



*Hazards forum*



# The Hazards Forum Newsletter

Issue No. 81  
Winter 2013

Web version

# Hazards Forum Newsletter

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***Edited by Dr. Neil Carhart***

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

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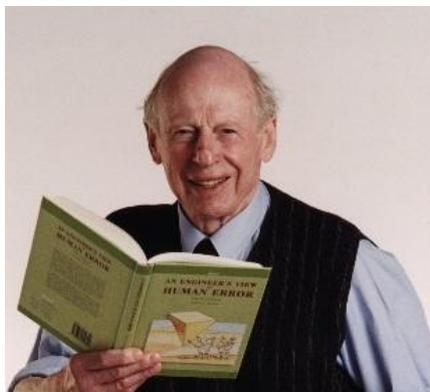
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Hazards Forum Executive Secretary: *Brian Neale*

*December 2013*

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## Trevor Kletz



Trevor Kletz, whose work was known to many, passed away on the 31<sup>st</sup> October at the age of 91.

He was one of industry's most respected figures in the professions dealing with hazards and considered a safety pioneer, following a celebrated career as an industry safety advisor, lecturer and writer.

IChemE chief executive David Brown says that the impact of Trevor's work will be felt for many years: "Trevor unquestionably saved lives. There are people working in the process industries today who will go home safely to their families and loved ones, thanks to Trevor. He had a profound impact on industrial safety."

Trevor worked for ICI from 1944 to 1982. In 1968 he was appointed as one of the process industry's first technical safety advisors with a broad remit which included advising designers and operators about how to avoid accidents, specifically with regard to process accidents. On leaving ICI, Trevor built a second career as a process safety consultant, writer and lecturer. He was elected a Fellow of IChemE in 1978, a Fellow of the Royal Academy of Engineering in 1984 and awarded an OBE for services to process safety in 1997. He authored fourteen books and more than one hundred peer-reviewed papers on process safety.

Trevor remained active professionally until earlier this year where a formal retirement reception was staged at IChemE's *Hazards 23* conference in Southport, UK.

The Institution of Chemical Engineer's president, Judith Hackitt, who is also Chair of the Health and Safety Executive has paid tribute to him saying: "Trevor's impact on industry was striking. His ability to convey safety information succinctly, and effectively, was central to his success. On behalf of IChemE, I extend our sincere sympathies to his family and friends. We will ensure the memory and work of Trevor lives on within the chemical engineering community."

*Thanks are given to the IChemE for the source material and permission for reproduction of the above photograph.*

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# The Crossrail Major Infrastructure Project – High-End Risk Management at Work

Neil Carhart

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On **Tuesday 24<sup>th</sup> September 2013** the Hazards Forum hosted an **evening event** at the Institution of Civil Engineers at One Great George Street, Westminster, London.

Crossrail represents **Europe's largest infrastructure project** delivering £14.9bn of new and improved infrastructure. Sponsored by the DfT and TfL it will deliver a world class affordable railway that links Maidenhead and Heathrow West of London with the West End, the City and Canary Wharf, to Stratford and Shenfield North East of London and Woolwich and Abbey Wood to the South East.

The Crossrail project is an **extremely complex and challenging** one. The project is upgrading operational railways to the east and west of London as well as constructing a new tunnel section under London and creating a number of new stations. Along with a dedicated fleet of new trains the Crossrail route will be fully integrated into the existing TfL network by 2019.

The evening's event examined how the risks and opportunities represented by this major infrastructure project are being managed.

The event began with a few brief words from **Hazards Forum Chairman** Rear Admiral (retd) **Paul Thomas CB** who also chaired the event. He welcomed the audience and thanked the Institution of Civil Engineers for hosting the event before introducing the evening's speakers.

The first of the three speakers was **Howard Smith**, Director of Crossrail Operations for Rail for London. Howard provided an overview of the Crossrail

programme, giving the bigger picture particularly in relation to how Crossrail is integral to the future transport vision for London. He talked about what Crossrail will deliver in terms of the final railway, how this will benefit the travelling public and London and the South East as a whole and what the passenger will experience when using the service. He also briefly described how the project has been funded by DfT and TfL and the financing of the rolling stock.

The second speaker was **Steve Hails**, Director of Health & Safety for Crossrail Limited CRL. Steve gave a presentation on the progress and challenges of building the central section. Tunnel Boring Machines (TBMs) are being used to construct new tunnels and a number of new stations are being constructed including interchanges to existing operational London Underground (LU), Docklands Light Railway (DLR) and National Rail (NR) stations. He described the key risks associated with the project, what has gone well and what not so well, as well as the planning going into the move from a construction and tunnelling project to fitting out a world class railway.

The final talk of the evening was delivered by **Dave Lawson**, Crossrail West Project Director. Dave gave a presentation on the Crossrail surface works. He talked about the risks and challenges of upgrading the existing railway whilst minimising the impact on current operations as well as the risks and challenges associated with delivering the work safely whilst working on live railways. Dave discussed how the works are coordinated with the NR Route teams as well as the train and freight operating companies and gave a brief overview of how the works fit into the

wider upgrade of the Great Western and Great Eastern routes.

**Howard Smith** began by describing his background as both rail operator and economist. He set out to introduce the fundamental information and background behind the Crossrail project. Crossrail can be traced back many decades; he described how first becoming aware of the project after finding an old copy of the Abercrombie Report detailing plans for the reconstruction of London after the Second World War in the London School of Economics library. In fact the project can be traced back even further to the 19<sup>th</sup> Century when the Regent's Canal Rail Company sought to build a railway to take people across London. There have been many incarnations, but in its modern form it launched in earnest just after the turn of the Millennium, sponsored by TfL and DfT.

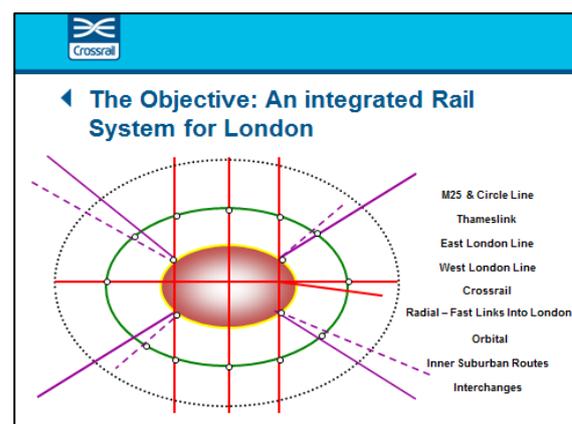
Howard joined the railway industry in 1986, a time which roughly speaking represents a low point in terms of London's rail usage. Since then population and public transport use have risen significantly. The population of London is predicted to rise 1.3m by 2031, with 750k more people in employment and living away from their place of work. Even where population and employment grow in the same geographic space, people still travel. The DLR moves as many people from the Isle of Dogs to work in the City as it moves people from the City to work in the Isle of Dogs. Journeys by rail are predicted to rise by between 30 and 40% over the period to 2031. Essentially, as London's population grows, its transport demand grows even faster. If the roads, in terms of their capacity, are not increasing then the excess finds its way onto public transport, and disproportionately onto rail. These are the drivers which provide the need for Crossrail and prompted the project's resurgence in the early 2000s.

It is interesting to note that the world's most successful cities are crowded cities. People seem to move into cities quicker than the supporting infrastructure can be constructed. In some ways having a demand in excess of supply is a nice

challenge to have. Other cities where the transport infrastructure outstrips the demand are not always more successful or productive.

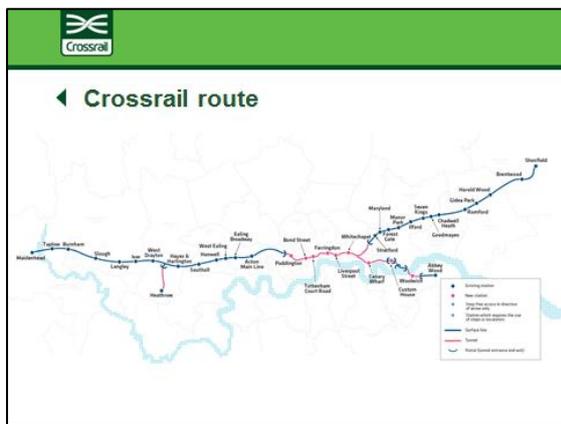
Most commuters find themselves getting on a large train to travel in from the suburbs to the edge of the city centre (often a site defined in the 19<sup>th</sup> century by the prohibition of railways north of the Thames and south of Euston Road) before switching to a smaller train, through an expensive and often congested interchange, to complete their journey. In London, as in other great cities where this pattern is replicated, people have been breaking down this barrier. The boundaries are becoming increasingly blurred. Overseas, the RER ('Regional Express Network') in Paris, the S-Bahn metro system in many German cities and similar systems in Spain and Tokyo set the precedent. Breaking down and providing this journey through to the city centre is becoming increasingly important.

Historically we have been used to radial routes and small trains leading into the centre. Increasingly we have orbital networks and other lines (East London Line, West London Line, Thameslink, Crossrail etc.). The integration of these systems, in terms of connectivity, creates a huge transformation for the city.



Having described the drivers behind it, Howard then discussed the Crossrail project itself in more detail. It is essentially a new railway for London and the South East running 100km from east to west. It will have nine new stations and operate 24

trains per hour through the central section in each direction, with the capability of being upgraded to take 30 trains per hour. It is forecast to carry 200 million passenger journeys per annum, a figure that will grow over time. This is a large addition to London's rail capacity. The vast majority of the Crossrail route mileage is actually above ground, however the most intensive and complex portion is the centre section which involves considerable tunnelling. Fundamentally it is a metro railway pushing out of the city, as opposed to Thameslink which is arguably better described as National Rail coming in to the centre. Crossrail will have trains with relatively limited seating and three doors per side.



Crossrail sums up its ambition in three statements:

- Recognised as world class – setting the benchmark for metro railway services in Europe
- A unique railway, but fully integrated with TfL's transport network
- Offering a step change in quality beyond anything we have achieved before.

Almost 70% of Crossrail journeys will not involve only Crossrail, so integration is imperative.

A project like Crossrail can change peoples' geographic sense of London. Traditionally people looked at distances but actually the duration of a journey is the important factor along with the frequency with which they can make it. Crossrail transforms London in terms of the time taken to get between places. This is

significant in terms of the places people can live, work, travel to etc. For example, the journey from Paddington to Canary Wharf will be cut from 30 minutes to 17 minutes, Liverpool Street to Abbey Wood from 40 to 22 minutes.

Crossrail has a funding envelope of around £14.8bn plus the cost of rolling stock. There are a number of sources for this funding. There are often debates about whether those who benefit from new infrastructure developments provide enough of the development and construction costs. While this may never be fully resolved, Crossrail has been particularly successful at balancing the various sources of income between central government, local government, and the various forms of taxation and developer contributions. While focused on the project in hand, they are keen to set a precedent for Crossrail 2 in this area.

In terms of the service pattern, the 24 trains per hour through the central section between Whitechapel and Paddington will include 12 which will continue on to the East through Canary Wharf to Abbey Wood and 12 will come from Shenfield to join the central section at Whitechapel. Only 10 of the trains will proceed beyond Paddington to the west under the current plans. In its previous incarnations Crossrail has involved other legs off to the West (e.g. Chilterns and Richmond).

Passengers increasingly assume and expect that safety and reliability will be high. They also expect seamless and reliable information. On new railways the requirement is for a high standard of environment. The differentiator in modern times though is becoming the quality and the training of the staff. Passengers value friendly and well informed staff. Howard hopes that Crossrail will not only take the physical infrastructure to a new level, but also the staffing and customer service.

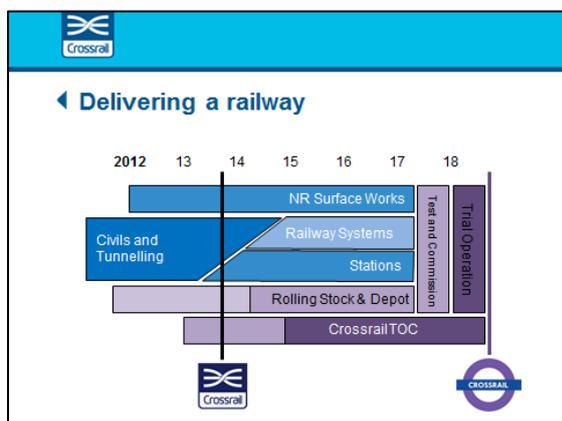
Crossrail involves significant over-station developments in central London locations. The stations themselves are also large. With the exception perhaps of Bank and Monument, these stations will for the first

time be characteristically linked to London Underground. Signage is very important as people will need to leave the station from one exit to emerge at one location and a completely different exit to emerge at a very different surface level location. A great deal of thought is going into the coherence of the stations and a theme which also links the rolling stock, surface developments and uniforms. This is being done in such a way that it integrates with TfL but maintains its own identity.

Crossrail expect to sign the contracts for rolling stock by April 2014 and have the first of the new trains in service by May 2017. The new trains will be lightweight and energy efficient, 200m long with 1,500 seated and standing passengers per train at peak times. They will also involve regenerative braking.

A Communications-Based Train Control (CBTC) signalling system was chosen for the central area. This will interface with the European Train Control System Level 2 (ETCS-2) to the west and conventional signalling in the east. It is hoped that this will allow for a very high frequency of trains and reliable service in the core. CBTC is the proven way of getting an appropriate functionality to deliver more than 24 trains per hour in the future.

The project is approaching the half-way point in term of the necessary tunnelling, and the focus of the organisation is now moving more towards systems and operation, and charting the course forward through to 2018.



Howard concluded by describing the planned phased opening of Crossrail. In May 2015 Crossrail (as an operator) will take over the section between Shenfield and Liverpool Street from Greater Anglia. Initially this will not be Crossrail branded. The Crossrail branding is expected to be rolled out with the introduction of new rolling stock in May 2017. In May 2018 the Heathrow to Paddington surface leg will begin operation resulting in two disconnected railways to the east and west. It is projected that in December 2018 trains will begin running through the central section but Paddington and Liverpool Street will be served separately by trains running both above and below ground. In May 2019 everything will be connected together, bringing to life Crossrail as a cohesive transport system before December 2019 when a full service will run through to Maidenhead.

Paul Thomas then introduced the evening's second speaker **Steve Hails**, Director of Health & Safety for Crossrail Limited. Steve began by reiterating the scale of the project as described in the previous presentation, and acknowledging that Crossrail has some of the most highly skilled individuals working on it. The project involves a great deal of construction, and the generic risks associated with this are all present, but it also presents some novel risks. He outlined key risks in three sections: the complexity and scale of the technical risks, the logistical risk behind this and the skills and resources that the organisation is trying to manage, not just for their benefit, but for the benefit of the future industry.

On Crossrail the executive team and leadership firmly believe that nothing is so important that it cannot be done safely. This is something they make an effort to stress in every single forum and a message they are keen to get across at every level. Crossrail operates on the three 'Target Zero' principles:

- We all have the right to go home unharmed everyday
- We believe that all harm is preventable

- We must all work together to achieve this.

There are so many different entities involved in the delivery of Crossrail that collaboration and working together is essential for safety and risk management.

Steve described how Crossrail proudly state that safety is their core value, not their number one priority. Priorities change on a daily or hourly basis, but values remain the same, and health and safety is at the core of this. Its other values include inspiration, collaboration, integrity and respect.

The organisation has learnt from other infrastructure projects to establish the foundations upon which Target Zero is built. The six pillars of Target Zero and health and safety excellence are:

- Leadership and Behaviour
- Design for H&S
- Communication
- Workplace Health
- Workplace Safety
- Performance Improvement

All principal contractors are expected to satisfy criteria under each of these six pillars. Performance is evaluated on a regular basis. Audits are used; surveillance and measurement are made on a month by month basis to monitor how the contractors are performing. Crossrail plays an active role in this respect and goes beyond the legal requirements as the customer.

Steve expressed a concern that in health and safety in general there is a danger that too much paperwork is being produced. There is too much reliance on documenting everything to the point where method statements are described over 20, 30 or even 40 pages, and as a result they are losing value. Crossrail is starting to look at the standards and expectations placed on documentation and stripping them back to ensure their value.

Crossrail also subscribe to six golden rules, with a seventh recently added, to reflect the amount of sprayed concrete

lining works currently underway in the project at the moment. These are fairly generic in the way that they are structured and several are expected to carry over into the next phase of the programme, moving from civil engineering works to station fit-out. The golden rules are linked to the risk profile. They are reviewed with every phase and every contract to make sure that they are applicable and of value. Compliance is measured with general day-to-day observations.

Steve showed a pyramid model for collaboration with legislative and contractual obligations as the foundation. We are fortunate within the UK to have good health and safety legislation, and each project that comes along looks to move the standards on large infrastructure projects incrementally forward. Crossrail was lucky to take the baton from the Olympic Delivery Authority. This forms the backbone of future success in terms of collaboration within Crossrail. There are a number of different entities involved in the delivery of Crossrail, and because of the extent of the complexity involved in the project some of the biggest and best construction companies are involved in this delivery.

At the top of the pyramid is Target Zero. It would be futile to insist on a Target Zero behavioural programme being mandated into the Principal Contractor organisations because they already have their own mature systems in place – a requirement of the contract. So below Target Zero sit the differently branded schemes of each contractor. The achievement of Target Zero is the common drive for safety. Contractors may have subtly different schemes, but everyone is trying to eliminate harm in the workplace. Between best practice and the individual contractor's schemes is a cross-pollination band where the Crossrail team is tasked with identifying the pockets of excellence in existence across the programme. While the project involves the best construction companies all working on Crossrail's behalf, they are also in competition with one another. The appetite is not always there to share positives and innovation.

That is why the Crossrail team have to facilitate that cross pollination and share best practice across the programme.

Steve then moved on to look at some of the challenges Crossrail is facing. In less than 18 months around 20km of tunnels have been cut, almost 50% of the 42km total. The tunnels have a diameter of approximately 6.2m which compares to the 3.81m diameter of the Victoria Line tunnels. The tunnels will be filled with 250,000 tunnel segments and in the process of digging them, over 6 million tonnes of spoil will need to be moved from the centre of London. That is enough material to fill Wembley Stadium 3 times. The tunnelling itself is obviously a considerable challenge. There will soon be 8 Tunnel Boring Machines (TBMs) operating at any one time, and perhaps the biggest challenge is how they weave their way through the existing infrastructure under London. Each TBM is almost 150m long and weighs around 1,000 tonnes. It is estimated that they will be able to tunnel 100m per week on average. There are seven machines in the ground at the moment, the eighth is being prepared. All the machines have names, the two most recent being Jessica, launched on the 14<sup>th</sup> of August 2013 and Ellie, the TBM being prepared. Ellie will start work just as the first two TBMs, Phyllis and Ada, complete their journeys from Westbourne Park to Farringdon and retire.

Boring the tunnels is not the only challenge; some of the biggest risks come with applying the sprayed concrete lining. There are 12km of sprayed concrete tunnels in the programme, and in the process of doing this Crossrail will be constructing some of the biggest and most complex caverns and tunnels seen in Europe, if not the world.

The project tunnels under some of the most expensive real estate in the world. Because of the removal of 6 million tonnes of earth from under London some settlement could occur. As a result there are over 35,000 instruments and 79,000 sensors monitoring the earth on a minute-by-minute or second-by-second basis.

The system which logs all this information is called UCIMS, the Underground Construction Information Management System. It has almost a billion data points already logged. Some of the sensors are visible at existing stations and other locations. Crossrail are taking this very seriously, and have automated alarms set up in case anything unexpected occurs and settlement goes beyond the tolerable limits. There are also a number of mitigation measures in place such as compensation grouting through grout shafts to counter the effect of settlement. The settlement is monitored and grout injected beneath the infrastructure as required to maintain the original level.

The extent of works above ground and at existing stations is also significant. At Paddington Station, along Eastbourne Terrace, works have been underway, and it is expected to be reopened to the public in February 2014. At Tottenham Court Road the station and ticket hall construction is also a considerable scheme giving some insight into the vast nature of the works going on underground.

Steve also displayed a cutaway diagram of Crossrail's Bond Street station to demonstrate the scale of the delivery, showing it to be 26m deep and 260m in length, the equivalent of 3 football pitches. The east and west ticket halls, as well as the interface with the existing London Underground station are considerable challenges. As well as delivering scale the project is also delivering complexity. For example at Tottenham Court Road not only is there the existing buried infrastructure and London Underground station to deal with, but the existing station is also undergoing its own upgrade. Using a Building Information Modelling (BIM) model of one of the TBM's recent passages through Tottenham Court Road shows how the 1,000 tonne machine passed within 850mm of the existing Northern Line and within 500mm of the passenger escalator barrel.

Steve then moved on to discuss the logistical challenges. One such example is the aforementioned removal of 6 million

tonnes of excavated material. Based on a tonne per km, 85% of the excavated material created is transported by rail or water. That still means that in an average week there are 4,000 lorries across London transporting the excavated material. The 6 million tonnes is taken to Wallasea Island in Essex where the RSPB is using it to create a wetlands and marchlands habitat over 600 hectares of land for rare breeds.

The 4 – 5,000 lorries travelling around London each week pose another logistical challenge. Crossrail have attempted to raise the bar in terms of vehicle safety. The 5,000<sup>th</sup> lorry driver recently passed through Crossrail's mandatory driver training programme. Anybody regularly driving on Crossrail business must attend this training. It teaches about the interactions of large numbers of road vehicles and vulnerable road users, in particular cyclists. It puts the driver in the position of the cyclist so that they can understand what they are dealing with in terms of blind spot etc. A number of 'exchanging places' events have been run where cyclists are invited to come and sit in the cab to understand the situation from the driver's perspective. This is to allow them to understand where the blind spots are so that they do not put themselves in unnecessary danger.

Crossrail insisted that all vehicles have had to undergo certain improvements such as side under-run guards and monitoring equipment to detect cyclists at the near side in addition to signage and mirrors. There is also a driver information pack, translated into 18 different languages. A number of senior managers within the haulage industry have been taken through corporate manslaughter seminars so that they understand their responsibilities and where the vulnerabilities are within their own organisation.

Crossrail have also looked at the routes the vehicles must take. Every vehicle must follow a planned and authorised designated route. Where there are vulnerabilities along the routes a number

of devices have been fitted to assist the driver and the vulnerable road user in managing that risk.

In the final part of his talk, Steve described the challenges associated with skills and resources. He noted that the Chairman of Crossrail, Terry Morgan, had discussed the Tunnelling and Underground Construction Academy in Ilford at a previous Hazards Forum event<sup>1</sup>. The academy aims to fill a skills gap within Crossrail and also within the industry as a whole, leaving behind a legacy of skilled workers and the training infrastructure. It is expected that 3,500 individuals will have passed through the Academy by the time Crossrail is completed. In addition to this, Crossrail is committed to having 400 apprentices on the project which will then feed into the industry. Crossrail is working closely with other projects, such as Thames Tideway to ensure that the benefits extend beyond the Crossrail project. With HS2 and Crossrail 2 potentially around the corner, these are skills the UK desperately needs.

Steve concluded that the Crossrail project is not just about moving London forward, but it is also about moving health and safety forward. They want to make that step and push the industry on and are engaging with the stakeholders of future projects to ensure that is the case. The project is far from over, but as described in the previous talk, the phase is moving from tunnelling to fit-out which will bring with it a whole new set of challenges and skills needs. The next phase will bring new risks and a new culture. Crossrail have worked hard with the Civil Engineering contractors, and this will continue with those involved in the fit-out and then commissioning and operation phases.

The final speaker of the evening was **Dave Lawson**, Project Director Crossrail West for Network Rail. He began by explaining the Crossrail On Network Works. The tunnelling operation is very visible, as will the fit out and new fleet of trains when they are commissioned. But the Crossrail service doesn't just cross London, it extends out of it to the east and

west. The On Network Works enable Crossrail to run from Stratford out to Abbey Wood and Shenfield in the east and from Paddington to Maidenhead in the west. Much of these routes are covered by already operational railways, so the project has to upgrade these lines such that they can provide a suitable and reliable service for Crossrail. While doing this it is also important that the current level of service is maintained for existing Network Rail customers (e.g. First Great Western, Heathrow Express and freight companies). In certain areas this means taking freight traffic off the network so that they can maintain trains passing through those areas. There will not be many visible changes from the On Network Works as there is an existing corridor to work within. While it does not involve the number of new stations as the central section, the On Network Works consist of:

- 2 major structures
- 27 stations (11 major)
- 66km of track
- 61 platform extensions
- 146km of electrification
- 360 signalling units
- 2 replacement interlockings
- 112 cab CCTV platforms

Dave described his focus on the western branch from Paddington to Maidenhead, identifying this as one of the busiest stretches of railway in the UK, and possibly in Europe. The volume of trains going in and out of Paddington is already very high, and there is a need to get another 24 trains per hour onto that infrastructure. While different from the central section, the project still presents many unique challenges, particularly logistical challenges. In many ways the project is driven by access. The network has to be kept running for the commuters coming into the west of London. Other than occasional short periods of time on Sundays, Christmas and New Year and Bank Holidays most of the work is done at night.

Being Network Rail they have many other customers' needs to service and so they have attempted to integrate those needs

with the needs of the Crossrail project in order to keep all services functional. He described Network Rail's values in respect to the Crossrail project, drawing particular attention to their role to "Safely deliver a key part of Europe's biggest construction programme on some of the busiest rail corridors in the UK." This goes beyond construction safety. There is a significant risk with the operational railway. While they have to keep their own workers safe, there are hundreds of thousands of people passing within meters of the worksites every day on the rail networks. These members of the public also need to be kept safe.

In addition to delivering the work commitments safely, the programme ethos states it must also do so openly and transparently, to the required quality and as an integrated railway. There are multiple train and freight operating companies involved, and scope for many impacts beyond this, for example as a result of diversion routes.

Dave stated that the objectives of Crossrail and Network Rail are completely aligned before moving on to discuss the level of complexity Network Rail has to deal with in this project. As previously described, the branch from Paddington to the West is already an operational part of the network, and this requires maintaining. This has to be taken in the context of improvements to the entire network. There are other schemes going on simultaneously. Some may be further out in the network but may affect access and when people are able to do the work, others may be going on in the same location as the Crossrail driven work. For example ETCS-2, mentioned in the first presentation, is being installed into the 27 miles of railway comprising the western leg. The electrification to Maidenhead, Intercity Express Programme, Heathrow West Access, signalling upgrades and maintenance and track renewals is all being undertaken at the same times as the specific programmes to increase capacity for Crossrail. It is necessary to ensure that while this is going on the network remains operational. This can be a challenge when

different people need to be in the same place at the same time, or doing different jobs that will affect each other.

Dave then turned to the complexity presented by their customers, the rail operators, and the rail operators' passengers. The rail operators have to keep their passengers moving so the majority of the disruptive work is carried out at night. It is unacceptable if the trains are not running in the morning, so a lot of work is put into planning this work. Freight must also be kept moving. There is a freight yard along the route which requires the trains to slow down. The freight trains need a faster route to be able to get off the main lines. So while most rail passengers will not see, the project involves the construction of improved access to freight yards.

The 'On Network Works' do not involve a phased build. It does not begin with demolition, move on to civil engineering works and finish with fit-out and commissioning. Every time a piece of work is undertaken it has to quickly be put back into operation so as not to cause a disturbance to the network. The project therefore involves multiple contractors each with different roles undertaking different tasks across the 27 mile project. This work has to be integrated such that the operational railway can be brought back in to operation at the given time. The contractors' plans are taken and integrated together along with access agreements to create an integrated project plan. These plans are then discussed with the customers. The customers' service will be affected so there is also a need to create appropriate contingency measures. Similarly there is a great deal of community involvement. As the work is above ground there is a lot of engagement over noise, access and dust control, as well as other potential impacts. A great deal of the work involves piling, all alongside an already operational railway. This also presents significant challenges.

As of September 2013 the Western leg of the project is around 35% through the

detailed design work and 11% of the way through the construction process.

The project will continue to have a busy period of work during the Christmas 2013 period. During this time the upgrades to the whole signalling system and the way data is processed will be conducted from London Paddington to Iver, crossings will be installed at East of Hayes, piling will be installed at Wexham Road to support developments later in the year, new access to the western yard will be created, signalling and new infrastructure are being installed at Old Oak Common and Paddington approaches, Stockley Stage 22 relay up relief and in Maidenhead platform five will be cut back.

He then turned to look at safety in particular. 100 years ago 400 people per year were killed on the Great Western Route alone. This was understandably considered to be unacceptable, and this year celebrates 100 years of GWR having a safety programme. They took cameras out onto the railways to document hazards and communicate these to the railway workers.

Eleven "lifesaving rules" are applied across Network Rail in order to clearly communicate the most important underlying safety issues to everybody (contractors, site staff, office staff etc.). Almost every unwanted event can be attributed to the failure to follow one or more of the eleven rules.

The work is spread over 27 miles of railway, but it is not a continuous site. This geographical spread presents a number of safety challenges, for example the ability to effectively communicate with all of the discrete work sites. There could be 40 or 50 work separate work sites in operation on a single Sunday. There will be significant and diverse groups of people out at work who need to keep in communication. It is also necessary to ensure that they are all maintaining acceptable levels of safety. Their access has to be controlled and the project also has to provide these sites with adequate welfare facilities. It is a mobile operation.

Some sites are very constrained with very limited access. Even getting into the site can be a challenge. The sites involve maintaining the functionality of existing Overhead Line Equipment (OLE), while new OLE is also being installed and extensive modifications to the existing OLE are underway. Once again this also presents a challenge as it has to be done during the short periods in which the railway is not operational, and has to be ready again for when it is re-opened. This presents a great deal of perceived time pressure. It is important to make sure that people do not work inappropriately because of this. This can be mitigated by taking great care in planning the work and integrating those plans with the access limitations.

There is over 100 years of infrastructure buried in the ground under or around the railway lines. Existing drawings and plans are used along with CAT-scans and RADAR. Any equipment that is found has to be treated as live. There is a lot of chopped out old scrap cable which was buried many years ago, but every time it is discovered work has to stop to ensure it is safe. And every time the work stops it means it will probably have to be rescheduled which along with the limited access windows can create further pressures. The project has to be mindful of the level of intrusive survey that is undertaken in advance. On some occasions a trial pit may be dug, but the team can go no deeper than 1.5m in order to guarantee that they will be able to backfill it and return the site to its operational condition within that work shift. Anything deeper than this would require a permanent site.

The worksites are often in close proximity to moving trains. Recently there has been an increase in the amount of open line work undertaken. It has been remarkably successful. Asbestos is also a hazard. It can come from building demolitions and old brake linings. The work is currently encountering a pocket of asbestos up to once a week. The weather provides a further hazard which can have particularly significant effects given the short and pre-

determined access windows. They have to ensure that the weather does not affect the existing infrastructure or cause any wash out.

The work involves mobile plant such as cranes which have to be brought onto site and moved around with a high degree of precision before being moved to return the track to service. There is not a lot of space to set up the cranes next to the railways so any work that involves lifting needs to be planned very carefully.

A lot of the work also needs to be conducted over night, adding further complexities to the task. Existing asset condition can be a problem and Asset Condition surveys have to be undertaken to make sure that when the work begins the condition of the assets is known. If during work things are found that need maintenance then the maintainer may need to be called in, putting them in the same restricted space.

The industry is still very labour intensive and such can involve many hazards associated with manual handling. Working in confined spaces, noise and the close proximity to residential areas can all present challenges and hazards.

To address these safety challenges, in addition to the eleven "lifesaving rules", the project involves work force engagement programmes. The workforce is actually relatively stable meaning Network Rail are able to influence them and their awareness. This involves both office based sessions and field based sessions. Innovative training programmes are used, such as those involving actors playing out the scenarios which can otherwise be embarrassing or uncomfortable to talk about. Bringing in external facilitators allows this to be done in a much freer environment. It allows for a sense of humour to be created in the room which can have an impact in drawing their attention to what really matters.

Network Rail uses the Star Award to recognise success with its contractors. It gives competition between the contractors

and it allows them to have demonstrable proof that they are achieving the standards that Network Rail sets.

Dave concluded by highlighting the Network Rail Crossrail Programme Safety Plan for 2013-14 which tries to bring in new ideas while refreshing the knowledge and emphasis on the core ideas.

The Chair thanked the speakers for their insightful talks before opening the floor to questions from members of the audience. The first questioner referred to a point made by Steve Hails regarding the proliferation of paperwork, and asked how that situation is dealt with by Crossrail. Steve expanded on the issue by making the distinction between the detail, length and complexity of a Safety Case (looking thoroughly at risk assessments and justifying outcomes) and the more day-to-day operational documentation. He postulated that the situation in Health and Safety in general had got to a point where nobody was willing to take responsibility without their being a thorough supporting or guiding document. This happens to such a degree that there have been cases where a procedure has required 18 separate individuals to sign it off before it becomes finalised. The issues become clouded with complexity and the management system becomes unnecessarily complex. A degree of the individual's autonomy to manage risk dynamically is removed for fear of reprisal. This may arise from a personal preference or because the organisation has installed such practices for fear of litigation. When such complexity is created for simple tasks, individuals do not or cannot follow the documentation's step-by-step process. They cannot see the wood for the trees within an overly complex document. Individuals can then find themselves in hazardous situations.

The second question related to workforce engagement over occupational health issues. The audience member asked whether the panel had experienced any misunderstandings amongst management or the workforce as to the role of

occupational health, and if so how it had been addressed.

Dave Lawson replied that there can be a difference between what the management perceives to be the occupational health risks and what the operatives perceive to be the occupational health risks. Network Rail has run wide surveys across the programme to try and identify where management is placing its attention and where the workforce thinks the areas are.

A lot of training has been undertaken within Crossrail looking at asbestos and what to do when it is discovered. One encouraging aspect of this is that in the last seven months every time asbestos has been uncovered it has been a member of the workforce that has found it and taken the initiative to stop work and follow the safe procedures to address it. In some areas, such as this, the project has been successful at driving awareness of the occupational risks across the organisation; in other areas there is still progress to be made. Steve Hails agreed with this adding that for too long they have whispered health and shouted safety. There is a need to get parity between the two. Because of historic incidents of ill health within the construction industry there is a responsibility to address the issue head on. There is a distinct difference between the legislative requirement through occupational health surveillance, which many employers understand because it is a legal obligation, and the health and wellbeing of individuals to understand the impacts to them. The Crossrail project has taken the standard set by the London Olympics and moved its health expectations on. They insist that all contractors involved in Crossrail are signed up to 'Constructing Better Health' and they look at the long term legacy of these actions. It is sold to contractors on the benefits of looking back at health records in the future within an industry with a transient demographic. Having access to that data for individuals coming on to sites will be beneficial. In the western leg of the tunnel boring, over 50% of one contractor's workforce did not have a GP mainly as a result of the transient

nature of the industry. Occupational health is vital for the continuation of the construction industry; it is about allowing people to be fit to work in the future.

A third question asked about tunnelling risks and the challenge of communicating the new hazards which tunnelling introduces to those who may be affected. Steve Hails responded by acknowledging the importance of stakeholder engagement. Crossrail will impact on the lives of many as a result of the activities they are performing, so information sharing in advance is very important. In some instances the project communicates with stakeholders on a week-by-week basis. Crossrail appreciates that it has the potential to be a disruption to its neighbours for the next five years. The benefit of 200 million passengers per year, 24 trains per hour, and bringing millions of people within 45 minutes of central London can only be sold so much to a neighbour who is putting up with the noise, vibration, dust and general nuisance that construction can bring. To some extent the times of activities are limited to minimise disruption, but there is still scope for disruption. In many instances it is about maintaining a dialogue; in some cases it may require compensation. There will be an impact, so it is the analysis of that impact and what you do about it and to keep people informed in an open and transparent way that matters. Not all impacts are negative, for example a café initially concerned about the impact of the project has found business booming as a result of increased trade from the nearby construction workers! The communication has to operate at an individual purpose, and not with an arrogance that tramples across the people who live and work within London.

The fourth question of the evening came from the perspective of the mining industry. The member of the audience asked what would happen if there was a fatality underground, given that if the same thing happened in a mine, the operation would be shut? Steve Hails addressed this point by saying that the response would be exactly the same, and not just

underground, but for any operation. The site would be made safe and work would stop until it was understood what had caused the incident and measures had been taken to ensure that it couldn't happen elsewhere. That doesn't just refer to fatalities. A similar approach is taken for other incidents, each of which is taken on its own individual merits. If necessary, work will be stopped across Crossrail. Nothing is so important that it cannot be done safely.

The final question drew from experience of working in Japan. It was noted that following problems with trucks turning left and injuring or killing cyclists lowered windows were introduced on truck doors. This is a huge investment but has really transformed that aspect of road safety. The first part of the question asked whether such a scheme had been considered in the UK. The second part of the question asked whether station platform barriers had been considered to prevent people falling or jumping onto the tracks at stations.

Steve Hails first acknowledged that the investment required to fit haulage vehicles with near-side viewing panels would be large. He represents Crossrail on Transport for London's Construction Logistics and Cycle Safety Working Group which brings together large construction organisations, hauliers, manufacturers and cycling groups to investigate what more can be done and what more needs to be done. Viewing panels would be a positive action, but not the ultimate solution. The vehicles are so long, with so many blind spots that there is a further need for education and additional technology. There is a lot of work to do in this area, but Crossrail feel they are leading the way. Other schemes elsewhere in the country are looking at what is being done in London.

Howard Smith addressed the second part of the question. Crossrail, like most new underground railways has doors on the platform edge. These have an interesting history as they were originally designed to keep platforms air-conditioned in hotter

countries. They are justified in the UK on grounds of safety and reliability. They not only protect people, but also prevent them from dropping things or otherwise disturbing the track and disrupting services. National Rail presents a much more complicated picture. One reason for this is the lack of standard gauge. The distance between the train and the platform edge isn't standardised nor is the spacing of doors. These are not insurmountable challenges, but undoubtedly make any solution much more difficult. Increasingly, platforms passengers do not regularly need access to are being fenced off on many of the stations Crossrail will pass through on the inner suburban network. Train operators are also focusing a lot of staff

training on the identification of people who might pose a risk of hazard. As the safety and reliability hazards are being eliminated access to the track becomes a bigger portion of the residual risk, so the area will continue to be the subject of analysis and activity.

Paul Thomas thanked the speakers on behalf of the Hazards Forum and everyone in attendance for their talks and the insight they gave into a project which spans from the very new to the very old. He encouraged further discussions over the refreshments provided.

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<sup>i</sup> See Hazard Forum Newsletter Issue 79.

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## From the Secretary.....

The **2014 AGM** is scheduled for Tuesday 18<sup>th</sup> March, to begin at 16.30, and to be held at the usual venue of One Great George Street, Westminster. As usual, an evening event will follow. Members are urged to attend and will be made most welcome. A formal notice will be sent to members early in 2014. More can be seen in the Calendar of Events in this Newsletter on Page 20. As advance notice, the **next Evening Event** after 18<sup>th</sup> March is being planned for June.

Visitors to the **Hazards Forum's website** can expect to see a new site during the coming months. The current site has existed for more than six years and the Executive Committee is commissioning a new site that will have a more modern look and feel, with new features that could be expected from forward looking organisations.

Readers will have seen in recent editions, **articles describing** various organisations, often with background about that organisation. What may not be clear always is why they appear in the Newsletter. It is because they are member bodies on the Forum and the reason for the articles is to help with mutual understanding of our fellow members.

Brian Neale

*The following article is by courtesy of the Rail Safety and Standards Board. Whilst the process described is focussed on railway practice, the guidance has relevance to the management of technical and organisational change across a wide industry base...*

## **RSSB's new practitioner-level guidance for applying the Common Safety Method on Risk Evaluation and Assessment**

**George Bearfield**

Head of Safety Knowledge and Planning, RSSB.



The 'Yellow Book' was published in various versions in the 1990s and 2000s and was part of a process of changing the UK railway's approach to engineering safety management. In particular it informed the processes that Railtrack, and subsequently Network Rail, used to support major engineering projects and the introduction of new technology. However, in 2012 the Industry Standards Coordination Committee, a group of senior industry representatives, withdrew the 'Yellow Book' because it no longer represented up-to-date guidance for the GB mainline railway system. In particular much of its content was aligned to outdated regulations and it didn't take account of replacement regulations such as the Railway and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) or the Regulation for the Common Safety Method on Risk Evaluation and Assessment (CSM REA). In particular, the latter regulation defines a risk management process that must be used when industry companies are introducing a 'significant change' to the railway system, which supersedes similar processes and standards used in the industry.

### **Guidance on the CSM REA**

In the intervening period RSSB has undertaken research (project T955) to develop methods, guidance and tools to

support the management of change in the railway. The objective of this project was to help the industry to meet the requirements of the CSM REA in an efficient and effective way. After extensive work and case studies the outputs from this research are being progressively published and rolled out to the industry. RSSB guidance documents have been published, aimed at those who are required to undertake an application of the CSM REA process in their work. These documents can be found on RSSB's website at

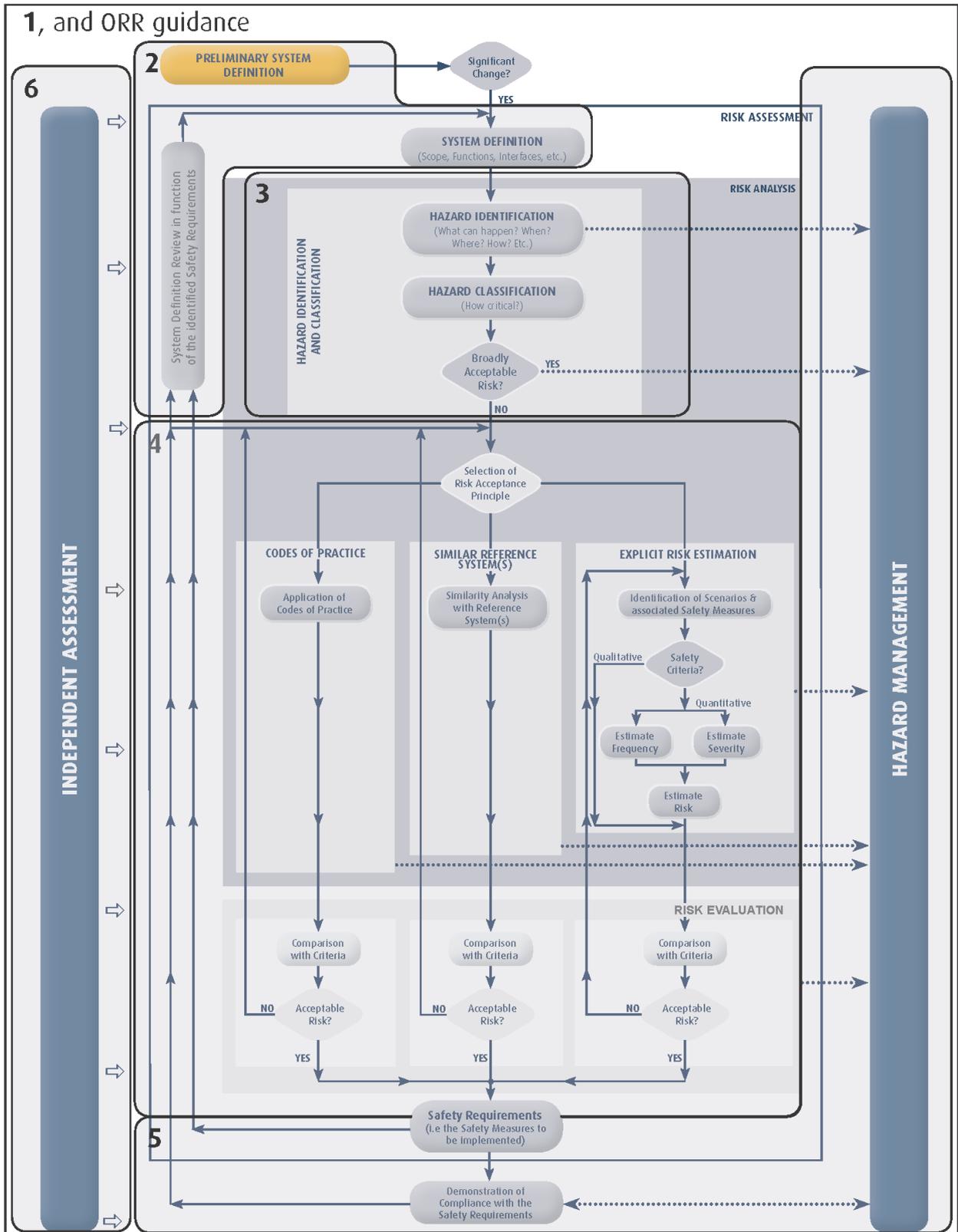
<http://www.rssb.co.uk/ManagementOfEngineeringChange/pages/default.aspx>,

There are six complementary guidance documents:

1. Guidance on planning an application of the CSM REA.
2. Guidance on system definition.
3. Guidance on hazard identification and classification.
4. Guidance on risk evaluation and acceptance.
5. Guidance on safety requirements and hazard management.
6. Guidance on independent assessment.

The ORR has also produced guidance on the application of the CSM REA.

The diagram on the following page shows the scope of these guidance documents mapped to the diagram of the CSM REA risk management process, taken from the regulation.



**Risk Management process taken from the CSM REA regulation**

It should be noted that:

- The scope of the CSM REA covers all significant changes to the railway system – ‘technical’ (engineering), operational and organisational. The guidance documents are equally appropriate for engineering changes and operational changes. Over time it is intended that guidance on organisational changes will be developed.
- The regulation requires the application of the process in the CSM REA for ‘significant change’ to the railway. However, even if its use is not required by law, it still represents a good process for assessing and controlling risk, and as such the processes are suitable for building into a company’s safety management system more generally.

The guidance documents will be published as Rail Industry Guidance Notes in the Railway Group Standards catalogue in March 2014. As the guidance relates to a European regulation it should be of use to anyone involved in significant change to any railway in the European Union, either as a duty holder or within the supply chain of such companies. Much of the guidance may also be of interest to other safety critical industries.

### Further work

In addition to the update to the guidance a number of underlying problems with practice in this area were identified. For example, it was identified that risk analysis is often carried out late in the project life cycle. There is a tendency to focus on the

use of safety analysis to support safety demonstration at the end of a project rather than its use to support good decision making in a timely way throughout the life of the project. This means issues are often flushed out too late and result either in costly re-work or remain as liabilities.

It was also found that most projects develop a bespoke hazard list, even though at a certain level of abstraction the hazards on the railway are known. The lack of a defined top-level hazard list makes it difficult for projects to reuse evidence from previous projects and also hinders good communication through the project lifecycle. These problems have been considered in the drafting of the guidance and in the case studies undertaken, but more work is needed and will continue.

In addition to the information described above, further case studies, tools, and guidance will be released over time. RSSB aims to develop the related web resource as a collaborative space, to make guidance and tools available, provide worked examples and forums for discussion, and to promote collaborative working.

For more information, or to provide feedback on the guidance please contact: George Bearfield ([george.bearfield@rssb.co.uk](mailto:george.bearfield@rssb.co.uk)) or Marcus Dacre ([marcus.dacre@rssb.co.uk](mailto:marcus.dacre@rssb.co.uk)).

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<sup>ii</sup> Please note: The RSSB website is in the process of being upgraded. When the new website goes live, go to the home page [www.rssb.co.uk](http://www.rssb.co.uk) and the documents will be searchable. Please contact the RSSB enquiry desk for assistance: [enquirydesk@rssb.co.uk](mailto:enquirydesk@rssb.co.uk)

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## HSE eNews – An Example

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### **++ Updated Guidance on Controlling Hazardous Substances in the Workplace ++**

The Health and Safety Executive (HSE) has revised its Approved Code of Practice (ACOP) to clarify and simplify practical advice to help dutyholders comply with the requirements of Control of Substances Hazardous to Health (COSHH). Contained within an updated document, the revised guidance is aimed at management, supervisory staff, safety representatives and technical specialists (e.g. occupational hygienists, consultants etc). The revised ACOP is available on the HSE website at: <http://www.hse.gov.uk/pubns/books/l5.htm>

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## Parliamentary and Scientific Committee

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The latest issues of “Science in Parliament”, the journal of the Parliamentary and Scientific Committee of which the Hazards Forum is a member, has among its contents the following articles. Any member who would like any further information on any of the articles below should visit the PSC website [www.SciencelnParliament.org.uk](http://www.SciencelnParliament.org.uk)

LEADING THE WAY: DIVERSITY AT THE ROYAL SOCIETY

Professor Dame Julia Higgins

ASPA 1986

Ida Barlow

SKILLS

Address to the P&SC by Diana Garnham

INNOVATION IS GREAT BETWEEN THE UK AND INDIA

Tom Wells

ITALY: THE SEA, THE SUN, THE SAINTS AND THE SCIENTISTS

Laura Nuccilli and Alessandra Ferraris

LA MERIDIENNE VERTE

Professor Alan Malcolm

HOW DO WE INSPIRE OUR FUTURE SCIENTISTS?

Kirsten Bodley

UK FOOD ENFORCEMENT WANTS MORE MONEY, BUT DOES IT NEED IT?

Professor Declan Naughton, Professor Andrea Petróczi and G Taylor

BIRAX REGENERATIVE MEDICINE INITIATIVE

Matthew Gould MBE

THE VALUE OF DIAGNOSTICS

Doris-Ann Williams

DRIVING ENGINEERING EXCELLENCE

Christoph Wiesner and Catherine Condie

RESOLVING THE CRISIS OF ANTIBIOTIC RESISTANCE

Professor Laura Piddock

ANTIBIOTICS

Addresses to the P&SC by Professor Dame Sally Davies, Dr Nick Brown and Dr Richard Bax

THE IMPORTANCE OF BEES

Addresses to the P&SC by Tim Lovett, Dr Lynn Dicks and Don Pendergrast

SCIENCE AND THE ASSEMBLY 2013

Leigh Jeffes

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## Calendar of Events

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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
February			
5 <sup>th</sup>	IChemE Event, Hf Supported: Human Factors in Health and Safety, Module Two	Edinburgh, UK	<a href="mailto:courses@icheme.org">courses@icheme.org</a>
27 <sup>th</sup>	ICE Event: ICE Nuclear 2014	Institution of Civil Engineers, One Great George Street, London SW1P 3AA	<a href="mailto:events@ice.org.uk">events@ice.org.uk</a>
March			
18 <sup>th</sup>	Hf Event: Annual General Meeting 2014	Institution of Civil Engineers, One Great George Street, London SW1P 3AA	<a href="mailto:admin@hazardsforum.org.uk">admin@hazardsforum.org.uk</a>
18 <sup>th</sup>	Hf Event: Back to the Brink – Returning to Operation following Disasters (provisional title)	Institution of Civil Engineers, One Great George Street, London SW1P 3AA	<a href="mailto:admin@hazardsforum.org.uk">admin@hazardsforum.org.uk</a>
19 <sup>th</sup>	IMechE Event, Hf Supported: Offshore Weight Control – Managing design, installation and cost	Institution of Mechanical Engineers, One Birdcage Walk, London SW1H 9JJ	<a href="mailto:eventenquiries@imeche.org">eventenquiries@imeche.org</a>
25 <sup>th</sup>	ICE Event: Infrastructure Asset Management 2014 – Future Proofing our Assets	Central London	<a href="mailto:events@ice.org.uk">events@ice.org.uk</a>
May			
7 <sup>th</sup>	IChemE Event, Hf Supported: Hazards 24 Conference	Edinburgh, UK	<a href="mailto:conferences@icheme.org">conferences@icheme.org</a>
21 <sup>st</sup>	IChemE Event, Hf Supported: Human Factors in Health and Safety, Module Three	Edinburgh, UK	<a href="mailto:courses@icheme.org">courses@icheme.org</a>

The Hazards Forum's Mission is to contribute to government, industry, science, universities, NGOs and Individuals to find practical ways of approaching and resolving hazard and risk issues, in the interests of mutual understanding, public confidence and safety.

The forum was established in 1989 by four of the principal engineering institutions because of concern about the major disasters which had occurred about that time.

The Hazards Forum holds regular events on a wide range of subjects relating to hazards and safety, produces publications on such topics, and provides opportunities for interdisciplinary contacts and discussions.

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