



*Hazards forum*



# The Hazards Forum Newsletter

Issue No. 95  
Summer 2017

# Hazards Forum Newsletter

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### Contents

- 2 Notes of Hazards Forum AGM 2017
- 4 The Hazards Forum Executive Committee
- 4 Advancing technology - the good, the bad and the need to manage the hazards
- 15 HSE eNews
- 16 Calendar of Events

*Edited by Dr Neil Carhart*

*Views expressed are those of the authors, not necessarily of the Hazards Forum*

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Hazards Forum Chair: *Dr Luise Vassie*

*June 2017*

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# Notes of Hazards Forum AGM 2017

Brian Neale and Tim Fuller

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The Hazards Forum Annual General Meeting was held on Tuesday 28<sup>th</sup> of March 2017 at the Institution of Civil Engineers, One Great George Street, Westminster, London, SW1P 3AA. The meeting began at 16:30 and was chaired by the Hazards Forum Chairman, Rear Admiral (retd.) Paul Thomas CB FREng.

The Chairman welcomed all those in attendance and reported the apologies for absence received from those who could not attend. He stated that this would be his last AGM to chair.

The notes from the previous Annual General Meeting were available as published in Newsletter 91 (Summer 2016) and were accepted as an accurate record.

He reported that from matters arising, there had been a suggestion that consideration be given to producing shorter summaries of the events than those currently in the newsletter. Consideration was being given to adopting the more detailed reports into formal proceedings. There would be greater use of social media to put out relevant messages from the shorter reports to get timely reaction. R/Adm Thomas turned the meeting to the Annual Report of the Trustees 2016. A copy of the report was made available to those in attendance. The Chairman sought and received acceptance for the Annual Report from the AGM, noting that it had been previously approved by the Hazards Forum Executive Committee. The report will be submitted to the Charities Commission with the year's Annual Return in the Summer.

R/Adm Thomas reported that 2016 had been a bit of a curate's egg. On the positive side there have been four excellent events but there was disappointment at the attendance level commensurate with the content.

- 1) Developing resilient infrastructure - the role of collaboration and interdependency (22<sup>nd</sup> March 2016)
- 2) Procedural compliance: what works and why? (14<sup>th</sup> June 2016)
- 3) The Nuclear Legacy: Progress with Hazard Reduction at Chernobyl & Fukushima and Regulation of the Legacy in the UK (20<sup>th</sup> September 2016)
- 4) Design Safety - the inherently safer way (7<sup>th</sup> December 2016)

R/Adm Thomas thanked all those involved, in particular the Champions and the speakers, for contributing to these events.

Turning to the financial accounts, the Chairman reported that it was another year where the Forum had failed to break-even. Like many charities the sustainability of support has been an issue, but thanks to the hard work of the Executive Committee the Forum is still supported by the engineering institutions and acknowledged by them to be of value. He posed the question what was the Forum doing to ensure that the books were balanced for 2017.

In the context of delivering the charitable objectives, there was a need to address or balance stakeholder value and fiscal security, to ensure the Forum was efficient and effective. In support of this, the

Executive Committee were engaging with key stakeholders to better understand the needs and wants, developing a portfolio of activities based on three strategic themes (Emerging Technologies, Natural Hazards, Socio/economic/political Developments) and to consider ways to distribute the excellent content other than just through newsletter (as referred to earlier).

Another objective would be to increase Executive Committee's activity in focusing on member retention and growth to determine fiscal security.

The Chairman also thanked the Trustees and other members of the Executive Committee, for their support and work in organising the regular events. On behalf of the Hazards Forum he went on to thank the independent accounts examiner, Alexander Bierrum; Accounting Technician, Janet Homer (in her absence); Forum Administrator, Tim Fuller; Editor of the Hazards Forum Newsletter, Neil Carhart, and Brian Neale, the Executive Secretary of the Forum for all his efforts throughout the year in keeping the Hazards Forum running effectively. He explained that Brian had decided to retire after ten years in the role and had tendered his resignation, which would take effect from end of April 2017. On behalf of the Forum, R/Adm Thomas thanked Brian for his dedication in providing a professional service and his ambassadorial role in promoting the Forum and wished him all the best for the future.

R/Adm Thomas also noted that, due to pressure of work, Neil Carhart, would be unable to continue his excellent work as the Newsletter editor- which the Forum appreciated. He would continue only to complete the "Summer 2017" Newsletter. There would now be a need to find a new editor. Ideas were welcomed.

The Chairman turned to Executive Committee matters as from this AGM where four Trustee positions were available, together with a vacancy for the position of Chair. There were four candidates for the Trustees positions, one from each the four main PEI members. They were: Bill Hewlett (ICE), John Wintle (IMechE), John Munnings-Tomes (ICChemE) and Steven Osborn (IET), Brief CVs were made available. There were no objections and the Trustees were ratified. The Chairman thanked the outgoing Trustees for their support and commitment to the Forum: Dave Fergie, Brian Wimpenny and John Armstrong. However, the latter would re-join the committee in a different role (see below).

The Chairman reported that there had been one nomination for the role of Chair and asked for ratification of Luise Vassie in that position, which was agreed.

The Chairman welcomed one new co-opted members to the committee, Thanos Manos. Additionally, as there were no further vacancies for co-opted members, Nick Shaw and John Armstrong were invited onto the committee as Observers without portfolio. [Full details of the new Executive Committee can be seen on the Hf website.]

At the conclusion of the meeting and with no further business raised, Luise Vassie took the opportunity to thank, on behalf of the Forum, the retiring Chairman, Paul Thomas, for his leadership for the last seven years in steering the Forum forward. She hoped that he would keep in touch as with the other retiring trustees. She stated that she was looking forward to the challenges the ExCom had set in motion. She thanked those present and informed them that the next Annual General Meeting was planned to be held at the Institution of Civil Engineers on Tuesday 21st March 2018.

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## The Hazards Forum Executive Committee

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The Hazards Forum Executive Committee is responsible for the management, finances, policies and overall direction of operation of the Forum. Following the 2017 Annual General Meeting, the members of the current Executive Committee are:

- Chair: **Dr Luise Vassie** *FInstP CFIOSH*
- Eur Ing Bill Hewlett** *CEng FICE FIET*
- Prof John Wintle** *CEng FIMechE FweldI FInstP*
- Mr John Munnings-Tomes** *Ceng FIChemE*
- Mr Steven Osborn** *CPhys CEng CFIOSH CRadP MInstP*
- Dr Owen Keyes-Evans** *MFPHM MFOM FRSA*
- Mr Andrew Buchan** *CChem MRSC FSarS MIFirE*
- Mr John Steed** *CEng FIET CMIOSH*
- Dr Thanos Moros** *CEng FIMechE*
- Lord Julian Hunt** *FRS HonFICE FIMA FRMetSoc (Royal Society Observer)*
- Prof Andrew Curran** *FSB FCMI Hon FFOM (HSE Observer)*
- Prof Stephen Garwood** *FREng CEng FWIdI FIMechE FIMMM (RAEng Observer)*
- Mr John Armstong** *CEng FIMechE (Observer)*
- Mr Nick Shaw** *CMgr FCMI (Observer)*

More information about the structure and mission of the Hazards Forum can be found on the Forum's website: [www.hazardsforum.org.uk](http://www.hazardsforum.org.uk)

The website also contains a great deal of useful information on the benefits of becoming a member of the Hazards Forum along with details on how to become a member, interesting articles, a calendar of events and previous issues of the Hazards Forum Newsletter.

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## ***Advancing technology - the good, the bad and the need to manage the hazards***

Neil Carhart

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On **Tuesday 28<sup>th</sup> March 2017** the Hazards Forum hosted an **evening event** at the Institution of Civil Engineers, One Great George Street, Westminster, London.

With an ever growing population, increasing urbanisation, the development of new materials, changing workplaces and rising aspirations for living standards, the natural balances of the earth are being stretched. The risks that affect humanity are changing in type and are growing in

scale, impact and longevity. Dust and pollution events, the increased magnitude and effects of floods and our vulnerability to events like 9/11 illustrate our more integrated and optimised world. Technology changes the profile of risks – in many cases improving our management of them, but in other ways introducing new and greater hazards as criticality and interconnectedness increase. In addition, our risk appetite is changing, as a result of our belief that we can manage risks more closely.

This event explored the changing risk and appetite profiles, underpinned by changing technology.

The Chair for the evening was **Prof Tim Broyd**, 152nd President of the Institution of Civil Engineers. Tim has developed his career in innovation and industrial research. He is now Director of the Institute for Digital Innovation in the Built Environment at UCL. While cognisant of the risks and challenges of a digital transformation, he is a passionate advocate that it can transform people's lives, helping engineers to deliver vastly improved services, and creating economic prosperity and improved living standards and a better quality of life for billions of people.

The opening presentation came from **Mike Webster** who presented an overview of the social and technical context. Mike is the principal of MPW R&R and works closely with corporates, regulators, insurers and the legal profession. His specialisations are structural safety and construction health and safety management. His long, global, experience in these fields gives him far-reaching oversight into the changing risk profiles in infrastructure.

**David Johnson**, Head of the Centre for Large Scale Testing and Evaluation at the Health & Safety Executive, then discussed how the UK regulator identifies emerging technologies and how it develops the scientific evidence base to regulate in a proportionate manner. He focused on a number of disruptive technologies such as composites, additive manufacturing and cobotics, exploring how these could influence the UK work and asset base.

The final speaker, **Jonathon Gascoigne** presented the highly pragmatic insurance perspective. Jon is a specialist in the insurance industry, designing, managing and delivering innovative products for the catastrophic loss assessment of natural and non-natural hazards. His firm, Willis Towers Watson, is a global advisory, broking and solutions company. His work has

increasingly focussed on regulatory aspects of model validation, own view of risk and risk communication. He presents widely on aspects of catastrophe modelling in a changing world.

**Dr Luise Vassie**, welcomed all those present to the event on behalf of the Hazards Forum, before introducing the Chair for the event, Prof Tim Broyd.

Tim extended a welcome from the Institution of Civil Engineers (ICE), the hosts for the evening. He outlined his primary theme for his year as President of the ICE: Digital Engineering. As well as being the primary theme of Tim's presidential year, it is also a topic about which he is very passionate.

A week prior to the Hazards Forum event, the ICE launched its core evidence-based policy statement for the year, the State of the Nation 2017 report. This focused on digital transformation. Tim reiterated some of the points he raised at the launch of that report.

The thread that links virtually all of Tim's work has been trying to understand and implement the appropriate use of digital technology and digital techniques. As engineers we can easily get distracted by gadgets and widgets, and we can forget what it is that we are actually here to do; that is to provide society and the economy with services that enable people to live healthy, happy and productive lives. We must engineer a digital future, but this means much more than just using existing technologies to keep doing what we are already doing faster and cheaper. We must engineer a complete transformation in the way we think about our infrastructure and professional services. Most importantly this transformation must address the issues the public care about. We must explain to them, in plain language, how we will meet their personal need and concerns. We know from recent research that the public are supportive of the need for better infrastructure, but they want to understand what it means to them, how it relates to them, and how their lives will be better.

Will they have more employment opportunities? Will they be able to visit places they have never been to before? Will their children be safer? Will they be able to afford to buy a home? These are the questions for which we must show we have answers.

Digital transformation will help us to meet these challenges. We need to shift our thinking to what people want and what our society needs to survive. The State of the Nation report does just that. It considers infrastructure from a user perspective. The recommendations are a product of evidence gathered from regional workshops, focus groups around the country, stakeholder interviews, a public opinion survey, the expertise of the ICE's knowledge panels, and the wider infrastructure, construction and technology sectors.

The report's recommendations are given in quite simple terms in areas of productivity, behaviours and resilience.

The launch was attended and spoken to warmly by Baroness Neville-Rolfe, Commercial Secretary to the Treasury, and Tony Meggs, Chief Executive of the Infrastructure and Projects Authority.

While digital transformation has the potential to offer significant benefits, there are risks involved as well. Cyber security and hacking are potential hazards. The more we rely on digital systems, the more we must do to ensure that they are secure to these threats. We have to beware the wrong data input. Increasingly we are looking at ways in which a single piece of data can be used many times. The integrity of the information becomes important as errors can propagate. There is a risk of wrong modelling techniques being used, or the right techniques being used in the wrong way. There is also the risk of the wrong user. If you don't know what type of answer to expect then you shouldn't be using a model. They are still fragile things.

Tim concluded that benefits and risks go hand in hand. If we want the former we do

have to make sure we understand and eradicate, or at least minimise, the latter.

He then introduced **Mike Webster** who gave the first presentation of the evening, titled '*A changing world of risk*'. Mike's talk looked at three areas: the changes to infrastructure risks that have been observed in recent years; the financial and reputational impacts of incorrectly managing those risks; and the characteristics of organisations that are more effective at managing risk.

The theme for the evening is *advancing technology*. One of the dictionary definitions of technology is '*the application of scientific knowledge for practical purposes, especially in industry*'. To take this a little further, technology impacts on everyday infrastructure, as well as those who create, operate and maintain it. Technology is embedded in materials, codes, practices and regulatory regimes. It covers a wide area, and as such several questions emerge that require reflection. Does technology improve the management of some risks? Does it create new or larger hazards? Does it change our risk appetite? Or does it just pass some organisations by?

Examples from the last few years illustrate many different aspects of infrastructure and technology risks. Malahide Viaduct provides such an example. It was originally constructed back in 1844, reconstructed in 1856 and a new deck installed in 1965. Unfortunately, there was a collapse in 2009 when Pier 4 was undermined by scour. Thankfully, there were no fatalities. Scour was known to be a risk since day one. A weir was built in 1846, two years after the viaduct, in order to protect the piers. Rocks were discharged regularly in order to provide rock armour. It was grouted in 1968. The risks were under control. For some reason, the maintenance regime stopped in 1996. As with all organisations there was a turnover of staff as people move on or retire. By 2002 there were no engineers left who were aware of the scour risk to the viaduct or the need for rock discharges to maintain rock armour

for the weir. An Infrastructure Asset Management System was introduced in 2005, but no historical documents were uploaded. Information Technology can give a false sense of security, but it is only ever as good as the information it contains.

A more recent example comes from Oxfangs School in Edinburgh. An external brick wall collapsed during strong winds in January 2016. It was one of 17 schools all constructed at the same time as part of a Public-Private Partnership (PPP). All of them needed to be closed for remedial works. They all had inadequate embedment of wall ties and missing head restraints. Wall ties are just twisted wire that connect the inner and outer skins of the building such that they act as one during high winds. For the ties to work, they need to be embedded at least 50mm into each brickwork skin. The way in which the structure was built meant that the cavities varied through the height of the building, and in some places there was very little embedment of ties. The head restraints that tie the wall to the steel structure at the top were also missing. These defects can have significant impact but you can't spot them from external visual inspection after construction, even when using very experienced engineers. This meant that when one failed, there was no way of knowing whether the other 16 schools constructed at the same time had the same defects. Intrusive inspection was required, ultimately revealing that they all had problems. These defects are something that can only really be sensibly spotted during construction. There were no independent site checks, so all of the defects had been missed during construction. This raises questions about whether any other buildings beyond the 17 schools, constructed in a similar fashion, might be at risk. The key lesson from this is that even tried and trusted technology needs someone to check that it has been constructed properly.

A third example of the risks associated with technology comes from the Robin Rigg wind farm. Wind farms are typically constructed by hammering a steel tubular

section known as a monopile into the seabed. A transition piece is then sat on top of it and then the tower is fixed to the transition piece. The load is transferred from the transition piece into the monopile through grout. The design was based on a the DNV OS J101 standard. Unfortunately, after construction there were signs of movement in the towers. The standard was based on historic experience of offshore structures. The standard assumed that the load on the transition piece would predominantly be axial load which would be carried by friction between the grout and the steel pieces. While this is true of many offshore structures, wind farm structures are subject to significant bending. This causes a lack of contact between the grout and the steel. As a result, the axial capacity was about 1/10<sup>th</sup> of the design load suggested by J101. The remedial works to fix this cost in the region of €26m. Codes may be a common way of communicating technology, and compliance is assumed to be good practice, but there can be errors in codes that designers may not be aware of.

With increasing scale, code design assumptions can cease to apply in temporary states. The collapses of reinforcement cages before concreting provide examples of this. In typical designs, such as office blocks, reinforcement stability is often a minor issue due to the size of the members. However, when the size of the structure is increased, the underlying assumptions can get pushed to the limit. There have been a few recent examples of reinforcement cages collapsing including: two tall lightly-reinforced water-retaining structure walls, a bridge pier and a deep ground beam. Design codes provide detailed guidance on designing for the permanent state, but not the temporary one. There may be a lack of awareness among designers that the assumptions about extending the permanent state to larger structures do not necessarily carry across to the temporary state. Technology can only be pushed so far, we need to appreciate its limits.

The final example, Mike described seems to stem largely from the London property market. Huge profits can be made by refurbishing old properties. Unfortunately, not everyone who does it is a competent builder. This can even lead to use of illegal labour or corner cutting. There is evidence of sites being run by people who can't read technical drawings or where communication is problematic. This has led to incidents where trenches were not supported, structures were not supported, and ad hoc demolition. In one example, a live gas flue was cut, and in another an explosion resulted when the underground tanks in an old petrol station under conversion were being decommissioned. Sometimes, even the most basic technology can pass people by.

The financial, custodial and reputational risks of getting it wrong are becoming more of an issue. In February 2016 new Sentencing Guidelines were released. The aim of these is to make sentences '*sufficiently substantial to have a real economic impact which will bring home to both management and shareholders the need to comply with health and safety legislation*'. Fines are based on culpability, harm and turnover. This has had quite an impact. Nineteen companies received fines of £1m or more in 2016, compared to three in 2015 and none in 2014. These include a £5m fine for Merlin for the crash on the Smiler ride and £4m for Network Rail for a fatality. There is also a trend towards the individual prosecution of site managers as well as the companies they work for. The threshold for custodial sentences is relatively low in these new guidelines. Only courts in England and Wales are bound by them. Scottish Courts have to pay regard to the guidelines, but sentencing there should also conform with domestic precedent. The largest fine last year in Northern Ireland was £5,000, a considerably smaller amount than the fines in England and Wales reported above. Enforcement notices also vary among the regions. In Scotland, it is possible to challenge them more effectively, taking into account all of the available evidence; while in England and Wales only the facts known to the

Inspector at the time of the decision can be considered – this difference is due to be addressed in the Supreme Court.

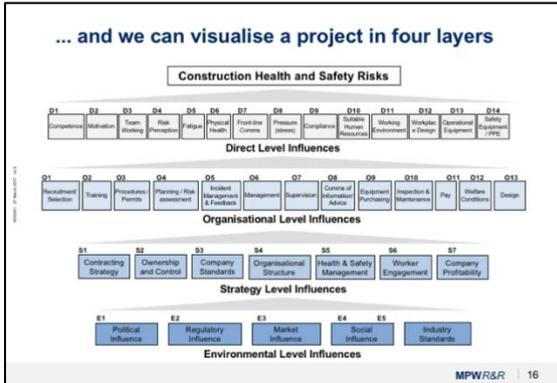
The financial and reputational risks of getting things wrong are growing. The Smiler ride at Alton Towers in June 2015 resulted in injury to 16 people, some very seriously. As a result the ride was closed for 9 months; the park itself was temporarily closed, as were rides at other parks. There was a substantial reduction in visitors to Alton Towers. Merlin expected their profits to be £40-50 million lower than the year prior to the accident; this resulted in a profit warning and fall in the share price. This is all on top of the £5 million fine for safety breaches. Technology allows powerful news images to spread very fast with reputations damaged soon after.

Mike then turned to look at organisational risks, and the differences between those that manage risk well and those that don't. His hypothesis was that those who managed risk well would be better able to cope with the 'changing world of risk'. He outlined five characteristics he has noticed exhibited by organisations that manage risk well:

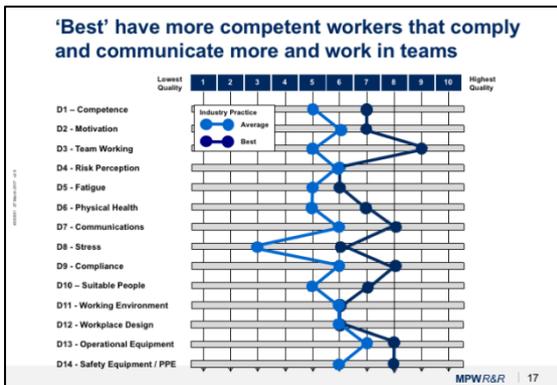
1. Integrated approach to risk management;
2. Culture of challenge to all significant decisions;
3. Planning starts early and is on-going;
4. Ideas and lessons learned are shared internally and externally;
5. Leaders set the priorities and reinforce them regularly.

Mike showed how the differences between 'best practice' and 'industry average' organisations could be measured. He described some quantitative techniques that had been used to look at practice in a range of construction industry organisations, and also in the construction of the London Olympic venues (which was considered to represent 'best practice'). The model upon which this is based takes a hierarchical approach. It looks beyond the individual on the front line, to also consider the operational context and direct influences such as equipment and

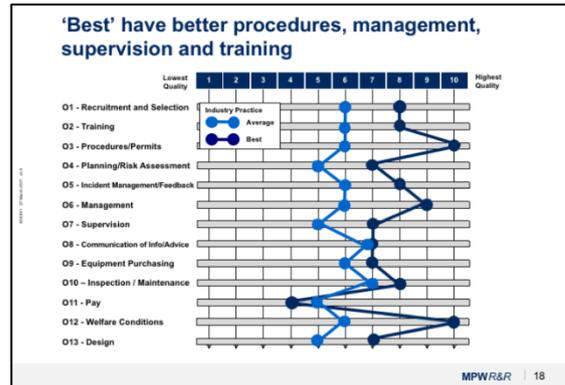
competencies. It also looks at the Organisational Level influences upon these such as site management, procedures and training. These are in turn influenced by Strategy Level factors (such as the organisational structure and company standards) and ultimately the overall Environmental Level influences such as politics, regulation and the markets.



Workshops were used to go through all of the factors, rating them on a scale of 1 to 10, where 1 is worst and 10 is best. At the level of direct influences, the construction industry average was worse than that exhibited at the Olympics on almost all factors.



At the Organisational Level this difference becomes even more pronounced, with best practice exhibiting better procedures, management, supervision and training.



At the Strategic Level better contracting, ownership and control, health and safety management and worker consultation was observed in the best practice of the Olympic delivery compared to the construction industry average.



This approach provides a way for organisations to audit themselves against the industry average and best practice. It allows for areas of weakness to be identified.

Mike concluded by looking at the characteristics observed among those organisations that do not manage risk well:

1. An institutional culture that puts more weight on positive information;
2. Culture focused on priorities to the detriment of key risks;
3. Inadequate communications within and between teams, departments and organisations;
4. Management systems that are deficient or not followed properly;
5. Assumptions that monitoring, performance management and corrective action are someone else's responsibility;

- 6. Inadequate training and supervision;
- 7. Tolerance of poor standards and risk.

**David Johnson** then presented on '*Enabling New Technologies – A Scientific Evidence-Base for Effective Regulation*'. He began by looking at the Health and Safety Executives science and evidence strategy and their horizon scanning activities.

HSE regulates a diverse array of different sectors, including offshore oil and gas, offshore renewables, offshore construction, onshore renewables, onshore petrochemical facilities and agriculture. Common to all of these is the importance role science plays in being an effective and proportionate regulator. The Health and Safety Laboratory in Buxton is the HSE's dedicated research facility. There are about 450 scientists and engineers based there, working on health and safety principles.

The HSE strategy has six pillars:

- **Acting Together** – everybody has a responsibility for health and safety, it isn't isolated to a particular department or person;
- **Tackling Ill Health** – to elevate health to the same priority as safety which often grabs the headlines because of the immediate nature of its effects. The latent effects of exposure on health can be considerable but are often not equivalently reflected in the public consciousness;
- **Keeping Pace with Change** – HSE is an enabling regulator, it seeks to identify emerging risks, carry out relevant work and regulate in a proportionate way;
- **Managing Risks Well** – in order to manage things well the response to risk has to be proportionate and not unduly burdensome. This can be overlooked;
- **Sharing Our Success** – good health and safety is actually good for business. More and more people are realising this, particularly those companies that are best in class;

- **Supporting Small Employers** – it can be difficult to engage with SMEs, supporting small employers relates back to the need for proportional responses to risk that don't put unnecessary complications and burdens on them.

The HSE Science and Evidence Strategy includes the anticipation of new challenges, fieldwork and testing, communicating important messages to the wider community and collaborating with others, particularly other departments across government.

HSE has set up a number of priority research hubs to look, pan HSE, at how best to achieve the goals and strategy of the HSE. They can identify gaps and undertake work to fill them. Ultimately this is all about ensuring the HSE has the necessary knowledge, resources and evidence to underpin the UK's regulatory structure.

He then went through some of the emerging areas of interest to the HSE as highlighted in the most recent Foresight Centre report. Through the horizon scanning of the Foresight Centre challenges, risks, synergies and opportunities are identified. This allows for better preparedness. The future depends on what we do in the present.

Horizon scanning is commonly grouped into three areas: the present, the probable and the possible. This is a dynamic system. There are externalities that will move things between these groups. The HSE needs to perform this in order to invest wisely in research to enable it to keep on top of emerging issues.

The Foresight Report identifies a number of important areas of interest:

- **Everything Everywhere Connected** – the Internet of Things;
- **Work Any Time, Any Place, Any Space** – modern technologies enable people to work in almost any location 24 hours a day, 365 days a year. A lot of remote working is

anticipated in the future, presenting new issues to be managed;

- Wearable Health and Safety – one can imagine in the future a worker with a wearable device allowing for remote real-time monitoring of exposure;
- What's Real and What's Not? – Immersive Technologies. This looks at virtual reality and augmented reality. It could be used as a training aid to teach people how to do with certain situations, to allow them to practice tasks before conducting them on site or to see how people may react in various scenarios;
- Co-Worker or Cobot? – developments are leading to sophisticated robots that can work alongside humans;
- Backseat Drivers – this relates to driverless cars and automation. There are potential advantages here in terms of health and safety, but also issues with automation and cyber-security;
- Welcome to the Cognitive Era – artificial intelligence and machine learning also presents many potential advantages and risks from a health and safety perspective as machines start to learn;

Robotic in the work place is not new, but the way it is managed from a health and safety perspective at the moment is through physical barriers and segregation. The safeguard is provided by removing the humans from the machines. Going forward this appears to be changing. We are increasingly seeing cobots, where a human and robot work together in close proximity. The robot might be performing the repetitive tasks while the human performs more complex cognitive tasks. This presents some health and safety advantages. If the robot is doing the kind of repetitive tasks there could be a propensity to reduce repetitive strain injuries. On the other side of the coin there is also an increased propensity for impact and collision. Collaborative workspaces are also possible whereby traditional robotics is employed, but without the

physical barriers and segregation from the humans.

Additive manufacturing is another area of interest. It can be done with metals, ceramics, polymers and even living tissue. With the right machinery and materials it offers the scope to manufacture components anywhere. For metallic substances a powdered metal bed or feed technique is used to deposit material to form often intricate shapes. The intricacy and complexity of the components that can be manufactured is one of the strengths of the approach. Some other traditional manufacturing techniques can still offer great value though, particularly for simple components. HSE is approaching this from a multidisciplinary perspective and throughout the product lifecycle, from cradle to grave. The whole process is being mapped out, looking at everything from the delivery of the powder stock to sites, how it is stored and used, to the machines themselves, post-processing and waste removal. While additive manufacturing is a disruptive technology, a lot of the health and safety related learning has already taken place. The HSE already has a body of knowledge regarding things like powder handling and dealing with welding fumes which can be relevant to additive manufacturing. Health and safety can be an enabler as existing knowledge is applied to an otherwise new technology. The health and safety aspects then do not become a barrier to the uptake of the approach. The key is to understand whether there are any differences in the way a component manufactured through this new method behaves compared to those manufactured using traditional approaches.

The growing area of composite materials is very similar to that of additive manufacturing. The specific nature of the material is effectively created in the process of manufacturing the required product or component. This presents potential issues in terms of manufacturing defects. Composites have been used extensively in aerospace and are being increasingly used in areas under HSE jurisdiction, e.g. wind turbines and off-

shore plant. The expectation is that composite materials will be used more extensively in the future, particularly on safety critical elements. As an enabling regulator, the HSE wants to work with industry to exploit the benefits of composite materials such as strength and environmental resistance, while at the same time mitigating the negative potential. High temperature and fire performance can be an issue for some composites for example. Composites respond to impact differently to metals. Metals tend to react through plastic deformation while composites are susceptible to matrix delamination cracking and fibre breakage. That means that while metals can show the damage in the form of indentations, composite materials may not show significant surface deformation in proportion to the level of structural damage they have received. The regulator is looking at impact performance. Composites also present a propensity for the accumulation and discharge of static.

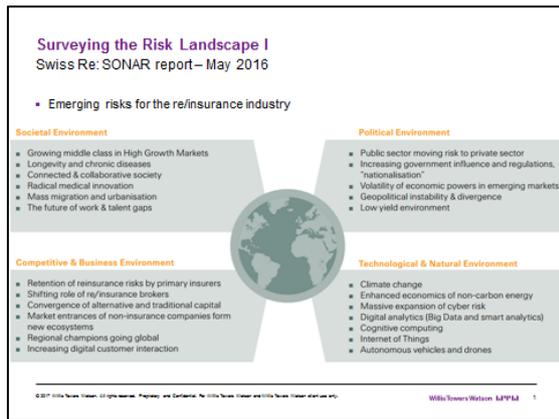
Composite repairs are being increasingly used on ageing plant. The composites are applied to mitigate effects of ageing in the form of fatigue or internal/external corrosion. Operators want to schedule all of the necessary maintenance for a periodic shut-down. These composite-based repairs allowed operators to patch up issues sufficiently to get the plant to the next periodic shut-down where it could be replaced or repaired through more traditional means. However, 50% of off-shore oil and gas facilities in the North Sea have passed their design life, with many due to cease production within five years. The appetite for replacing plant has dwindled. A dialogue has opened as to whether the composite-based repairs can be left on for longer. As it is a new technology neither the regulators nor the industry have the answers. A shared two-year research project has been set up on this topic to engage with industry. This will pool knowledge and expertise to try and get the data so that all parties can make an informed decision.

A key part of HSE's strategy is to keep pace with change. That means managing existing health and safety, while keeping cognisant of future developments. The dedicated Foresight Centre looks at emerging issues and what the regulator needs to do in order to respond effectively.

The final talk of the evening, '*Re/insurance and the New Normal: Emerging Risks and Analytics for their Management*' was delivered by **Jon Gascoigne**. Re-insurance is the insurance of insurance companies, but re-insurers also tend to work with governments. This provides a higher-level perspective from the focus on individual risks too portfolios of many thousands of risks. An example might be looking at earthquake risks in Kyrgyzstan. This requires collaborating with experts to investigate things such a peak ground acceleration fragility curves and retrofitting strategies. In a global perspective Kyrgyzstan is ranked sixth in terms of both the scale of the potential hazard and the vulnerability of society. Advanced technologies are combined with intermediate technologies to assess and manage these risks, particularly with questions relating to collating data inventories of the existing infrastructure. Checklists are developed in order to collect data reliably, robustly and cost-effectively. This is combined with modelling approaches.

The insurance industry is very proactive in developing and publishing risk landscapes. Swiss Re's SONAR report from May 2016 is an example of such a risk landscape overview. It looks at four quadrants:

- Societal Environment;
- Political Environment;
- Competitive and Business Environment;
- Technology and Natural Environment.



Technological and Natural Environment risks include the massive expansion of cyber risk, digital analytics, Big Data, smart analytics, the Internet of Things, and autonomous vehicles and drones.

The Insurance Chief Risk Officers' Forum produces a similar horizon scanning report, RADAR. The latest version from October 2016 looks at four areas:

- Environmental sector;
- Social/Political/Economic sector;
- Technological sector;
- Regulatory/Legal sector.

The technology sector includes the emerging risks associated with cyber security, energy blackouts, autonomous vehicles and blockchain. Blockchain, for example, opens up many new opportunities but also presents new potential hazards. The computation involved is said to produce so much heat that future systems may be located in cold environments.

The World Economic Forum also produces a horizon scanning report looking at Global Risks in terms of severity and likelihood. The January 2017 edition identifies extreme weather events, natural hazards and the failure of climate change mitigation and adaptation measures as the top risks. Cyber-attacks and the breakdown of critical information infrastructure also feature.

Technology is a double-edged sword; it presents new opportunities as well as risks that we do not yet fully understand. Jon highlighted a recent newspaper report

that ironically identified 'insurance underwriters' as the profession most at risk from the development of robots alternatives.

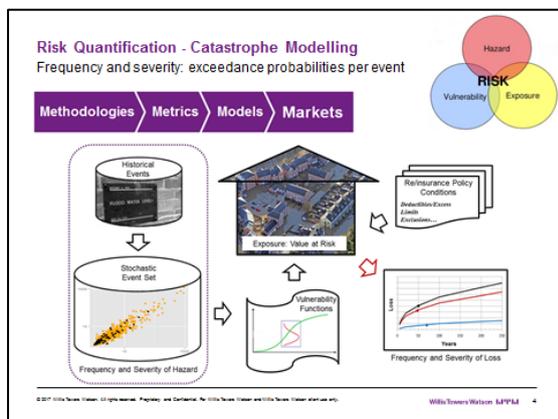
Lloyd's of London has always been a centre of emerging technologies in terms of risk assessment and management. They offered the first insurance policies against hurricanes and earthquakes. Something they unfortunately started just before the San Francisco earthquake of 1906. However, paying out every resulting claim in full was key to launching them in the American market. London is still the financial centre for insurance, with a concentration of knowledge and expertise.

At the other end of the spectrum is *Lemonade*, a landlord and property insurer based in New York. The service is offered online and uses artificial intelligence and machine learning. They look at innovative approaches to redesign insurance through a peer-to-peer model. They claim that they do not want to make an underwriting profit. Any extra money they have that is not paid out for claims is given back to policy holders. They charge a fixed 20% management fee. Their argument is that for a normal insurance company fraud makes up between 10 and 40% of costs, but by using smart behavioural psychology techniques they can get around these fraudulent claims. For example, customers make a claim by recording a video on their mobile phone. It is believed people lie less when they are looking at themselves in the mirror. They do not have the legacy systems of older insurance companies, so can design their own to collect the data they think they require. After a couple of years they will have a significant data set of users' claims which they can analyse.

Jon then moved to discuss the role between insurance and the public sector. The Sendai agreement for sustainability, the UN Sustainable Development Goals, COP21 climate change agreements and the Office for Coordination of Humanitarian Affairs all start to mention the role that insurance can play. Insurance and re-insurance is generally centred in

the industrialised regions, but there are rapidly evolving areas of risk in other centres. For example the risks associated with coastal flooding in China. There are significant Civil Engineering challenges evolving with regards to the protection of cities as large concentrations of risk. These presents question of who is going to pay and how they are going to pay. Rather than insurance being the last thing to be considered in the process of moving from the design to construction of infrastructure, it would be wise to reflect on the role it could play in the earlier stages.

Technology can enable new models that can in turn enable new risk management techniques. They can allow various portfolios to be compared in a framework of risk pricing so that we can start to handle risks that we may not have seen before. This applies geographically for the consideration of risks in emerging markets and also to aspects of natural capital that may not have been considered before.



The Insurance Development Forum brings together insurers, brokers, re-insurers, banks and other international organisations to look at aspects of societal resilience. It was launched in 2016 after COP 21. It looks to optimise and extend the use of insurance and its related risk management capabilities to build greater resilience and protection for people, communities, businesses and public institutions. One example of its work is the Africa Risk Capacity (ARC) scheme involving 20 countries across Africa. This looks at the immediate financial response

for drought, working with the World Food Programme. The insurance mechanism can pay out very rapidly to the sovereign countries than more traditional methods of humanitarian aid.

**Tim Broyd** thanked the speakers for their presentations, and invited questions from the audience. The first question related to the imbalance in incentives to regulators and policy makers with regards to innovative technologies. There is a possibility that they are more likely to prevent or hinder a new technology in case it goes wrong than allow it to happen and its benefits to emerge. A lot of the risks of new technologies are not just a question of science, but also geo-political and societal acceptance. Are we equipped to deal with either of those aspects?

David described how HSE is engaging much more widely than it has in the past to ascertain different perspectives. This helps shape their focus and enforcement decisions. From this position they can make very informed decisions to address these concerns. Jon highlighted Flood Re. There was previously an implicit agreement between the industry and government that every householder should be able to get insurance against flooding to their property. With changing flood regimes and increasing claims this position has become difficult. Investment in flood defences has collapsed, exposing people to much greater risk than before. Flood Re has been set up to deal with this situation, and as such exhibits much greater communication between the public and private sectors than was happening 10 years ago. Evidence based risk and insurance decisions can help to get through otherwise political dialogues so that everyone engages on a more level playing field. That is not to say there isn't more that could be done.

The second question raised the issue of competition, and whether the degree to which people are beginning to compete in reducing risk, in areas such as climate change, is being taken into account. Jon responded by discussing the mechanisms of risk based pricing that go some way to

reflect these dynamics. The spread of the insurance industry into emerging economies allows people to take risks that they may not have been able to otherwise. This exists at a micro-level through the spread of telecommunications up to the areas of larger infrastructures.

The third question asked how we can best deal in evidence-based risk decisions in a world where there are so-called “alternative facts” and outrage. David encouraged scientists and engineers to engage with the wider community, to understand what is tolerable, but also to communicate that there will always be errors and differences of opinion. The important thing is to learn when things do go wrong to try and prevent reoccurrence.

The final question asked whether the panel felt that traditional professionalism

based on experience and learning is being replaced by machines that lack a moral basis. Mike reflected on the speed with which modern technologies could provide us with answers to questions and uncertainties, but that these did not come with a guarantee of accuracy. The ability to recognise the right answer from the wrong answer requires a skilled and competent individual. This judgement requires the morals or experience of humans. The intelligent human intervention will never go away.

Concluding the event, **Luise Vassie** thanked the ICE for sponsoring before inviting those in attendance to continue their discussions over refreshments.

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## HSE eNews

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### **++ DWP Announces Appointment to HSE Board ++**

The Secretary of State for the Department for Work and Pensions has confirmed Martin Esom as a Non-Executive Director to the Board of the Health and Safety Executive (HSE). He will take up his appointment in July 2017.

<https://www.gov.uk/government/news/non-executive-director-appointment-to-the-health-and-safety-executive>

### **++ Construction company fined £750,000 after asbestos failings ++**

Barroerock Construction Limited has been fined after repeated asbestos failings. Canterbury Crown Court heard yesterday how the Health and Safety Executive (HSE) carried out two investigations of working practices of the site in 2013 and 2014 while Barroerock were converting into flats a former nine storey office building in Ashford, Kent, which was known to contain asbestos. It was found in both HSE investigations that these incidents could have been prevented if Barroerock ensured they had effective management controls in place to avoid the risk of exposure to asbestos.

<http://press.hse.gov.uk/2017/construction-company-fined-three-quarters-of-a-million-pounds-after-asbestos-failings/>

### **++ Essar Oil UK Limited fined after explosion at Ellesmere Port refinery ++**

An oil company has been fined £1.65m following an explosion at its Stanlow refinery in Ellesmere Port. Liverpool Crown Court heard that while there were no injuries, the blast from the early hours of 14 November 2013 caused internal structures to collapse; damage totalling more than £20m. Problems started at the site during the start-up of its main distillation unit, when extremely flammable hydrocarbons were allowed to enter an unignited furnace. The heat from another furnace nearby triggered the explosion which destroyed the furnace, starting a number of fires which the Fire Service had to safely bring under control.

<http://press.hse.gov.uk/2017/essar-oil-uk-limited-fined-after-explosion-at-ellesmere-port-refinery/>

# Calendar of Events

Please check the Events section of the Hazards Forum website for more information at [www.hazardsforum.org.uk](http://www.hazardsforum.org.uk) and to see any updates in the calendar. These may include additional events or perhaps amendments to the Events shown below. Please note that attendance is by invitation.

Date	Event	Venue	Contact/further information
June			
6 <sup>th</sup>	IMechE Event, Hf Supported: Fit for Purpose Safety Cases in the Nuclear Industry	Birmingham, UK	<a href="mailto:eventenquiries@imeche.org">eventenquiries@imeche.org</a>
20 <sup>th</sup>	Hf Event: Safety Lessons from Sport	Institution of Civil Engineers, One Great George Street, Westminster, London, UK, SW1P 3AA	<a href="mailto:admin@hazardsforum.org.uk">admin@hazardsforum.org.uk</a>
29 <sup>th</sup>	SaRS Event: Advances in Risk and Reliability Technology Symposium (AR2TS)	Friends House, Euston, London, NW1 2BJ	<a href="http://www.sars.org.uk/events/ar2ts2017/">http://www.sars.org.uk/events/ar2ts2017/</a>
July			
15 <sup>th</sup> – 19 <sup>th</sup>	ICE Event: GeoMEast 2017 International Conference	Sharm El-Sheik	<a href="https://www.ice.org.uk/events/geomeast-2017-international-conference">https://www.ice.org.uk/events/geomeast-2017-international-conference</a>
September			
20 <sup>th</sup>	Crane Safety 2017	Institution of Mechanical Engineers, One Birdcage Walk, London	<a href="http://www.imeche.org/cranesafety2017">www.imeche.org/cranesafety2017</a> Discounts for Hazards Forum members: select “supporting organisation” or contact <a href="mailto:eventenquiries@imeche.org">eventenquiries@imeche.org</a> and mention your Hazards Forum membership and save £60 on your place
26 <sup>th</sup> – 27 <sup>th</sup>	Delivering Onsite Nuclear Projects 2017	Manchester	<a href="http://www.imeche.org/nuclearprojects2017">www.imeche.org/nuclearprojects2017</a> Discounts for Hazards Forum members: select “supporting organisation” or contact <a href="mailto:eventenquiries@imeche.org">eventenquiries@imeche.org</a> and mention your Hazards Forum membership and save £90 on your place
November			
21 <sup>st</sup> – 22 <sup>nd</sup>	Heat Recovery Steam Generator User Group	Nottingham Belfry Hotel	<a href="http://www.imeche.org/hrsg">www.imeche.org/hrsg</a> Discounts for Hazards Forum members: select “supporting organisation” or contact <a href="mailto:eventenquiries@imeche.org">eventenquiries@imeche.org</a> and mention your Hazards Forum membership and save £75 on your place