



Hazards forum



The 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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Hazards Forum Chair: *Dr Luise Vassie*

September 2017

From the Executive Committee...

As noted in the Summer newsletter (no 95), there has been several changes in the membership of the Executive Committee, with four new trustees - Bill Hewlett (ICE), John Munnings-Tomes (ICChemE), John Wintle (IMechE) and Steve Osborn (IET), two new members - Nick Shaw and Thanos Moros. Combined with existing members of the Executive Committee, we have an excellent and talented team to take forward the Hazards Forum activities.

In addition to maintaining our programme of quarterly events, offering high access to high quality speakers on topical themes and networking with senior professionals, we'll be exploring new formats and event partners. As an example, we're looking at a 'Question time' event with the London Branch of SaRs early in 2018.

Our stakeholders, including our members and partners, are key to our success and we have recently started project to identify both our and our stakeholders needs and wants so that we can better deliver on our

remit. Specifically, in relation to members, it's essential that we remain relevant and offer value to retain them but equally important we can attract new members. So, over the coming months, we'll be looking in depth at membership retention and recruitment.

Ensuring our governance arrangements are fit for purpose is another piece of work we've started. So, we're currently, reviewing how our constitution stacks up against current good practice from the Charity Commission. We'll be reporting back on this at the AGM in 2018.

Finally, this newsletter will be the last produced by our editor Dr Neil Carhart of Bristol University. On behalf of the Hazards Forum members, we'd like to thank Neil for his five years of service to the Forum and his excellent accounts of event proceedings. We wish him well in his future endeavours.

Luise Vassie

The Hazards Forum Congratulates Prof Richard Taylor

The Hazards Forum extends its congratulations to Prof Richard (Dick) Taylor on receiving an MBE in the Queen's Birthday Honours for his services to engineering.

Prof Taylor was both a Trustee of the Hazards Forum (2005 – 2011) and member of the Executive Committee (2011 -2013). He is currently Visiting Professor at the University of Bristol's Safety Systems Research Centre (SSRC).

Through his distinguished career he has held roles as the Director of Health and Safety for Magnox Electric and then, after its takeover, Corporate Head of Environment, Health, Safety and Quality, Policy and Strategy for the new parent company, British Nuclear Fuels Limited.

Prof Taylor has also worked with the International Atomic energy Agency (IAEA) over many years, first chairing the international group which established the International Nuclear Event Scale (INES), then as a member of the Advisory Committee on Nuclear Safety to the IAEA Director General (INSAG). He chaired the Institution of Engineering and Technology's Health and Safety Policy Advisory Group for more than ten years and established the Inter-institutional Group on Health and Safety (JIGSR).

His current research looks into the organisational and cultural precursors to industrial disasters, and the cost-effectiveness of safety measures to improve safety. In particular he has been working on the J-value (J for Judgement) for judging the amount that ought to be spent to protect people and the environment from harm.

Safety Lessons from Sport

Neil Carhart

On **Tuesday 20th June 2017** the Hazards Forum hosted an **evening event** at the Institution of Civil Engineers, One Great George Street, Westminster, London.

Sport is a significant and growing industry within the UK, now with the backing of its own government strategy. More and more people are engaging in higher-risk sports, and there is considerable publicity when things go wrong. Even so, prevalent views vary widely as to risks and their tolerability, the effectiveness and reasonableness of control measures, and who should be responsible for what. Furthermore, preparation and planning can help manage risks up to a point, but individual and/or team behaviour will remain at the centre of safety.

The event looked at how risk-based issues in sport relate to other high-hazard activities.

The Chair for the evening was **Jon Berman**, a Chartered Ergonomist and Human Factors Specialist with long experience gained across such high hazard industries as aviation and nuclear power. He is a Past President of the Chartered Institute of Ergonomics and Human Factors (CIEHF), and his interests include culture and decision-making, resilience, and how to achieve sustained high performance in organisations.

The opening presentation, "Influencing Risk Taking in Unsupervised Water Sports" was delivered by **Michael Wright**, a Director at Greenstreet Berman. He has spent 30 years researching and consulting on the behavioural aspects of risk and safety. His work has taken him into many domains, from major accident prevention and occupational safety to promotion of safety in leisure, at home, food safety, health promotion and sports safety. Key in this has been how safety behaviour can be influenced by education and communications, and lessons have been learned from a recent line of work with the Royal National Lifeboat Institution.

Dr Grant Trewartha, Honorary Reader with the Department for Health at the University of Bath described a number of research

programmes focussing on injury prevention initiatives in rugby, working in partnership with the sport's national and international governing bodies.

The final talk on "The Evolution of Rules and Communications within Motor-Sport" came from **Dennis Carter**. Dennis was a racing driver at international level, for 22 years. He then became Competition Director and later Chief Executive at the British Automobile Racing Club, and has acted as International Sporting Delegate on behalf of the FIA. A member of the Motor Sports Council and with a number of directorships within motor racing, he also still officiates at races either as the race director or the senior FIA or MSA steward.

Dr Luise Vassie, Chair of the Hazards Forum, welcomed all those present to the event before leading them in a period of silence in respect to the victims of the Grenfell Tower fire on the 14th of June. Following this moment of quiet contemplation she introduced Jon Berman who set the scene for the first speaker.

Michael Wright began his presentation drawing a distinction between occupational health and safety and the management of hazards in leisure pursuits. In the business environment there are supervisors, policies, training, procedures and safety rules. In these circumstances there is an acknowledged hierarchy through which some degree of instruction can be disseminated. In contrast water sports and recreational activities such as swimming, sailing, kayaking are mostly unregulated, unsupervised, voluntary activities. There are no qualification or training requirements to own or use a kayak. Anyone can swim in the sea. In many ways they can be the antithesis of the work environment.

The work Michael discussed came from a long period of engagement with the Royal National Lifeboat Institution (RNLI). In recent year they have taken a close interest in the reasons people lose their lives at sea, and

what can be done in terms of education to help prevent further fatalities.

Many of the immediate causes of accidents are perhaps unsurprising. They include things such as sailing boats capsizing, boats colliding with other boats; people falling overboard; swimmers becoming fatigued; kayakers capsizing and unable to get back in; scuba-divers suffer from underlying medical problems; diver error, etc. Looking more closely another context is revealed.

Michael described a tragic canoe accident involving two men and their children. When the canoe capsized into very cold water one of the men was quite quickly unable to stay afloat and drowned. The canoe sank, and there was nobody to call for help at the shore. The children had personal flotation devices, but they are not the same as life-jackets. A personal flotation device has space to move, and is designed to just about keep you vertical. It is designed such that the wearer can get back into the canoe or kayak. A life-jacket will make you buoyant above the water-line, angled slightly backwards to keep your mouth out of the water. Tragically three of the children did not survive. The type of canoe they were using is not recommended for use on open water as it is not buoyant or stable enough.

It can be difficult for people to fully understand the hazards, risks and necessary precautions. Other similar cases include a kayaker who went to sea with no buoyancy aid at all, and one who had no method of communication (such as flares) in case of difficulty. Some people take very few precautions even when they are aware of the hazards and risks. Sometimes, even seemingly illogical behaviours have been arrived at through fairly rational routes. In hindsight it might look strange, but when understood from the participant's perspective there is logic. Psychologists often attempt to explore this underlying reasoning.

Common themes behind fatal coastal accidents include:

- Underestimating vulnerability, fatigue and the impact of cold water;
- Failing to understand hazards (for example rip currents are faster than Olympic swimmers);
- Inexperience;

- Behavioural norms (such as a failure to wear a lifejacket);
- Over-estimating own ability.

These common causes can be put down to knowledge, perceptions, attitudes and behaviours. Understanding of the impact of cold water provides a clear example of this. Cold water shock can cause heart attacks and hyperventilation that results in uncontrollable gulping down water. This can be triggered in water around 20°C depending on age, physique and acclimatisation. Everyone is at risk in water temperatures below 15°C. Average sea temperatures in the UK in winter are around 5°C. Swim fatigue can affect people after only 10 minutes, resulting in loss of control of their arms and legs. Typical wave height is around 1m and rip currents of a few mph are faster than any Olympic swimmer. Hypothermia can set in after 30 minutes.

The work Greenstreet Berman undertook with the RNLI resulted in them attempting to raise awareness of the risks associated with bodies of water and to increase understanding of the hazards. This meant getting press coverage to make people aware, for example, that more people in the UK die at sea than when cycling. Campaigns were also launched on social media and other locations. They set out to try and change social norms regarding the hazards, in the hope that this would make people more open to the practical advice, training and equipment they provide.

In the UK, the majority of RNLI Lifeguard incidents involve rip currents. They can be hard to spot and are a major cause of accidental drowning on beaches around the world. Without being aware of the associated risks, it can be hard to convince some of the safety benefits of swimming where trained lifeguards can indicate them with flags and be on hand in emergencies.

This publicity of the hazards and risks is also supported by extensive advice and support. This comes in different forms, from written advice on the RNLI's website to lifejacket clinics where people can take their lifejackets for testing. The failure rate is around 30%. At one clinic a school rowing club was found to have a lifejacket failure rate of 100%. As

the rowers got out of their boats they put the lifejackets on the floor and walked over them.

Michael concluded by highlighting some lessons from industry from the work on unsupervised water sports. There needs to be an understanding of risk and hazards, so that people are receptive to the information, guidance and support available. Targeted communications are valuable. Divers are given information specific to them, kayaker are given information specific to them. Practical safety advice is important. Finally, understanding behavioural norms is also very important.

Dr Grant Trewartha began the second talk of the evening by emphasising his belief that despite many risks and faults, sport is overall a force for good. He acknowledged the support for his research from World Rugby, the Rugby Football Union (RFU), the RFU Injured Players Foundation and Premiership Rugby, but also stressed that the content of the presentation represented his views and he did not represent those organisations.

Any sport carries an inherent risk. Participants must be aware of those risks and take the necessary precautions to reduce or mitigate them. Sport is a particularly significant cause of injury amongst young people, accounting for 41% of all injuries suffered by those aged 10-14 and 32% in those aged 15-19ⁱ.

The risks of collision and full-contact aspects of rugby in particular receive a great deal of attention in the press. Some sections of the media have questioned whether it is too dangerous for children and should be banned in schools. Data from a survey of 82 school coaches' revealed 58% perceive the overall injury risk in youth rugby as Quite High or Very High. The coaches were also asked how preventable they thought muscle, ligament, bone and total rugby-related injuries were. On a more positive note, 83% felt muscle injuries were Quite Preventable or Very Preventable. 53% thought the same for ligament injuries, 30% for bone injuries and 54% though total rugby-related injuries were either Quite or Very Preventable.

Sport governing bodies use risk management processes similar to those seem in other industries. They involve identifying hazards, assessing the risk,

controlling the risk and reviewing the risk controls. The communication of these risks is becoming better.

In terms of injury prevention, most within the sports science community would refer to the 1987 model by Van Machelen et al.



This is a four step sequence that starts by assessing the scale of the problem. This is followed by a process of attempting to understand the mechanisms and methods for injury. Preventative measures are identified and their effectiveness is assessed.

Professional premiership teams can expect on average to experience one injury per game that will keep a player off the pitch for a week. Schools (under 15s and under 18s) as well as amateur community rugby can expect to experience a similar injury once every three games.

In elite sport the focus is on performance and winning, so it is useful to consider whether injury prevention initiatives can improve performance. A studyⁱⁱ looking at professional rugby over seven seasons (15 teams and 1,462 players) witnessed 6,967 injuries. They found a relationship between injury and performance, where a 22% reduction in injury burden within a team correlated to an additional 3 league points at the end of the season. The task then turns to identify potential measures that may help to reduce injuries, in particular those that can be implemented at an organisational level. This a particularly important issue in school sports, as there are legitimate questions as to whether the children should be expected to take on that level of responsibility.

Grant described an example of the sorts of research they had been conducting with World Rugby. The rules of engagement during scrums, prior to 2013, were linked to a disproportionate number of catastrophic spinal injuries. Looking at lots of different

combinations for scrum engagement it was possible to devise methods that reduced peak forces by 25%. These recommendations were taken on board from the 2013/14 season. Data from South Africa indicates a clear drop in catastrophic spinal injuries suffered per year since the new method was adopted.

Another route towards injury prevention is to ensure existing laws are actually being applied. There is a six-fold higher risk from illegal tackles. Applying the rules consistently discourages such risky behaviour.

Further studies looked at the roles the coaches could play in minimising risk of injury in matches, specifically through the warm-up routines used in schools.

A specific warm-up intervention was devised and compared against a control group following a more traditional warm-up regime. The teams were then tracked over the course of a season. It was observed that those following the intervention exercise programme experienced reduced injury, including reduced concussion incidence of 29%, compared to those following the standard warm-upⁱⁱⁱ. Ultimately though, the efficacy of the interventions is meaningless if people do not comply with them.

Grant summed up his talk by acknowledging that while rugby has a relatively high injury risk, it is comparable with other full contact sports (e.g. American Football and Ice Hockey). Injury risks at youth levels are much lower than they are at senior elite levels. Importantly though, injury risk can be reduced in rugby through law amendments (e.g. scrum engagement), applying existing laws (e.g. over illegal tackles) and improved physical preparation (as in the warm-up interventions).

Dennis Carter gave the final talk of the evening on the evolution of rules and communication within motor sport.

Circuit design developed initially from Road Racing, gradually moving on to closed circuits with the primary purpose of protecting other road users. Initially there was no separation between the vehicles and the spectators or other people nearby. It was not uncommon to see people at the side of the circuit as cars when past at considerable speeds. This led to design modifications to

the circuits with the purpose of protecting the spectators. Both of these changes were initiated with no regard for the competitor's safety. The first protective measure for spectators was the introduction of rope barriers, but unsurprisingly these were not particularly effective. The evolution of this led to ditches being dug to separate the spectators from the circuit. These were effective in protecting the spectators but naturally prompted safety concerns from competitors. This started a move towards the design of safety features that would protect the spectators and drivers. This first came in the form of a two layer protection system, one layer to arrest the vehicle and another to protect the spectators. Initially this would have been concrete walls with some rope or low fencing a few meters back stopping spectators from getting too close to the wall, or worse sitting on it. Over time deformable structures were introduced to arrest the cars. If you stop a vehicle very quickly you are likely to cause the driver immense damage to their internal organs, brain or spine. The deformable Arco barrier, of the sort seen on motorways, became the standard barrier. Gravel traps were introduced, though they can cause vehicles to roll or be thrown into the air. Water barriers and hydraulic rams were developed, but they can be expensive and cumbersome. Modern soft barriers are very sophisticated structures largely made of foam.

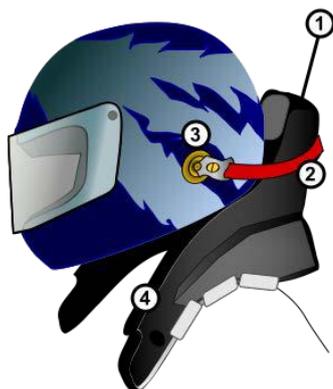
Dennis then turned to look at vehicle design. The vehicles used for racing were originally re-engineered road cars with reduced weight. Vehicle manufacturers quickly realised that the races provided a way of demonstrating their skills and technology, initiating the development of ever faster cars. The increasing speeds brought increasing danger. While the manufacturers saw the advantage of demonstrating performance, they initially saw little need in voluntarily improving safety, especially if doing so interfered with performance. However, it was soon realised that safety needed to improve, particularly with regard to fire protection. Many of the cars carry a large volume of fuel, so fire was a significant risk. Roll-over protection was also important as it was associated with several fatalities. There were also a number of deaths from drivers being

thrown out of the cars, leading to an interest in improving driver restraint. Many people did not want seat belts as they felt there was a risk they would be trapped in cars that had rolled. It took some time to persuade people of the benefits of driver restraint. Initiatives to improve driver safety resulted in increased interaction between the sporting side of the manufacturers and their research and development departments.

Roll cages, advancing from a simple hoop to an all-encompassing cage, are one of the most important vehicle design safety features along with on-board fire extinguisher systems and crumple zones.

When motor racing started there were no restrictions or regulations on drivers. The only requirement was a suitable vehicle. It was therefore largely the domain of the very wealthy. There were no requirements on experience or even driving ability. Nowadays drivers have to be licensed, with various stages of progress to reach an international level. The drivers used to wear short sleeved shirts and some, but not all, would wear a cap for head protection. Gloves were only worn to prevent blistering from constant gear changes. Regulations were slowly introduced enforcing more personal safety equipment for the drivers. Modern drivers wear fire-proof underwear, long sleeved vests, multiple-layer fire-proof overalls, fire-proof gloves, fire-proof boots, neck braces, balaclavas and crash-helmets.

Perhaps the most important personal safety device of the last century is the Head and Neck Support (HANS) Device shown below as (1)^{iv}. This attaches to the helmet via a tether (2) and anchor (3), resting on shoulder supports (4). It allows the driver to move their head as normal, while restricting excessive movement during a crash.



National governing bodies ensure that regulations and procedures are applied as written, but they also take on a role in creating them. At a national level the governing bodies will convene a number of safety committees to recommend rule changes or new regulations to a motor sport council. The council then considers these recommendations prior to implementation. The international governing body, the FIA, has a similar structure in terms of making regulations.

Dennis concluded his talk by discussing the barriers to change. The people designed to be helped by the change are often the source of the barriers. Competitors would rather spend money on performance than safety. Venue owners would rather spend money on facilities than safety. This is not because they don't believe in investing in safety. In many situations it arises from a perception that the case for the specific changes has not been adequately made.

Jon Berman thanked the speakers before opening the session to questions from the audience.

The first question asked whether the panel had seen any evidence of those who worked in safety-critical industries taking their in-work approaches home and to their leisure activities. Michael responded that having looked at hundreds of incidents in detail there was little evidence of carry-over from work place safety practices.

Reflecting on this the second question asked whether there was any evidence that people were taking the risks they take participating in sport back into the workplace? Could we identify people as risk takers from the leisure activities they engage in? Michael suggested that people's behaviours seem to change depending on the context and surroundings. Even within the workplaces a person's response to one aspect of health and safety can be very different to their reaction to a different aspect. People can be very conscientious of workplace safety (e.g. wearing protective equipment) but think nothing of driving long hours to attend a meeting. The norms and recognitions of hazards can vary enormously. Social settings can have influence over people's dispositions. Most tend to try and anticipate

how the company expects them to act and do so accordingly. Outside of work the social influences can be very different. Jon added there is evidence people compartmentalise risk, being very safe in one context and surprisingly different in another.

Jon then summarised some questions raised by the three talks. How do you engage with people who are effectively undertaking unregulated activities alone? How do you engage with people who are undertaking activities that are regulated, but where participants face challenges in implementing those regulations? How do you engage with people who present resistance to change? How do you implement changes without fundamentally and detrimentally changing the experience for participants?

Answering these questions is not easy. Improving safety in these areas is a complex challenge. The high-hazard industries can both learn from, and offer support to, the control of risk in sport.

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

ⁱ EU Injury Database (IDB) at

http://ec.europa.eu/health/data_collection/databases/idb

ⁱⁱ Williams et al. Br J Sp Med 2016; 50(11): 651-656.

doi:10.1136/bjsports-2015-094978

ⁱⁱⁱ Hislop et al. Br J Sp Med 2017; doi: 10.1136/bjsports-2016-097434

^{iv} By Duke Own work, based on Image:HansF1.jpg, CC BY-SA 3.0,

<https://commons.wikimedia.org/w/index.php?curid=4048629>

Calendar of Events

Please check the Events section of the Hazards Forum website for more information at 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
September			
19 th	>>Hazards Forum Event: Hazards for Emerging Technology	Institution of Mechanical Engineers, One Birdcage Walk, London	admin@hazardsforum.org.uk
20 th	Crane Safety 2017	Institution of Mechanical Engineers, One Birdcage Walk, London	www.imeche.org/cranesafety2017 Discounts for Hazards Forum members: select "supporting organisation" or contact eventenquiries@imeche.org and mention your Hazards Forum membership and save £60
26 th – 27 th	Delivering Onsite Nuclear Projects 2017	Manchester	www.imeche.org/nuclearprojects2017 Discounts for Hazards Forum members: select "supporting organisation" or contact eventenquiries@imeche.org and mention your Hazards Forum membership and save £90
26 th – 27 th	Tunnel Tech 2017	Institution of Mechanical Engineers, One Birdcage Walk, London	http://events.imeche.org/ViewEvent?code=CMP6544
October			
16 th	Human Factors in Nuclear Decommissioning - Chartered Institute of Ergonomics and Human Factors	Hilton Manchester Airport, Manchester	http://events.ergonomics.org.uk/event/human-factors-in-nuclear-decommissioning/ 20% discount for Hazards Forum Members
30 th – 1 st Nov	Safety Systems and Cyber Security 2017	IET, 2 Savoy Place, London, WC2R 0BL	http://events.theiet.org/cyber-safety/index.cfm?origin=hazards-forum
November			
21 st – 22 nd	Heat Recovery Steam Generator User Group	Nottingham Belfry Hotel	www.imeche.org/hrsg Discounts for Hazards Forum members: select "supporting organisation" or contact eventenquiries@imeche.org and mention your Hazards Forum membership and save £75
December			
7 th	>>Hazards Forum Event: Natural Hazards and the High Hazard Industries	IChemE, 1 Portland Place, Marylebone, London, W1B 1PN	admin@hazardsforum.org.uk

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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