proposed changes.

Each change report will need to show that relevant stakeholders have been consulted on the developed change proposal and that the changes will improve the Code of Practice's alignment to the Code objectives.

POWER ON
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Is there a place for electric heating in the UK?

Paul Bennett, registered professional energy consultant with the Energy Institute and Executive Chairman of BSSEC, looks at the technologies available for electric heating and the building regulations you should be aware of...

As a technology, electric heating has been with us since the invention of electricity in the late 1800's with the first available electric heaters being used in the 1900's. Electric heating has developed greatly over the last 115 or so years, from electric resistive heaters that have been used in panel heaters, night storage heaters, radiant heaters to warm air heaters and more complex heat pumps.

At the same time, the way electricity is generated has changed dramatically from coal-powered electricity generating stations, to gas and nuclear and now onto greener hydro, wave, solar and wind-powered methods.

Electric heating is a controversial choice to heat a building. On the one hand, it is seen as the most carbon intensive method to provide heat for thermal comfort and the most expensive to run. When compared against gas heating, electric heating causes carbon dioxide emissions that are approximately 2.7 times higher, and energy running costs are approximately three times higher. However, owing to cleaner and greener methods to generate electricity, electric heating can have zero-rated carbon emissions. Green electricity can also benefit from government subsidies.

Technology has moved on tremendously, and electric driven heat pumps can dramatically reduce the carbon dioxide emissions and energy costs further owing to their high efficiency – termed as Coefficient of Performance (CoP). The CoP rating is the multiplier of input energy to the heat output. A CoP of 2 would mean that, for every unit of electrical energy input, twice as much heat output can be achieved. The seasonal CoP rating for an air source heat pump in a heating mode is typically 2.5. However, if the heat pump takes its heat from a more stable source than

the air, for example the ground, then the efficiencies improve to around a seasonal CoP of 4.

What do the building regulations say about electric heating?

Part L2 of the Building Regulations requires that the actual Buildings Emissions Rate (BER) is determined using software and is compared against a building regulation compliant Target Emissions Rate (TER). In order to pass, the BER must be lower than the TER. The TER is based upon a notional building specification that typically includes standard thermal resistivity 'U values' for elemental constructions (e.g. roof, wall, floor, and windows) and a building air permeability standard that restricts air leakage from buildings. In terms of systems, it assumes a heating efficiency (gas heating and hot water) of 91%. Heating is only one of all the building services that consume energy and systems such as lighting, ventilation and cooling collectively make up the TER. So it is important to understand that the heating system is only a part of the overall TER.

The choice of heating impacts the whole BER and can therefore affect the choice of other building services. This is the concept of the trade-off. For example, a highly efficient heating system can enable the provision of a lower efficient ventilation system to achieve compliance. Most designers would prefer to opt for the highest efficiency choices – where the budget can afford the best systems.

The Building Regulations are technology neutral and do not require that any specific heating system be provided. However, these regulations do recognise that low and zero carbon options exist and can help. These include co-generation (using Combined Heat and Power (CHP) techniques), district heating (from a centralised heat network that feeds many buildings,



typically from biomass or CHP), energy from renewable sources (including solar, geothermal water, biomass, biogases) and heat pumps.

As far as the Building Regulations are concerned, the best choice for a compliant electric heating system, is whether it is going to be a form of heat pump and whether it being air/water/ground source. There are also options for using heat pumps to recover waste heat.

Taking technology and legislation into account, in my personal opinion, electric heating using heat pumps that are fed from green energy is the ideal heating solution. It can be zero carbon and very efficient (with seasonal CoP's at 4), meaning that running costs can be cheaper than gas. They can also attract Renewable Heat Incentives making the business case quite attractive.

Looking to the future and thinking about how we heat our buildings in the UK, my own prediction is that, as battery technology continues to improve at a dramatic rate, we will see some very clever takes on the simple storage heater design that are linked to heat pump designs. Watch this space!

Paul Bennett is a Chartered Engineer, Chartered Director and Executive Chairman of BSSEC. He is an approved ESOS Lead Assessor and accredited with the Energy Institute on its Register of Professional Energy Consultants. ■

For more information from the Energy Institute, please visit their website at www.energyinst.org and follow them on Twitter [@EnergyInstitute](https://twitter.com/EnergyInstitute)

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Biometrics gaining identity

As the influence of biometrics continues, Christopher Brown, Programme Manager for Governance & Resilience at BSI, explores its growing role in modern society...

Biometrics can be defined as the identification of an individual based on biological (such as fingerprint, iris and facial) and behavioural (such as voice, gestures and gait) characteristics.

Such information can be recorded by an electronic device or system as a means of distinguishing and confirming an individual's identity.

Having an increasingly significant impact on a wide range of applications, biometrics is spreading its tentacles globally into many facets of everyday life. As such, the UK needs to continue to invest in the development of biometrics standards to ensure that our current pre-eminent position in using biometric data is not eroded.

BSI committee IST/44 is responsible for developing British standards in this area and also providing input

to international standards via its work with ISO IEC JTC1 SC37, which has dedicated expert working groups covering such diverse topics as 'Harmonised biometrics vocabulary', 'Biometric data interchange formats', 'Testing & reporting', and 'Cross-jurisdictional and societal aspects of biometrics'. The use of a wide range of standards can therefore assist government in the creation and maintenance of effective national regulation.

Over the next 5 to 10 years there are a number of key areas likely to impose the biggest challenges to systems that are becoming increasingly dependent on biometric technologies. A familiar and universal trend is that of mobile biometrics. When the iPhone 5s was launched in 2013, its in-built biometric sensor represented the largest deployment of biometric devices ever, with reportedly over 9 million units sold on the first weekend alone. As Dr Peter Waggett, Chairman of IST/44 and Director, Emerging Technology for IBM UK

Ltd exclaimed: "This sensor has done much to make the general public familiar and comfortable with the use of biometric technology. Since that launch more manufacturers have shipped devices with different biometric technologies and it is becoming the de-facto security mechanism for mobile technologies."

The sensor system was not only used to unlock the phone but also to access and authorise transactions on iTunes. It is likely that this technology will continue to progress as the interfaces to such devices are enhanced and more accurate biometric techniques (e.g. iris recognition) are developed for mobile use. "The systems in use are becoming increasingly sophisticated and this trend will continue", adds Dr Waggett. "The uses for the technology are increasing. The interface has been opened up for general application and this wide-scale use has gained great public acceptance. New applications being developed should ensure that they take advantage of this technology."

Another area primed for growth is that of Presentation Attacks. The increasing use of biometrics has led to sophisticated approaches to attempt to fool their successful operation. As Dr Waggett points out: "If we take face recognition technologies as an example, early systems could be fooled by simple photographs being presented to them."

"The 'flat' nature of these photographs was used to detect and counter this technique and this led to more sophisticated masks being used. This required more sophisticated counter techniques that used skin texture measures to ensure that they were not being attacked."

"Currently state of the art masks made from pig skin can fool most systems and these are likely to require liveness detection to ensure operation. Future measures will be required to counter increasingly sophisticated counter measures."

The issue of privacy and particularly of enhancing biometric technologies in this area will always be under the spotlight. According to Dr Waggett, "public concern about the storage of biometric data can be reduced or eliminated by the use of techniques to ensure that their biometric data cannot be stolen or misused. One example of this is cancellable biometrics."

In this instance a fingerprint is intentionally distorted in a repeatable manner and this new print is used. If, for some reason, an old fingerprint is stolen or lost, a new print can be issued by simply changing the parameters of the distortion process. This also results in enhanced privacy for the user since the true fingerprint is never used anywhere.

There are several other trends indicating that biometrics will have a significant impact on a range of applications affecting the general public. Examples include:

- Incorporating biometric technologies in debit/credit cards used for withdrawals at ATMs and making purchases. These could be extended for remote payment over the internet;
- Biometric algorithms are becoming more capable, making it possible to identify individuals using data sets that would have been considered as non-biometric data in the past (e.g. real-time analysis of signatures as they are written);
- Voice recognition biometrics which are now gaining favour in banking and financial institutions to provide additional security.

As with any fast moving technology, there will always be concern that the development, implementation and use of biometric systems are appropriate and respect the rights of citizens and consumers.

The challenge ahead is to ensure that this rapid pace is met with a marriage of robust solutions and practicality. ■

To see the current IST/44 scope and work programme, visit <http://standardsdevelopment.bsigroup.com/Home/Committee/50087978> or to purchase standards in this sector, visit <http://shop.bsigroup.com>

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Civil Service on the road

The municipality of Egedal in Denmark has put wheels on their civil service, with the municipality now issuing passports to citizens from a minibus

The geographically extensive municipality of Egedal now offers their civil service in a new way. With the Citizen Bus, the civil service is brought to the public.

The Citizen Bus is equipped with a high-tech suitcase that can record the biometrics necessary for issuing identity papers in Denmark: passport photos, fingerprints and signatures. When citizens in the municipality of Egedal need a new passport it is handled via the municipal website. Citizens enter their data, pay the fee for the application online and book an appointment in the booking system, so they can just show up when the bus comes by and be processed without delay.

Civil service in your backyard

The municipality of Egedal is a merger of 3 municipalities. On March 1st 2015 the civil service and the library were joined. This sparked thoughts about how to make the civil service more efficient.

"After the merger, Egedal was a very large municipality with many small towns. We felt it was necessary to make an effort to accommodate those who had a long way to travel to the Civil Service office," says Birgit Hansen, Coordinator with the Civil Service in Egedal.

With a suitcase from Biometric Solutions ApS, it was possible to move the



Civil Service out into the communities, which has been a success.

"Everyone uses the Citizen Bus, both families with children and the elderly. People are delighted that we are practically in their backyard," says Birgit Hansen.

The municipality hired an interior designer to organise the bus, but the solution has been so popular that the bus is not always large enough.

"When we announced a tour with the suitcase, the list was quickly filled, and the bus was limited by its size. When we, for example, go out to the village of Slagslunde, we set up in a children's institution, and in Smørum we set up at the library. The suitcase solution makes it possible to set up our service wherever there is room."

The citizen's experience in focus

According to Alex Ramskov Johannsen, CEO of Biometric Solutions, who delivered the suitcase to the municipality of Egedal, the solution has been designed to make the civil service more efficient, but with just as much thought to the fact that citizens need to have a positive experience with the service:

"The core of the solution is not the technology itself, on the contrary, it is the process supported by the solution. The system is designed to streamline the civil service to accommodate both the need for flexibility and mobility of families with children, as well as help those who find it difficult to get around," he says.

"The municipality of Egedal is the first to install our biometrics suitcase on a bus,"



offering mobile citizen services to the entire municipality. The computer in the suitcase is connected to the municipality's servers via an encrypted VPN tunnel over the cellular network (LTE). With the suitcase the civil service staff can record biometrics and make passports, driver's licenses and ID, but they are also able to supply all other services, such as helping with relocation, tax folders or pensions."

A passport takes 3 minutes

10 minutes have been allotted for each citizen who needs a new passport, although the procedure typically only takes 3-5 minutes. This extra time allows room for unforeseen events, for example, when a child needs help taking their passport photo or a citizen turns up without an appointment.

At the same time the suitcase makes it possible to conduct the civil service

outside of the regular office hours of the municipality.

"In some places we are out at 3-5 pm, and at other times we go out on Saturdays. We try to accommodate the needs of the working people, making ourselves available in places where it makes the most sense for the citizens," says Birgit Hansen.

Satisfied citizens makes for committed staff

The suitcase is a novelty in Egedal, and so far the Citizen Bus has only recorded biometrics for passports, but the flexible civil service has been a great success in the municipality.

"The self-service solution creates flow and the suitcase makes the civil service more accessible. This provides for both satisfied citizens and happy employees.

The staff thinks it's great to get out and deal with happy citizens, it is a bit of a kick. The last time we were planning a trip, more employees than necessary wanted to come," says Birgit Hansen.

"We have no doubt that the suitcase is here to stay. All types of citizens are making use of the extra service. When we set up around the municipality, we meet people's needs and that creates a good atmosphere."

Alex Ramskov Johannsen adds: "We are pleased that the municipality of Egedal, with great creativity, is making our vision of enabling the municipalities to provide civil service where their citizens are, come true."

Try it: Order a passport in the municipality of Egedal at:
<https://selvbetjening.mitpas.dk/?key=A240>
 (NB: In Danish)

Read about the passport suitcase:
<http://biometric.dk/en/biometric-suitcase/>



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Urban terrorism

Jonathan Wood, Director of Control Risks outlines how urban areas are increasingly becoming targets for terrorist attacks...

Urban terrorism is not new, or even the 'new normal'. Previous waves of terrorist activity, such as decades-long campaigns by the Irish Republican Army (IRA) in London and Euskadi Ta Askatasuna (ETA) in Madrid, consistently targeted capital cities. The most lethal terrorist attacks in history on 11 September 2001 symbolically targeted the financial and political centres of the US. Baghdad, Cairo, Islamabad, Mumbai, Buenos Aires, Beirut, Jerusalem, Paris, Jakarta, Los Angeles, Nairobi: regrettably few major urban areas are unfamiliar with major terrorist attacks.

Terrorist groups target cities because they are centres of political power and population, (Also, leftist terrorism associated with agrarian peasant insurgencies has largely subsided outside of South Asia.) In cities, more people are directly or indirectly exposed to individual terrorist acts, and the concentration of interest ensures publicity and attention. Urban systems such as mass transit also rapidly transmit the disruptive effects of terrorism citywide. Put another way, population density and urban complexity multiply the desired physical, psychological and strategic impacts of terrorism. The attractiveness of cities to terrorists will only increase: since 2007, more people live in urban than rural areas for the first time in human history; by 2050, its estimated that 75% of the global population will be urban.

The speed of urbanisation over the last few decades, especially in emerging and developing countries, has also shaped the threat environment. Rapid, often unplanned city growth leaves glaring gaps in public service provision, including law enforcement. Concurrently, it has aggravated social divisions by thrusting disparate ethnic, religious, linguistic and economic groups into often uncomfortable proximity. Terrorist groups strive to take advantage of gaps – for



Jonathan Wood, Director of Control Risks

example, by cultivating safe havens and staging grounds in the anonymous urban sprawl – and exploit social divisions to radicalise sympathisers.

Threat environment

Urban terrorism is certainly evolving. Post-9/11 obstacles to al-Qaida's preferred strategy of symbolic 'spectacular' attacks in top tier Western cities devolved much responsibility to homegrown, lone wolf extremists by the late 2000s. Al-Qaida propagandists have long incited sympathisers to strike local, familiar targets using any available means. As a result, the terrorism threat environment became less severe, but also much less predictable: plots and attacks spread to secondary cities like Exeter (UK), Little Rock, Springfield, and Portland (all US), Toulouse and Nantes (France), and Victoria (Canada).

In Western countries, increase surveillance and strict controls on explosives also shifted tactics away from complex, large-scale vehicle bomb attacks against hard

targets towards so-called marauding terrorist firearm attacks (MTFAs) in public spaces. Both al-Qaida- and Islamic State (IS)-affiliated terrorist groups embrace the tactic: firearms are cheap and widely available, and uncertainty around the movements, size and capabilities of mobile teams of gunmen can effectively paralyse a city during an attack. Indeed, disrupting the normal life of a city – and by extension a society – by forcing an indefinite security lockdown is likely to be part of the point of such attacks.

Urban attacks are often even more effective in emerging and developing countries, where law enforcement capabilities are usually under-developed and under-resourced. Most Western and some developing country civilian law enforcement agencies responded to earlier waves of terrorism (or social unrest) by developing units specialising in intelligence collection, hostage rescue, and building assault. Similar capabilities in most emerging and developing country police forces are non-existent or very limited, forcing them to rely on slower and blunter military intervention. The September 2013 assault on Nairobi's Westgate shopping mall highlighted gaps – widespread globally – between the terrorist and security force capabilities.

Response

Cities continue to develop ways to deter, prevent and mitigate terrorist attacks. The City of London instituted its famous 'ring of steel', the US Department of Homeland Security (DHS) disbursed risk-adjusted urban security funding after 9/11, and companies worldwide incorporated building design features and security procedures intended to thwart common attack scenarios. Many of these innovations are now standard urban planning practice, especially in the construction sector, and threat mitigation is becoming more effective and less obtrusive.

Recent efforts, in both the public and private sectors, revolve around 'big data' analysis of social media and other communications activity. The unpredictability inherent in soft target attacks – and the potential lethality of firearm assaults – puts a premium on threat identification and early warning. Many major attacks since 2014 have been cases of failing to connect

intelligence dots, rather than failing to develop intelligence in the first place.

Law enforcement agencies are also working to overcome jurisdictional and organisational structures that inhibit rapid response. So called 'fusion centres', which cut across agency, jurisdictional and political boundaries, are a primary response: such structures became widespread in the US after 9/11, and are currently under development in Europe. Western countries are deeply involved in supporting such structures internationally, particularly in sub-Saharan Africa.

“The speed of urbanisation over the last few decades, especially in emerging and developing countries, has also shaped the threat environment. Rapid, often unplanned city growth leaves glaring gaps in public service provision, including law enforcement.”

Conclusion

The future is undeniably urban. This ensures that cities will also dominate the future terrorism threat environment. While cities are inherently – and impressively – resilient, even in the face of devastating attacks, they are also complex and vulnerable to disruption. The challenge for cities – meaning municipal officials, law enforcement, private organisations and urban residents – is to continue to innovate ways of enhancing response and resilience in tune with the changing terrorism threat environment. In particular, the rising threat to public, open access spaces is likely to encourage increased emphasis on automated threat identification and early warning, as well as increased investment in more robust response capability. ■

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SAFEPOST Project Pilots

Dr Antonino Scribellito, European Affairs – Senior Project Manager at PostEurop highlights how SAFEPOST has enhanced security in postal systems across Europe

SAFEPOST enhanced the security and safety of approximately 1.6 million postal employees in the EU, by mitigating the risk of explosives, radioactive materials, biological weapons, and dangerous chemical substances, among other harmful materials, causing health or life-threatening incidents with the personnel operating the postal networks. The project supports the reduction of theft and pilferage in the postal system, e.g. through more accurate mail identification and tracking capabilities, as well by introducing training and creating a strong transparent, co-operative culture.

The Postal system plays an important role in the smuggling activities of narcotics, including cocaine and heroin, with societal costs (health care, legal etc.) in billions of Euros in the EU. SAFEPOST supports the identification (and seizures) of mail containing narcotics materials, thus reducing the societal cost in the EU.

SAFEPOST has made significant contribution in the following areas:

1. Improved the EU's awareness and coordination of activities within and between EU Member States in the field of postal security and developments in supply chain security.
2. Linked EU projects from (DG MOVE, DG TAXUD, DG ENTR) and national efforts, to exploit synergies and created a coordinated approach to security throughout the entire supply chain.
3. Encouraged all European postal providers and related authorities to assume responsibility in securing their own processes within a European wide cooperative distributed model.
4. Created transparency on the way postal security measures are enforced, and provided benchmarks.
5. Established a Europe wide forum to discuss and agree a Postal Security Target Operating Model (PostEurop Framework), which will provide the basis for potential improvements in the existing standards.

The quality, efficiency and reliability of postal services are a pan-European challenge. If equipment, procedures or competencies in a European post office differ from one Member State to another, there will be a high risk that organised crime and terrorists will take advantage of the weaker checkpoints, jeopardising the efforts of other Member States and of the European Union as a whole. Because of this, SAFEPOST is coordinated by PostEurop with the ultimate goal to establish solutions designed to address collectively agreed priority areas and have been adopted by all. SAFEPOST promoted new operational concepts through increased integration between systems and organisations, it is clear that this cannot be achieved without international cooperation.

The SAFEPOST integrated Project gathered all the operational critical



mass necessary to conduct such a complex project. The size of the consortium was kept to the necessary minimum, as SAFEPOST reused an extensive know how from reference projects and incorporated existing products and prototypes, focusing effort on innovative improvement, adaptation and integration and not on the full development of completely new technologies. This approach focused on producing real tangible results creating added value to the whole European postal services community.

SAFEPOST being an EU scale project answered to key European policy challenges by allowing better integration of European R&D, facilitating the transfer of skills and knowledge across Member States.

SAFEPOST Project Work Package 6 (WP6) - SAFEPOST Pilot (Demonstration) is a crucial part of the project and is well on its way. WP6 is aimed at organising full scale demonstrators of SAFEPOST, based solutions in order to



First demonstration in Iceland

evaluate the feasibility and the benefits of the SAFEPOST approach. This helped in acquiring postal operations related data, handling it, exchanging it, sharing it and in screening and optimising the distribution chain.

One of the SAFEPOST Project partners TelluSecure (TLS) has developed a prototype system, D-tube, for scanning controlled substances. The prototype system is able to detect packets and bags containing explosives or narcotics in real time and is suitable for integration into the sorting facility conveyor belt flow.

The D-tube prototype detection system uses a multi element detector for the generation of the chemical profiles. The system operates in near real time with high precision and specificity by examining vapour substances. The system also takes into account the varying background vapours ubiquitously present in the air. Following a positive match to one or more targeted profiles, a number of possible actions are triggered: as an example, by interaction with the IT system in the packet sorting facility suspicious packets could be automatically diverted to a separate destination and information sent to the appropriate authorities.

One of the most important events in relation to the SAFEPOST Project is the live demonstration meetings applied on the field in the Postal Operators Sorting centers. The demonstrators have been designed to validate the SAFEPOST solutions under realistic conditions, to ascertain feasibility and

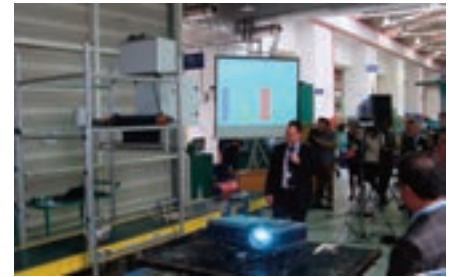


Second demonstration in Spain

benefits of the solutions and to provide feedback to enable improvements.

The first live demonstration took place in Reykjavik, Iceland, on 20th May 2015 to thoroughly analyse the process of postal items flow through D-Tube and find any room for improvements.

The second demonstration was held in Correos sorting center on 11th June 2015 in Zaragoza, Spain with a high level of participation. In total 70 participants, from European Commission DG Home Affairs, DG TAXUD, PostEurop members, external supply chain stakeholder, Customs Authorities and SAFEPOST Project Consortium partners. The live demonstration of the SAFEPOST Project illustrated the improvements made since the first demonstration in Iceland. The meeting at Correos provided a showcase for the 'e-Nose', the Image Recognition software, the risk assessment module (PSS) and the CPSS Dashboard. The primary objectives were to demonstrate how these solutions could enhance the operators capability, for effective & effortless risk assessment, including a new range of detection options which are cost-effective, and do not slow down the existing parcels throughput in the operators sorting centres. Furthermore, through the provided CPSS Dashboard, the operators are able to consolidate in a single user interface, a view of all their common as well as security related data, and draw conclusions both on a parcel level as well as on a set of parcels examined for a specific period of time.



Third demonstration in Greece

The third live demonstration meeting took place in Athens, Greece, again with high-level participation of PostEurop Members, Customs Authorities, Law Enforcement Agencies, UPU and several stakeholders – in total 90 participants.

The demonstration meetings at Iceland Post, Correos and Hellenic Post showed that the SAFEPOST technology can be applied directly in postal production lines and processes that are currently separate but can be brought together with the Common Postal Security Space. The purpose of the SAFEPOST demonstration was to provide an operational environment to showcase and test the SAFEPOST security solutions in order to evaluate the feasibility and the benefits of the project's approach in acquiring mail related data, handling it, exchanging it and sharing it.



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Smart cities: the implications for the private sector

Nicolas Reys, Cyber Security Services Consultant at Control Risks
looks at the risks of cyber-attacks on smart cities...

Faced with rapid urbanisation, city planners are turning to technology to solve a wide range of problems. Smart cities are the outcome of the deepening integration between technology and the urban landscape.

Smart cities are set to fundamentally change how many of us experience the world. In practice, this transformation will arise from the combination of 3 technologies: inexpensive logic controllers, millions of sensors connected to devices dispersed across a city, and networks that connect everything together. But, although smart cities enable the more efficient provision of complex urban services, increased connectivity carries with it potentially severe cyber security risks. City planners would do well to start thinking about them.

How smart is smart?

The potential benefits of smart cities are numerous. For instance, a city's electricity infrastructure can be significantly improved with 'smart meters' which provide real-time data, via an internet connection, to consumers, suppliers, and authorities. This would allow better management of the power supply by tailoring it to demand, thereby reducing the costs and outages which blight many traditional, and analogue cities. These benefits are replicable across almost all domains of urban life. Cities such as Amsterdam, Barcelona, Santa Cruz and Stockholm have all started to incorporate elements of a "smart grid" – or a network of interconnected sensors within the city – across energy provision, transport systems and telecommunications infrastructure.

New city, new risk

Smart cities are dependent on machine-to-machine (M2M) interactions. This is partly a result of the sheer

speed with which associated calculations need to be completed. In the case of a smart energy grid, it would be impossible for a human operator to process all the data necessary to make decisions at the speed required. However, while M2M decision-making (M2MD) is an unavoidable feature of smart cities, it is also one of their greatest vulnerabilities.

“Smart cities provide cyber activists with a big surface on which to be a nuisance – or worse. Hackers might simply deface a city’s billboards, but at the extreme end they can attempt to destroy cities’ physical infrastructure.”

The risk of a cascading error is especially acute. A cascading error is a small mistake which spreads through a system and becomes a systemic risk. For instance, if a minor bug caused a smart electricity reader to transmit inaccurate data readings to its control centre, this could lead to an automated (and mistaken), assessment that a company's premises required increased power. This would necessitate rerouting energy to the building which would raise costs for the affected company and would reduce the energy pool available for everyone else. On a bigger scale, the consequences of such cascading errors could prove disastrous.

Smart cities and cyber threats

Smart cities also provide cyber threat actors with a large – and tempting – attack surface. Cybercriminals, hacktivists, and even sovereign states can all exploit smart cities for nefarious ends.

Cybercriminals

Smart cities are a boon to criminals capable of deploying self-propagating malware. 'Worms' injected

into the digital fabric of a city might be used to acquire healthcare information, social security numbers and banking credentials. Were attackers able to successfully hijack these systems they could then be used for powerful distributed denial of service (DDoS) attacks or to hold an entire city for ransom in extortion attacks.

Cyber activists

Smart cities provide cyber activists with a big surface on which to be a nuisance – or worse. Hackers might simply deface a city's billboards, but at the extreme end they can attempt to destroy cities' physical infrastructure.

“Smart cities are set to fundamentally change how many of us experience the world. In practice, this transformation will arise from the combination of 3 technologies: inexpensive logic controllers, millions of sensors connected to devices dispersed across a city, and networks that connect everything together.”

The potential destructiveness of a cyber-attack on smart cities is such that even its mere threat is likely to be viewed by governments and businesses as existentially significant. When capricious and uncontrollable cyber activists have the power to cause widespread material damage, the security of smart cities becomes essential to their survival.

Nation states

As well as criminals and activists, state actors can also pose a threat to smart cities. For instance, belligerent states can interfere with the traffic management system of foreign cities, with the possibility of causing substantial damage. Similar scenarios are conceivable for the interruption of energy supplies or water networks.

Securing the implementation of smart cities for the private sector

Smart cities offer clear benefits, but they are also burdened by risk. Businesses and city planners can take a number of precautions to ensure a smoother implementation process and, ultimately, more secure infrastructure.



Nicolas Reys,
Cyber Security Services
Consultant

Prioritise the security of critical assets: Contemporary networks are already impossible to protect in their entirety, a problem which applies equally to smart cities. Some components of the system will have to be made more secure than others. Public and private sector organisations will need to work together to identify cities' critical assets and oversee the institution of appropriate security measures.

Behaviour based security: Auditing millions of separate devices for signs of malware simply isn't feasible. A superior approach would be to evaluate the behaviour of smart city components and systems against an established baseline of normal functionality. Any deviation from the norm above a pre-determined threshold would trigger an investigation into the possible presence of malware on the subcomponents.

Rapid component replacement: Given the potential for component failure or attacks compromising these components, an automated replacement system will enhance the security of the whole system. Although difficult to apply to critical components without full redundancy, such measures would be suitable for low-level, relatively isolated components. ■

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Digitalising Europe

Adjacent Government highlights plans from EU Commissioner for the Digital Economy, Günther H. Oettinger to make the EU a digital force to be reckoned with...

The European Commission's Digital Agenda is one of their top priorities to develop a more digital friendly Europe. In order to develop their Digital Single Market, the Commission aims to help Europe overcome barriers with regards to infrastructure, broadband accessibility, copyright and data protection. They will do this by enhancing the use of online services and digital technologies.

In February the Commission published results of the 2016 edition of the Digital Economy and Society Index (DESI), which shows which member states have made progress in areas such as connectivity and digital skills. The results revealed that the pace or progress is slowing down and action is still needed at both EU and national levels.

The DESI revealed that Denmark, the Netherlands, Sweden and Finland continue to lead the rankings. The EU as a whole attains a score of 0.52 out of 1, which is an improvement from 0.5 last year. It revealed that all EU countries bar Sweden had improved their score.

Leading the digital revolution is Commissioner for the Digital Economy and Society, [Günther H. Oettinger](#). Speaking about the results in February, he said: "The EU makes progress, but too slowly. There is no room for complacency. Action is needed if we want to catch up with Japan, the USA and South Korea. Based on today's Index, we will come forward in May with concrete recommendations for EU Member States to improve their national performance."



“With this, combined with our work to create a Digital Single Market, I am sure that the EU as a whole and its Member States will do much better in the coming years.”

One area in particular that Oettinger is keen to push is new 5G technologies. The Commission hails the next generation technologies of 5G and Oettinger sees the adoption of this as “the most important goal” of his mandate.

Speaking at the [Mobile World Congress](#) in Barcelona earlier this year, Oettinger expressed his support, labelling 5G as the “essential network infrastructure for the digital transformation of our economy and society”.

He said in his speech: “My vision for 5G which I presented at the MWC in 2015 is not only about more speed and more bandwidth for mobile but about building the communication platform that will power the digital revolution.

“This means that public service, utilities, manufacturing, healthcare and farming will all be using 5G networks to deliver new, smart products and services based on next generation connectivity.

“The 5G public-private-partnership we announced at the MWC back in 2013 has brought together telecom sector and experts from other industries to discuss how 5G technology can match the expectations of many industrial sectors.

“However, it is not enough simply to develop technology: 4G technology was made in Europe but first deployed in Asia and the United States. Telecom operators will not invest in new networks in Europe if it does not make economic sense.

“The Digital Single Market which we are building will ensure that 5G technology will benefit industry and customers in Europe, mainly because it will provide a large scale. Support for investment in Europe for 5G networks needs to start now.

“We need to take a close look at the necessary framework conditions and incentives that can lead to the deployment of the underlying network infrastructures. And we need to make sure that there will be industrial players who are ready to invest in 5G services.

“This discussion must not only include EU telecom operators and equipment manufacturers but also representatives from key industries. We are starting already with the area of connected cars.

“However, our 5G action plan for Europe needs eventually to cover all sectors if we are to secure our leadership in 5G technologies, deploy new networks in time and most importantly contribute to the digitalisation of European industry and society.

“The race is on: we have 4 years to make it happen. With everybody on board I am confident that we will be successful.” ■

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Accessing 5G mobile networks

The University of Kent is leading research focussed on the radio access network of future mobile communications

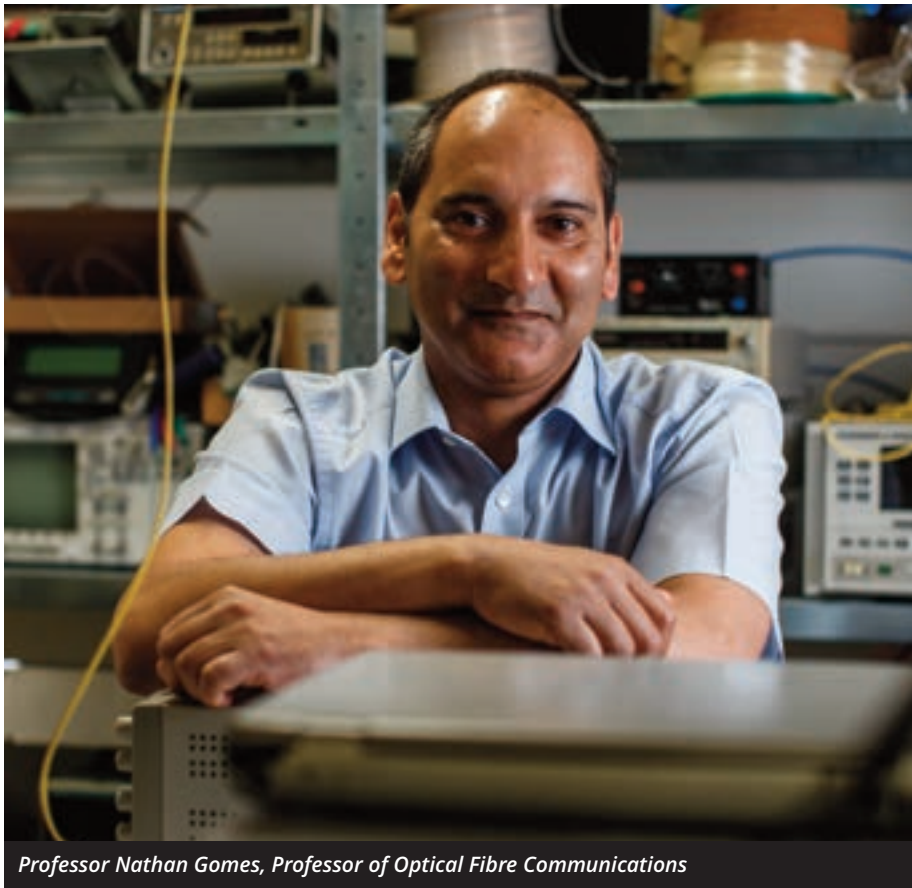
The next, 5th generation of mobile communication networks is expected to support ultra-high-bit-rate services, such as for high-definition video, low-latency, for gaming, self-driving vehicles, tele-surgery, etc., and the vast interconnection of devices which will be the internet of everything. Substantial changes will be needed in the way mobile networks operate to support these diverse demands, with the technology advances being made in current research around the globe, including that funded by the European Union's Horizon 2020 (H2020) programme, vital for success.

While many developments have been occurring for the high-speed core of the networks, for data centres and for increased "softwarisation" to enhance the organisation and optimisation of networks, it is in the radio access, which must connect the many, and often bandwidth-hungry users, that revolutionary changes may be needed. It may seem odd that a Professor of Optical Fibre Communications, such as Nathan Gomes at the University of Kent should be leading projects contributing to such advances, but fibre optics has a key role to play in future radio access networks. "5G will need numerous radio access nodes, closer to the user to provide high bandwidths – only fibre optics can bring the necessary bandwidth to these nodes, for many of the services envisaged", says Professor Gomes.



In projects such as iCIRRUS (funded by the EU's H2020 programme) and NIRVANA (funded by the UK's Engineering and Physical Sciences Research Council), the integration of the optical fibre distribution within the radio access network is being investigated. The fibre distribution and the radio access are seen and designed as a whole. The projects use the concept of a virtualised radio access network (or vRAN), where the communication functions that need to be carried out can be distributed as required in different physical entities, dependent on current demands and in a manner that optimises user experience and overall network performance. In iCIRRUS and NIRVANA, an Ethernet-based fibre optic distribution network (a "fronthaul") is used to interconnect these flexible physical entities, Ethernet offering a high potential for shared infrastructures and low cost.

The vRAN is a new concept going beyond the centralised, cloud-RAN, which has quite recently been of significant interest to mobile operators. Whereas the cloud-RAN envisages centralised operation, the vRAN permits functions to be performed where necessary. This can bring benefits to device-to-device (D2D) communications, where users are allocated network resources to communicate directly, unburdening the rest of the network. Placing some control locally in a vRAN could enhance the setup processes necessary. Also, users who are between radio access points can beneficially send/receive signals to both (it could be more than 2) while those close to a radio access point do not need to. This affects where the signals for such users should be processed – a flexibility enabled with a vRAN. In iCIRRUS, an 11 partner project, a University of Kent D2D team collaborates with industry



Professor Nathan Gomes, Professor of Optical Fibre Communications

partners such as InterDigital in the UK and Primetel, Cyprus, while an Ethernet fronthaul team collaborates with partners such as ADVA Optical Networking, Germany and Orange, France.

Over the last couple of years, standardisation work has started for using Ethernet in the RAN fronthaul. However, up to now, it has not taken into account the vRAN and its flexible allocation of functions to physical entities. "Among EU projects, iCIRRUS is unique in its proposal and detailed investigation of the use of Ethernet within the new vRAN", says Professor Gomes. "The iCIRRUS partners have a particular opportunity to contribute to new, flourishing international research and standardisation efforts. It is a project like no other I have been involved in, with rapid developments to keep track of from industry and academia across the globe. Conversely, it also means that there is a great deal of international interest in what we

are doing; iCIRRUS partners are disseminating the progress being made in the project in meetings of many international standards bodies and industry groups, as well as at major conferences".

What are the next steps? They mainly focus on validation of the key concepts. In fact, there are considerable challenges in making an Ethernet fronthaul work, as the packetisation and variable buffering delays that typically occur in these networks could be catastrophic within the vRAN. After laboratory experiments, for example, at University of Kent, Faunhofer-HHI (Berlin), and ADVA (Munich) it is intended to use the operators in the consortium, such as Orange and Telekom Slovenije, to validate the technology in their test networks. Watch this space, as some of the validation setups should be opened for a public viewing at the end of the project (late next year).

Fronthaul information

Fronthaul is used to describe the links between base stations and radio units in a mobile network (as opposed to backhaul which connects the base stations to the core network). Currently, fronthaul technology is mainly based on an industry specification called CPRI, which transports digital samples of radio waveforms, and leads to bit-rates orders of magnitude higher than the user data bit-rates. Projects such as iCIRRUS and NIRVANA propose transporting different digital signals with reduced bit-rate requirements. Other projects, such as the EU-Japan project RAPID propose analogue signal transport to reduce bandwidth requirements. For more information, visit the project websites.



<http://www.icirrus-5gnet.eu>



<http://www.intelligent-nirvana.net>



<http://www.rapid-5g.eu>



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PETRAS – Cybersecurity of the Internet of Things

Jeremy Watson, Professor of Engineering Systems at UCL and Emil Lupu from Imperial College London outline how the new PETRAS research hub aims to fill knowledge gaps and promote safe and secure use of the Internet of Things...

The PETRAS Hub, with £9.8m funding recently awarded by the Engineering and Physical Science Research Council (EPSRC), brings together 9 leading UK universities and around 50 user partners representing both the private and public sectors. User support extends the funding by a further £13m, to nearly £23m.

Strategic review of IoT

Following a strategic review chaired by the Government Chief Scientific Advisor in 2014, a report, 'The Internet of Things: making the most of the Second Digital Revolution', was published. This emphasised the economic importance of the IoT, which would only be released by maximising its cybersecurity while not inhibiting vibrant technical and business development. Recommendations included research and skills development, smart procurement by government and the creation of standards to ensure a safe and effective IoT ecosystem.

A response by government including EPSRC and Innovate UK, created the £40m IoTUK initiative, which is being delivered through funding from DCMS. This also includes a city demonstrator (won by Manchester with their CityVerve initiative), Healthcare projects with NHS England, an Innovation Accelerator and the PETRAS Hub. The Digital and Cities Catapults are playing a key role in connecting outcomes from IoTUK with the greater community.

Principles of the PETRAS Hub

PETRAS stands for Privacy, Ethics, Trust, Reliability, Acceptability and Security – these are vital in ensuring the successful adoption of the Internet of Things (IoT). These 6 themes form the central focus of PETRAS, which gives emphasis in equal measure, to the physical and social science aspects of the adoption of new technology. The Hub partners comprise a core cross-disciplinary

team of UCL, Imperial College, Oxford, Lancaster and Warwick, augmented by 4 specialist contributors at Surrey, Southampton, Cardiff and Edinburgh. Each of the academic partners links to several of our large cohort of user partners, which range across sectors from banking, through healthcare to mobile telecommunications.

“PETRAS stands for Privacy, Ethics, Trust, Reliability, Acceptability and Security – these are vital in ensuring the successful adoption of the Internet of Things (IoT). These 6 themes form the central focus of PETRAS, which gives emphasis in equal measure, to the physical and social science aspects of the adoption of new technology.”

In order to best represent and investigate the opportunities and challenges of the wide span of IoT applications, we have created a project structure which feeds into the generic themes of interest; privacy & trust, safety & security, harnessing economic value, standards, governance & public policy, and adoption & acceptability. A number of projects will provide evidence under these headings; these we have grouped by type or sector into 'Constellations'. Around 20 initial projects cover the constellation themes. The programme has been designed so that further internal calls for projects can be shaped to fill the research gaps identified with user partners and then consolidate the research outcomes into concrete demonstrators. PETRAS aspires to become the go-to place for research in cyber security of the IoT in the UK by creating an inclusive technical and social platform for innovation that will continue beyond the end of the funded period.

Constellation project examples

Transport & Mobility projects will include smart street planning, pricing and road maintenance, and security



and privacy solutions for communicating autonomous and semi-autonomous cars and infrastructures. The *Health & Care* constellation will include modelling and analysis for body sensor networks, security mechanisms for miniaturised low power chips, and an investigation of the factors of user trust in medical applications of IoT. *Design & Behaviour* explores the role design plays in influencing the adoption of IoT. In particular, how design and engineering can actively encourage or discourage behaviours, so that privacy and trust are enhanced and adoption is promoted. Projects under the *Infrastructure* heading look, from a policy angle, at approaches in various countries and across borders to manage IoT threats and increased attack surfaces. These projects include tools to analyse threats in many contexts. *Identification* constellation projects deal with the trustworthiness of identification systems and evaluating identification technologies, protocols, and procedures alongside privacy strategies, to identify robust solutions that deliver a balance between identifiability and privacy of IoT technology. *Supply & Control Systems* projects cover secure IoT-augmented control systems for industry and buildings, and exploring the economic value of IoT data in cyber-physical supply

chains. The *Ambient Environments* constellation investigates the impact of security on adaptability within cross-layered network wide protocols for low powered IoT devices. A combination of 'In the Wild' experiments on the Olympic Park and focus groups will explore the boundaries of privacy, trust and personalisation. ■

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UK to benefit from big data and IoT

Mark Wilkinson, Regional Vice President – Northern Europe and Russia/CIS at SAS Software UK outlines the value of the Internet of Things and big data for the UK economy...

The value of big data equity in the UK was estimated at £12bn a year or 0.7% of the annual Gross Domestic Product (GDP) in 2012. Four years flew by and the second report by the [Centre for Economics and Business Research \(Cebr\)](#) has put the opportunity at £46bn by 2020, or 2.2% of GDP – nearly 4 times the original value.

That's just big data analytics adoption. We've now put a value on what adoption of the Internet of Things (IoT) could deliver to the UK economy in 2020 – a further £16bn, so £62bn in total.

Big data and IoT together are expected to generate £322bn in revenue for the UK economy from 2015 to 2020. To put this in perspective, it's twice the size of the combined education, NHS and defence budgets for 2014-15, and more than one-fifth (22%) of the UK's net public debt (circa. £1.5 trillion in 2014-15).

This extra revenue to UK plc should be taken seriously when you consider how the UK government – as evidenced by The Chancellor's recent Budget – is having to tighten spending, amid predictions of an economic slowdown.

Manufacturing bucks the trend

Big data and the IoT are expected to bring [much needed relief](#) to the manufacturing sector. Big data is expected to inject a healthy sum of £57bn, along with £27bn of IoT value by 2020.

This is largely driven by the diversity of firms in the industry and variety of areas in which efficiency gains can be achieved. Benefits are multifold. Over time, the industry should expect improvements in areas such as supply chain management and enhancements in customer intelligence.

For example, one of our customers provides cranes to ports and industries. By looking at sensor data from the cranes, it's possible to detect in advance when they need repairs or maintenance carried out. This maximises the time they're in service, reduces repair costs and optimises spare part availability.

Other key industry sectors set to benefit most are telecoms and retail.

Customer intelligence sparks telecoms adoption

The telecoms industry will experience the highest current rate of big data analytics and IoT adoption at 67% and 61% respectively. However, by 2020, retail banking is expected to leapfrog telecoms and become leaders in big data analytics adoption at 81%, while the telecoms sector remains ahead in IoT adoption at 81%.

There are plenty of other interesting findings and industry sector comparisons to be found in the report. What's for certain over the coming years, is that more organisations from multiple industries will embrace data and IoT to improve decision-making that affects efficiency, risk management and new business opportunities.

So the real question is what's holding some businesses back from doing this now?

Barriers to adoption

The skills gap is something we're all aware of – we need more data scientists and people in the workplace now (as well as future graduates), with skills in handling and analysing data to meet the current demand.

Technology has helped in that the latest data visualisation solutions, for example, can be used by people



who aren't necessarily experts in statistics or data science. The outputs are easy to understand and solutions that have a predictive analytics capability built-in do much more than simply historical reporting. Cloud-based as-a-service offerings also allow organisations to effectively hire in the analytical expertise where they don't have this in-house.

But a major barrier can be creating a valid business case. This may require the leadership and/or culture within an organisation to become more data driven. But often it can be how do we justify the investment, and how will new technology be integrated into what we have already?

A way forward

Well, organisations can easily build a business case. It may be a very specific business problem that they know they can resolve with data – that might be something that we could help them with [using SAS Results](#). This is analytics-as-a-service where we provide a solution and expertise to answer that particular problem. If it's a more complex, big data issue, then a business can

experiment with its data to see what the potential ROI is, using our [Big Data Innovation Lab](#).

SAS solutions are also scalable and can be integrated with existing technology from other vendors, so there's no need to always 'rip and replace'. We have many customers whose analytics platform is a combination of SAS and other technologies.

As our report on ['The value of big data and the Internet of Things to the UK economy'](#) clearly shows, many organisations will be adopting solutions to exploit big data and IoT over the next few years – but the ones that don't risk being left behind by the competition. ■

.....
Mark Wilkinson

**Regional Vice President –
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Shedding light on government shadow IT

Joel Dolisy, SVP and CTO/CIO of SolarWinds gives an overview of Shadow IT, and how it can make a difference within government IT departments...

Everyone wants the shiniest new mobile or tablet on the market, so it's no surprise that employees are continuing to bring personal devices into the workplace. Although these devices may arguably increase productivity and connectivity, this influx of technology into people's lives makes them think they know best, even when unauthorised devices or software can create major challenges and wreak havoc for the IT team.

'Shadow IT' is the term referring to the IT systems, solutions and services used by employees in an organisation without the approval or knowledge of the IT department. According to a [SolarWinds survey](#), Shadow IT was ranked second among the areas that IT departments have least control over, and this threat

will continue to grow as 58% of survey respondents expect an increase in its use over the next 2 years.

With the popularity of mobile technology and devices so pervasive that everybody believes they need to be able to use them anytime and anywhere, the IT department is often kept in the dark about these technologies, losing control of the cyber environment is expected.

Understanding the tech know-it-all

As employees seem willing to compromise their security by using their own devices, government IT professionals need to identify the reasons behind the use of other devices to allow IT to address them and keep the network safe and secure.

With the need to feel empowered to have access to the latest gadgets, to be connected at all times and feel ahead of the tech-curve, employees often believe that they know better than their IT counterparts on what they need to do their job. Furthermore, security has always taken a backseat to convenience, as employees enjoy being able to use their own devices without considering the potential cyber security risks.

By gaining a better understanding of the end user, government IT pros can better identify the triggers to unsecure mobile device use and develop safe practices while ensuring their employees' technological needs are being met.

Active management

In order to better secure government IT environments, a focus on an active management of endpoint security is required. Rather than burying their heads in the sand, IT professionals need to use network management software to identify unauthorised apps before they start causing problems.

An overview of what devices are connected to the network, what they are accessing and to whom they belong is crucially important. While micromanaging everybody on the network is not necessary or realistic, proactive IT monitoring can enable employees to continue to explore new mobile technologies while still maintaining security.

Awareness and network management

In addition to proactive monitoring, IT pros can tackle shadow IT by educating employees about potential dangers to the business, as well as vigilantly managing and monitoring access to the network.

Awareness campaigns are excellent tools to educate employees about their mobile technologies and potential threats to cyber security. The IT department should encourage best practice in terms of making it necessary for devices to be regularly patched to use the latest versions of protocols. This will help IT professionals to ensure that systems aren't vulnerable to unauthorised and insecure devices.

Network management ensures protocols are up to date. Government IT pros must be aware of the importance of having strong policies in place for controlling access to their networks. These policies help IT professionals track who uses the network, how they access the network and what devices they use. In fact, [research](#) showed that organisations who use management and monitoring software are significantly more confident than those who do not, in terms of their ability to protect against the negative consequences of shadow IT.

Sharing best practice

Each level of government has its own perspective on cybersecurity and threats. However, the ability to safeguard networks and infrastructure exponentially increases when different levels combine resources, improving the overall response efforts with more manpower and better technology.

By keeping tabs on business cycles, strong partners can be identified to make for better problem solving. Organisations can keep up-to-date on cyber risks and mobile technology by learning best practices from third party organisations and identifying common vulnerabilities.

Shed light in the shadows

Government IT pros must actively manage and monitor behaviours and best practices in order to move towards access of newer technology and devices which, in the end, will make the employees happy. The best way to tackle Shadow IT is to shed some light onto the issue by embracing new technology within a secure and satisfied organisation. ■

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SVP and CTO/CIO

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Tackling the challenges of cyber-attacks – a local authority perspective

Cath Birch, Chief Information Officer at Buckinghamshire County Council outlines why they take cyber security very seriously...

No one can deny that digital technology is having a huge impact on the way we live our lives. From video calls to online shopping, almost every aspect is being transformed.

At Buckinghamshire County Council (BCC) we are also embracing new trends like bring your own device to work (BYOD), remote and mobile working policies and cloud computing applications.

However, as cyber-attacks become more sophisticated and widespread one of the main challenges we face today is how best to ensure security in an interconnected world where employees' ability to communicate anywhere and at any time via multiple devices can put them at greater risk of a cyber-attack.

As a local authority delivering a number of statutory services – our biggest risk due to slipping security standards, would mean personal and/or sensitive data being leaked or falling into the wrong hands.

For us, it's all about having assurance that what we have in place is fit for purpose.

Every year we complete the Public Service Network (PSN) Compliance Assessment and have N3 accreditation.

The PSN is a network which allows organisations, authorities, and agencies that deliver public services, whether national, regional, or local to share information.

To provide PSN services, we must meet agreed standards of security, technical performance, service management and governance.

N3 is a very large network, with 1.3 million NHS users. The accreditation allows us to access and share data securely with colleagues in health and social services including GP practices and hospitals.

In addition, we were offered free 'cyber assessments' by central government which helped us to identify and

address areas where we were potentially susceptible to risks.

Furthermore we have recently achieved ISO 20000 accreditation. ISO 20000 is the international standard for IT Service Management (ITSM) and is published by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

It allows us to not only continually improve our delivery of IT services for the authority but also demonstrate excellence and prove best practice in IT service management.

Our next step is to look at cyber essentials – a scheme which covers the basics of cyber security in an organisation's enterprise or corporate IT system.

For an organisation such as Buckinghamshire County Council with vast information systems that are susceptible to a wide range of security threats, the cyber essentials controls scheme will be a beneficial component.

Implementation of these controls will significantly reduce the risk of prevalent but unskilled cyber-attacks.

From a technical perspective we are a member of the South East Government's Warning, Advice and Reporting Points (SEGWARP) and the Cyber-Security Information Sharing Partnership (CiSP) to share knowledge and best practice.

If we can tackle problems, such as malware threats, before they happen it means we can learn as we go and benefit from a greater level of protection.

Our e-mail system is filtered through MS Exchange Online Protection (EOP) which helps to eliminate threats before they reach staff email inboxes, and has real time anti-spam and anti-malware protection. All emails passed clean are then subject to virus protection at the desktop.

However, in recent months there has been an increase in sophisticated scam and malware attacks attempting to get information and/or plant potentially dangerous viruses into BCC computer systems.

We are now looking to implement Microsoft's Exchange Online Advanced threat protection (EOATP). This will allow us to protect our email system against new attacks in real time by pre-screening any emails containing links or attachments in a secure environment before they are let through.

To raise awareness amongst staff, who can potentially be our biggest threat to cyber security, we continuously run internal campaigns so they are clear on the 'do's and don'ts'. We hope training staff, especially new joiners, will mean greater protection across the system.

We have recently updated our IT policy security protocols – a set of guidelines for managing, operating and using the council's information systems.

We ensure these policies are always available on our intranet system so staff, contractors and third parties can familiarise with them and understand their obligations.

We are now looking to enhance this system further with the introduction of software to record if staff, have 'accepted' individual policies to support our compliance and assurance agenda.

As the majority of BCC staff live in the County, the best way we feel to get messages to residents is by encouraging them to share any advice we give about staying safe online with their friends and family.

For example, when ransomware (a type of malware) was doing the rounds we advised people not to click on any suspicious emails or links attached to them, and offered guidance on the different ways scammers try to plant malware or extract sensitive information such as passwords. ■

.....
Cath Birch

Chief Information Officer

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Protecting data from the insider threat

Esther George, Director of Cyber Crime and Prevention at 8MAN highlights how organisations such as local authorities are discovering data breaches every day and what can be done to prevent them...

Data protection has become one of the biggest challenges for organisations of every size and in every sector in recent years, as demonstrated by the now familiar headlines of household names being hit by huge data breaches.

While all sectors are at risk however, the public sector has unfortunately established a poor track record in the field, especially at a local government level. Research from Big Brother Watch found that more than 4,000 data breaches occurred in local councils in just 3 years – equalling almost 4 breaches every day.

While most people tend to think of anonymous hackers as the cause, a surprisingly large number of these incidents are caused by staff within the organisation itself. Often these cases are accidents that could easily have been prevented, such as emailing sensitive data to the wrong recipient.

Less common, but much more damaging are malicious incidents where employees have purposefully stolen or misused confidential data, usually with the intent of selling it on the black market.

Cybercrime and the law

These incidents can be extremely damaging, with single employees often able to steal records of tens or even hundreds of thousands of people at a time, including sensitive data such as financial and medical information.

Despite this however, such insider thefts tend to be taken lightly by the legal system. One recent case, which saw an administrative assistant at Enterprise Rent-A-Cat steal 28,000 customer records, resulted in a fine of just £1,000, with just under £1,000 more in other costs. The case prompted the Information Commissioner, Christopher Graham, to call for greater

sentencing powers for insider cyber thieves to end the disconnection between their actions and the punishments they receive.

At present, most cases if handed to the Police and Crown Prosecution Service (CPS), can be dealt with under Section One of the Computer Misuse Act 1990, which deals with unauthorised access to a computer and can result in a fine and imprisonment of up to 6 months. The ICO prosecutes under the Data Protection Act, so they are limited to fines alone.

However, we should be looking to prosecute offenders under Section 55 of the Data Protection Act. Currently this means that only fines can be imposed, but the Secretary of State has the power to alter the penalty for an offence of unlawful obtaining data which will give judges greater sentencing powers, including longer imprisonment. This hasn't happened yet and therefore lighter penalties are still given. It is no surprise that cyber-crime continues to rise with low fines acting as the only deterrent.

More importantly though is the need for much greater education within organisations as to how to handle these incidents, who they inform and what they should do to prevent them in the first place. For many organisations they presume that if data is lost that they should go to the ICO, who then run their own investigation and prosecute. This means that the police and CPS are not even aware or able to impose tougher sanctions. Education must also take place into what policies and procedures are needed to prevent these incidents, when they should go to the police versus the ICO and what information needs to be provided to build a solid case for prosecution under the Data Protection Act. Only with tougher penalties will we deter cyber criminals.



Safeguarding data

While stronger sentencing powers should help to deter thieves, organisations should of course be doing everything they can to protect their data directly. Many internal data breaches can be prevented by simple policies and technology implementation to prevent users accessing restricted files.

Even large organisations tend to give users admin access by default because the native Windows Active Directory System, which governs access rights, makes assigning access rights for each new user into a slow chore. This also makes it difficult to gain an oversight of the existing access rights that each employee has.

As a result, many organisations have little idea about what information their staff can access, and rarely rescind access once granted, even when someone has left. The issue is greatly increased when large numbers of staff join at once, either full time as the result of a project or merger, or as temps.

Locking down access

Unfortunately, insider thieves are often taking advantage of data they have legitimate access to. Without the right measures in place, staff abusing their employer's trust in this way can easily get clean away with their crime. With the right technology in place however, organisations can effectively set an alarm for their most important data. This will alert them whenever it is accessed if needs be, or when the user is attempting something strange such as access it out of office hours or from a remote location. ■

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Esther George

Director of Cyber Crime and Prevention

8MAN

www.8man.com

The General Data Protection Regulation

FEDMA interviews Olivier Proust from Fieldfisher regarding the General Data Protection Regulation and its importance...

FEDMA, the Federation of European Direct and Interactive Marketing, wishes to dedicate this editorial to the implementation of the General Data Protection Regulation (GDPR). Indeed, organisations, Data Protection Authorities, the European Data Protection Supervisor and all other stakeholders are now impatient to start implementing this Regulation. In this context of anticipation, we decided to interview Olivier Proust, Of Counsel, Privacy and Information at Fieldfisher, to help us all “keep calm and carry on”.

What would you recommend organisations do immediately with regards to processing data?

Before the GDPR comes into force (most likely in 2018), organisations should do 2 things: build a case to their senior management and assess their compliance with the GDPR.

Organisations need to build a case to their C-level management (if they haven't done so already) to explain the legal changes under the GDPR and how these will affect them. Raising awareness is an important first step to ensure the management understands the challenges ahead, supports the overall strategy for compliance and provides the necessary human and financial resources to its teams to start putting in place a privacy compliance program.

Following that, organisations need to start assessing their level of compliance to the GDPR. The simplest way to do that is by carrying out a gap analysis that helps them to understand the standards and requirements of the GDPR, the organisation's current level of compliance, whether there are gaps in their compliance, and the actions to be taken in order to remedy these gaps. Once they have carried out this gap analysis, it then becomes easier to develop a privacy project plan setting out specific actions and priorities.

What would you recommend data-driven marketing organisations to focus on?

Companies in the field of direct marketing, data analytics and the Internet of Things, should focus on 2 key requirements: consent and data profiling.

The broader definition of consent under the GDPR can have a real impact for marketing companies because the ePrivacy Directive mandates consent requirements, both for direct marketing and for the use of cookies or other tracking technologies. Furthermore, where consent is relied upon as a legal basis for processing personal data, the GDPR imposes the burden of proof on companies to demonstrate that they have obtained valid consent, in particular that consent was obtained by means of a “clear and affirmative action” of the individual. In light of these changes, companies may need to bolster their existing e-marketing and cookies consent notices. They also need to check their internal consent mechanisms so as to keep track of any given or withdrawn consents by individuals (in particular, to expunge an individual's personal data from the system where that individual has withdrawn consent). Finally, when providing information society services to minors below the age of 16, companies must ensure they obtain consent from a parent or legal guardian.

Second, the GDPR will also have an important impact on companies who carry out profiling activities given the broad definition of ‘profiling’ and the fact that it falls within the scope of “automated decision making”. As a result, those companies will need to assess whether their profiling activities are based solely on an automated form of processing that enables them to make decisions that either produce a legal effect or significantly affect individuals. Where that is the case, they must demonstrate that such automated decision-making is authorised by a law, or is necessary for the



performance of a contract with the individual, or is based on the individual's explicit consent.

It is important to note that the GDPR will apply to organisations that are established outside the European Union, but nonetheless are monitoring the behavior of individuals within the EU. Therefore, even though a company has no presence in Europe, it may still be subject to the GDPR, for example, if it does online behavioural analysis of individuals in Europe.

What further legislative proposals will impact data-driven organisations?

The EU Commission has proposed an array of reforms that are aimed at bolstering existing privacy and data security laws, enhancing consumer rights and protecting online privacy. A key development will be the announced reform of the ePrivacy Directive. It remains to be seen how the EU Commission wants to amend the ePrivacy Directive and what will be the impact of this reform on the marketing sector. One thing is for sure: privacy is very much a key priority for the current Commission and many new laws that regulate privacy at a general and a sectoral level are likely to be adopted in the years to come.

Should organisations communicate with their consumers about these new rules?

Absolutely, they must. Individuals have a right to fair processing and the GDPR imposes on data controllers an obligation to provide detailed information to their data subjects regarding the types of data they collect and the purposes for which they process such data.

Organisations must provide notice in a concise, transparent, intelligible and easily accessible form, using clear and plain language. Companies will need to be creative and to adapt their privacy notices to the type of audience (particularly if they are targeting minors) and the medium that is being used.

Beyond what is required by law, what matters also is that companies should build a relationship with their consumers based on trust. Communicating about privacy goes beyond providing a legal notice to individuals. It's also ensuring that consumers understand and feel comfortable with the way an organisation is using their data. Such level of trust may be obtained, for example, by communicating often and via open channels of communication, by explaining clearly to consumers what the uses of their data are, and providing consumers with accessible means to contact an organisation when they have a query or a complaint.



Olivier Proust is a French-qualified lawyer specialised in privacy, data protection and cybersecurity law and a member of Fieldfisher's Privacy, Security & Information group. Olivier can be contacted on – olivier.proust@fieldfisher.com ■

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The Federation of European Direct and Interactive Marketing (FEDMA)
www.fedma.org

X-RAY VISION

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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun Svizra

Niederländische Eidgenossenschaft
Administration fédérale des douanes AFD
Amministrazione Federale delle Dogane AFD



Automated Comparison of X-ray Images for cargo Scanning (ACXIS)

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 this project are to implement a manufacturer independent

reference database for X-ray images of illegal and legal cargo, to develop procedures and algorithms in order to uniform X-ray images of different cargo scanners, to develop a training simulator for inspection officers and a toolbox enclosing several assisted/automated identification techniques for potentially illegal cargo. Historic images of real detections, images of illegal cargo mock-ups as well as images of legitimate cargo will be integrated into the reference database.



To read the digital ebook

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Developing a “mechanism-based taxonomy” of Alzheimer’s and Parkinson’s Disease.

Currently, the established disease classification systems such as ICD (international classification of disease) make use of phenotypes measured clinically or using standard laboratory and imaging techniques to establish major types and subtypes of diseases.

In contrast to the established disease classification systems, a “mechanism-based taxonomy” is based upon the knowledge about the biological pathways involved in the aetiology of a disease to guide the classification of disease classes and subclasses.

A specific challenge we face in the course of the AETIONOMY project lies in the fact that for most neurodegenerative diseases the dysfunctional biological pathways underlying the disease are not well understood.

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ResilienceDirect:

A common information platform
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Emergency responders need to be ready to deal with crises and disruptive events – ranging from natural disasters to deliberate attacks. Now the emergency response community in the UK have access to a new, fully accredited and secure information-sharing platform called ResilienceDirect™, underpinned by OS location data provided under the Public Sector Mapping Agreement (PSMA).