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THE ERGONOMIST

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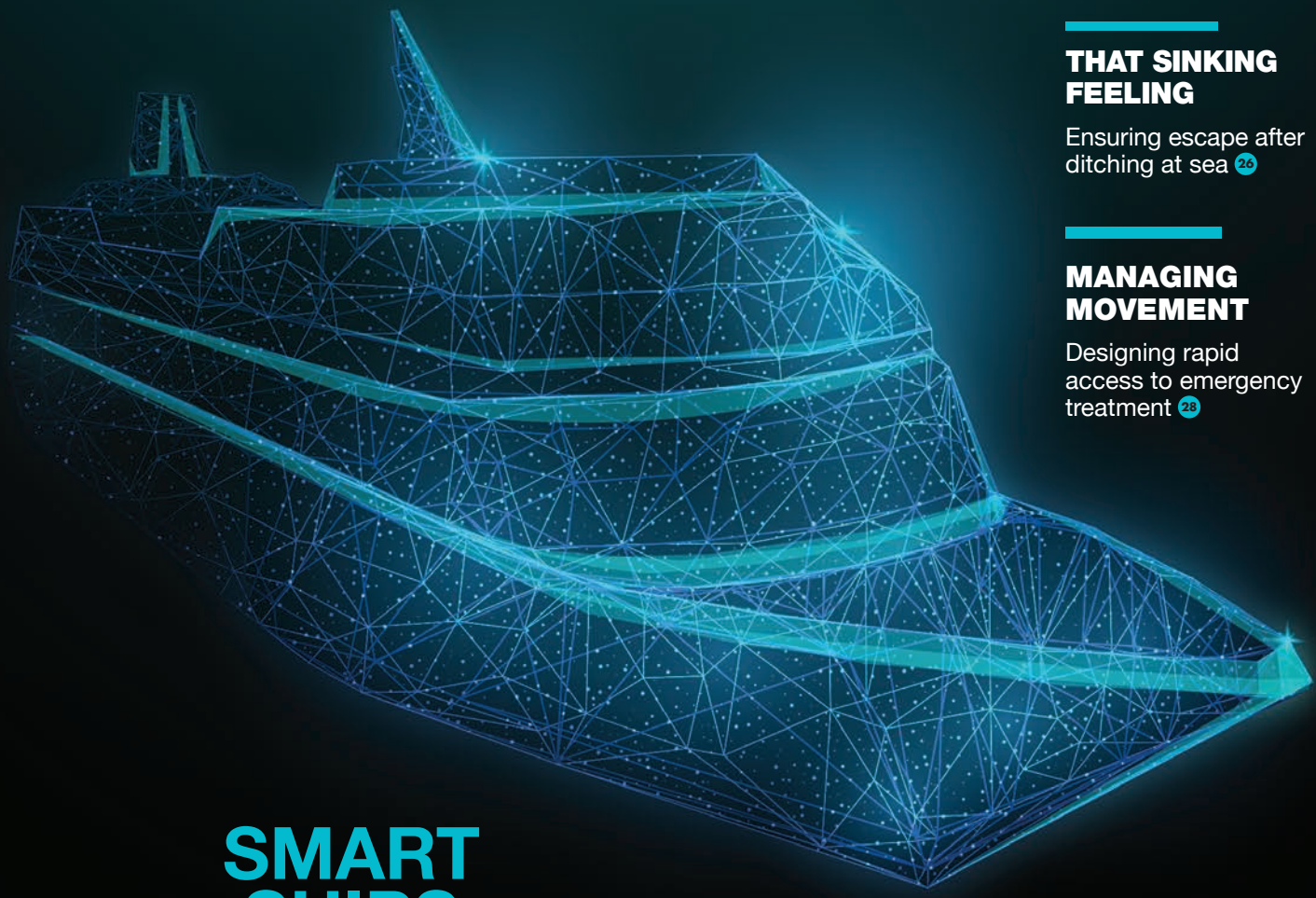

SMART SHIPS

Crewless vessels are already here. Could this be the end for seafarers?






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NEW YEAR ... NEW OPPORTUNITY

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We believe this is a great opportunity to take part in the challenges presented to a growing team within AREVA's UK operations. **Should you feel that you have the relevant knowledge and experience, please forward your CV along with a covering letter explaining your reasons for interest in the role to: Viv J Matthews, Head of UK HR, AREVA RMC Ltd, Suite 7 Hitching Court, Abingdon Business Park, Abingdon OX14 1RA or to viv.matthews@arevarmc.com as soon as possible.**

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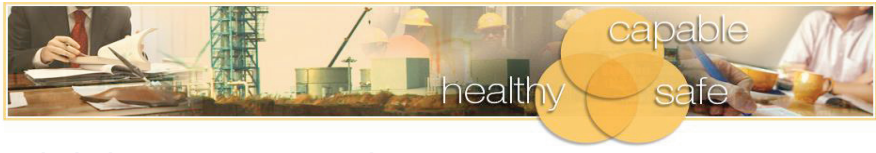

Principal Human Factors Consultant

Edinburgh-based, Salary £50 – 60k basic, discretionary bonus, contributory pension, private healthcare, 25 days' annual leave plus public holidays.

This position is for a highly experienced professional and the successful candidate is likely to possess the following:

- Registered or Chartered with a recognised professional body
- A minimum of ten years' successful delivery of HF projects, ideally across several industry sectors
- Demonstrable record of client management and business development
- Experience in a range of project types, including development and delivery of training
- Willingness to travel

Human Factors Consultant / Senior

Edinburgh-based, Salary £30-50k basic, discretionary bonus, contributory pension, private healthcare, 25 days' annual leave plus public holidays.

This position would suit either a recently qualified post graduate with some relevant work experience, or someone with strong HF knowledge whose consultancy skills are still developing. The Senior position would suit someone with several years' experience in consultancy who is looking to further develop their skills.

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- A minimum of three years' HF related work or project experience
- Strong oral and written communication skills
- Willingness to travel

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If you have any questions about the position, you can phone the office on 0131 229 6140 and speak to Janette Edmonds (Director).

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The Keil Centre is a privately-owned consultancy of Chartered Psychologists, Ergonomists and Clinical & Counselling Psychologists. Established in 1983, with a Head Office in central Edinburgh and a branch in Australia, our award-winning team support an international client base through a unique blend of skills and enthusiasms. We were the first business in Scotland to be recognised at Platinum level by Investors in People, a testimony to the nurturing and inclusive nature of our culture.

We continue to enjoy steady growth and a strong demand for our products and services. This includes:

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FROM THE PRESIDENT

Onwards and upwards in 2018

Claire Dickinson
CIEHF President

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@cdickinson10

Compliments of the season to you - and wishing you all a healthy and prosperous 2018. It is at this time of the year I take two to three hours out to prepare my CPD return. Step 1: download the form from the CIEHF website. Step 2: sit down quietly with my diary and record the learning events, books read, activities, etc., and reflect on how I have truly benefitted. The New Year and what's next go hand-in-hand. Submit back to CIEHF. Job done.

CPD emerged as a requirement of Chartership - no acceptable CPD, no Chartership, or put it another way, submit an acceptable CPD and this enables you to have Chartered status in addition to your Registered Membership or Fellowship.

With efforts going into re-invigorating the Regional Groups this year - and special thanks to those volunteer members who have led this - my CPD return will show attendance at the excellent industrial visits to Airbus and the Transpennine Express. If you haven't attended an event organised by your Regional Group this year, I would encourage you to give it a try.

And what else for 2018? Well, like any professional institute, CIEHF is keen to see its members progress through its professional grades. If you have been a Graduate Member for six or more years, how about getting your CPD, log book and references in to apply for Chartered status? Or, if you have been a Registered Member for ten or more years, how about making your New Year's resolution to apply for Fellowship? Onwards and upwards in 2018 - good luck to you.

We're keen to see members progress through our professional grades

FROM THE EDITOR

Keeping up with technology

There's a distinct focus on technology in this issue. Our cover article claims that autonomous ships will be a reality before autonomous cars, but key technologies driving development of autonomous systems are not specific to maritime, and will emerge from automotive, aerospace and healthcare sectors.

Our Human Factors in Aviation Safety event report mentions the use of technology in assessing human performance in air traffic control. Adaptive automation was highlighted by a strong keynote from the US Federal Aviation Administration, noting the gap between fact and fiction in areas such as self-driving vehicles.

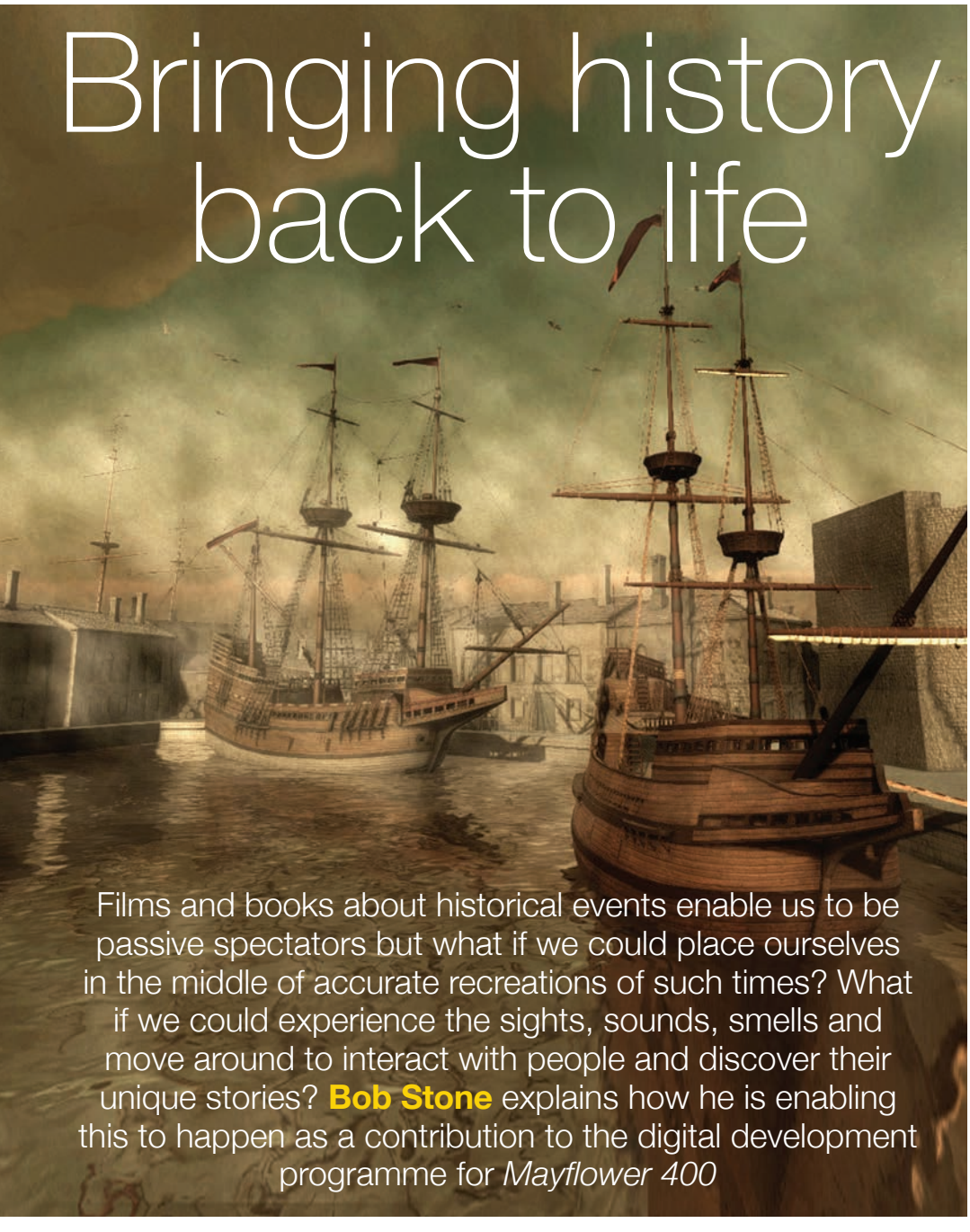
New technologies is also a theme running throughout our showcase Ergonomics & Human Factors 2018 event next April. 'Life in the Smart Age' includes demonstrations, workshops, presentations and discussions on intelligent mobility, autonomous vehicles, tactile navigation and the Internet of Things, to name a few.

In contrast, Bob Stone's article details the use of the latest in Virtual and Augmented Reality to look back into history, rather than forwards into the future, to see what life was like on the *Mayflower*, in a ground-breaking project to mark the 400th anniversary of its voyage to America.

The maritime theme continues but with a look at low tech solutions to safety at sea in the form of survival suits. With healthcare, data, manufacturing, life in academia, and Serbian ergonomics also featured in this issue, there's plenty to read about as we move through to 2018. I wish you all the best for a healthy and happy New Year!

Tina Worthy
editor@ergonomics.org.uk
@ciehf

Bringing history back to life



Films and books about historical events enable us to be passive spectators but what if we could place ourselves in the middle of accurate recreations of such times? What if we could experience the sights, sounds, smells and move around to interact with people and discover their unique stories? **Bob Stone** explains how he is enabling this to happen as a contribution to the digital development programme for *Mayflower 400*

It's early September in the year 1620. Western gales begin to make the North Atlantic a dangerous place for sailing but the *Mayflower* sets out with 130 passengers and crew on a journey that would make history.

The voyage took much longer than expected due to the ship's design. She was a typical English merchant ship of the time, square-rigged with high, broad structures fore and aft that protected the ship's crew and the main deck from the elements. A 30-foot high castle-like structure at the stern made the ship extremely difficult to sail against the wind and this resulted in the voyage from England to America taking more than two months.

Mayflower and *Speedwell*

Imagine life on board during that time. Winds battered the ship, the seas were rough and spray lashed the decks. The passengers resided on the gun deck during the voyage, in a space measuring about 50 by 25 feet and just five feet high. Food was in short supply and the threat of disease from the unsanitary conditions was always present.

In early November 1620, they sighted present-day Cape Cod and an expedition was carried out a few weeks later. Unprepared for the bitter cold, the passengers remained on board the *Mayflower* during the winter, suffering disease and pneumonia. By the spring, the 53 passengers that remained finally ventured ashore.

Reliving the voyage

Since 2015, The University of Birmingham's Human Interface Technologies (HIT) Team has been developing a range of concept demonstrators designed to show how Virtual, Augmented and Mixed Reality technologies can be used to recreate long-gone environments. One of their goals is to 'launch' a virtual *Mayflower* in 2020, the 400th anniversary of its sailing. Basic Virtual Reality models of both the *Mayflower*, and its ill-fated accompanying ship *Speedwell*, now exist although considerable effort is still required to give the vessels a sufficiently life-like level of detail that includes passengers, crew and cargo.

Through a partnership agreement with Plimoth Plantation in Massachusetts, USA, the HIT Team has been able to acquire not only copies of the plans of the *Mayflower II* prepared in 1951 by naval architect William Baker of MIT, but also the results of a detailed laser scan survey of the vessel, both inside and out.

In August 2017, using Augmented Reality techniques, the HIT Team was able to take their 3D recreation of the *Mayflower*, and visualise its departure from Plymouth, sailing in view of famous Hoe seafront, passing Drake's Island and proceeding out into the English Channel. But they acknowledged that generating convincing visually simulated effects

of ship in motion would be more challenging, especially with differing lighting and weather conditions, not to mention the quality of the seascape on which the virtual vessel would ultimately be placed. A second trial, which involved enhancing the virtual model of the *Mayflower* with believable ship motion, reflections, bow wave, wake and sail and flag motion effects, was conducted live on Plymouth Hoe later in the month.

Throughout the course of the period during which the current version of the Virtual Mayflower project has been developing, demonstrations and presentations have been delivered to a number of organisations, from primary schools and rural special interest groups to the Brownies and Guides, as part of a Science, Technology, Engineering and Mathematics (STEM) workshop.

Shipboard motion capture

A unique trial of a new, wearable motion capture technology was conducted in collaboration with the crew of the Jubilee Sailing Trust's tall ship the *Lord Nelson* when it was moored at London's Canary Wharf. The *Lord Nelson* is one of only two tall ships in the world specially designed to be sailed by a crew with a wide range of physical abilities.

The aim of the trial was to establish whether or not this particular technology – the Perception Neuron – could record useful body motion data from mariners undertaking typical onboard tasks, such as climbing the ship's rigging and unfurling the sails. The Perception Neuron takes the form of a flexible exoskeleton comprising small Inertial Measurement Units (IMUs) each containing a gyroscope, accelerometer and magnetometer. The exoskeleton can be worn over other clothing and the movement data collected from each IMU is transferred to a lightweight laptop, in this case, contained within a low-profile backpack worn by the subject.

Despite some appalling weather, the *Lord Nelson*'s Bosun's Mate completed the 34m climb of the vessel's main mast and was able to go through the motions of deploying one of the mainsails. In addition to the Perception Neuron, she was also equipped with two 360-degree panoramic video cameras, to record her activities as she went aloft. The results of this trial are being evaluated with the aim of developing techniques similar to those found in today's film productions, exploiting the captured motion data to animate computer-generated crewmembers, or avatars, that will populate the virtual *Mayflower*. The ability to represent human-like movements accurately, especially at a distance from the viewer, is an important feature in enhancing the believability of interactive virtual environments.

The ability to represent human-like movements accurately is an important feature in enhancing the believability of interactive virtual environments

Autonomous ship developments

The HIT Team has also successfully demonstrated how Virtual and Augmented Reality technologies can enable autonomous and semi-autonomous systems to be controlled remotely. The research was inspired by the concept of the Mayflower Autonomous Ship, a crewless vessel designed to sail across the Atlantic in 2020, also as part of the *Mayflower 400* commemoration programme.

A unique demonstration was staged in August 2017 during which video and sensor data were transmitted from a small, remotely controlled vessel deployed at sea off Plymouth, back to a unique Mixed Reality 'Science Station' located in the HIT Team's Laboratory on the University campus in Birmingham. Research into the concept of an advanced Mixed Reality Science Station had initially been carried out by the HIT Team under sponsorship from BAE Systems and the Ministry of Defence. This early work was designed to show how the situational awareness of the human supervisor of complex remote systems can be enhanced through the presentation of data in the form of an interactive 'wrap-around' workspace.

The trials vessel took the form of a modified angler's 'bait boat', a small catamaran with an integrated echo sounder and colour camera, piloted via a radio control system, giving an operational range up to 4000 metres. The Birmingham team modified the catamaran to include live footage from a gimbal-stabilised GoPro camera for recording at sea alongside a webcam that provided video footage via local Wi-Fi and cellular telephone links to the Science Station. A sensor module was also included to capture data such as GPS, temperature, pressure, humidity and the output of a digital compass.

This work is continuing to develop, and will ultimately allow members of the public and school children to experience the historic transatlantic crossing and to conduct future science experiments based on the data returned from a myriad of sensors on board the vessel.

Bob Stone is a Professor of Interactive Multimedia Systems and Director of the Human Interface Technologies Team at the University of Birmingham. See www.birmingham.ac.uk/research/activity/eese/ise/hit-team/.

References

For a collection of video sequences charting the HIT Team's contribution to the *Mayflower 400* programme, including those projects mentioned here, visit http://bit.ly/Mayflower400. See more information on *Mayflower 400* at www.mayflower400uk.com.

Influencing aviation safety

Human performance was under the spotlight in a recent event focusing on aviation safety. Two of the programme organisers, **Barry Kirwan** and **Will Tutton**, talk us through the discussions and conclusions

CIEHF's recent Human Factors in Aviation Safety event, held in the middle of November at Gatwick, was a great opportunity for those with an interest in civil and military aviation to come together to talk about issues and achievements across the aviation spectrum from pilot wellbeing, air traffic control and airports to unmanned aerial vehicles and rotorcraft. International representation from airlines, regulators, research bodies and consultancies ensured all sides had a platform to voice their views.

Many issues were presented and discussed across automation, fatigue, maintenance, remote control, and the over-arching theme of human performance in aviation which initiated the event. A clear element of this theme was the diversity of human factors aspects that influence aviation safety. The keynote introduction by Sian Blanchard of Easyjet outlined a prospective organisational approach to integrating human performance within safety management processes that includes mental health and wellbeing, not an element traditionally associated with safety management systems. Human performance aspects covered wellbeing, safety culture pre-requisites (Amsterdam University), management of multiple Unmanned Arial Systems (BAE Systems), cockpit interfaces for angle of attack (Coventry University), predictive human error approaches (DSTL), responsibilities for helicopter air traffic control (Coventry), and a regulator's view of the current human factors elements in the International Civil Aviation Organisation's training manuals (UK Civil Aviation Authority). Much discussion focused on human performance and the recognition that human wellbeing is vital if performance is not to degrade to unacceptable levels. Innovative research is being carried out by NATS to understand performance-shaping factors affecting air traffic controllers in real-time operations.

Understanding automation

The adaptive automation theme was a high interest area, with a strong keynote from the US Federal Aviation Administration's Kathy Abbott, showing that fact and fiction in areas such as self-driving vehicles are far apart, especially when it comes to safety. Question time discussion called for better clarification, via aviation-relevant examples, between automation, adaptive automation, autonomy and artificial intelligence. Martina Ragosta of Deep Blue presented a video on an adaptive automation project in air traffic control, and asserted that automation should not be included to replace people, but to empower them to achieve greater things. All presenters were clear that automation would not lower workforce needs in aviation, rather different kinds of support would be needed. One of the keys to this whole area, as mentioned in presentations by both Sylvain Hourlier of Thales Avionics and Fiona Cayzer of BAE Systems, is the social interaction between human and machine based on a deep understanding of how humans make the system work, so that the automation acts like a super supporting agent in a team, anticipating the user's needs and preferences. Designers need to really understand how work is done and this is where human factors has a strong skill set.

Managing fatigue

Fatigue in aviation is an ongoing and increasingly worrisome issue, which presenters claimed is not widely appreciated or supported at executive level. The onus is often on pilots to manage their own fatigue levels whilst still adhering to rosters that take them back and forth across time zones with little opportunity to acclimatise. The three speakers from this session (FRMSc, Taylair Aviation and Clockwork Research) recognised that the science underpinning fatigue risk management systems (FRMS) is 'under-cooked', and many of the systems available often ignore strong fatigue-inducing factors outside the work schedule such as commuting or inevitable roster changes.

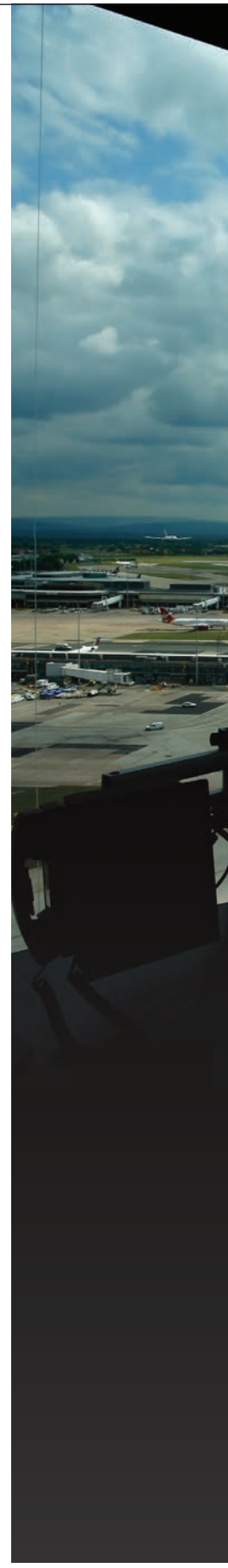


IMAGE: GETTY

Automation should not be included to replace people, but to empower them to achieve greater things

Nevertheless, sensible application of FRMS can help inform critical business decisions, and some excellent case study examples of where human factors methods can improve the situation in a cost effective manner were presented by Sarah Booth from Clockwork Research.

Remote control

The use of remote towers to control air traffic is spreading fast in countries such as Australia where there are vast areas to control, and airports like Schiphol with runways separated from the main airport. The most significant recurrent challenge, as stated by a keynote presenter, Per Ahl of Saab, is change management for those expected to switch from onsite control to remote control of one or more sectors of airspace. This message was echoed by Des Whitty from the Irish Aviation Authority, who presented on the challenges and approaches taken to integrate remote towers into their operational systems. According to the speakers in this session, including Jocelyn Clark of NATS, human factors specialists are working hard to understand and mitigate the associated risks, working closely with other professions to deliver high quality and safe systems. Regulation, however, is already starting to lag behind.

Reducing maintenance errors

Another area of continuing discussion is maintenance, where it can be difficult to see where and how to make robust and sustainable improvements. A prominent example of the loss of a fan cowl door was presented by Kyriakos Kourousis from the University of Limerick, showing just how hard it can be to develop a fix to a maintenance problem, especially when human factors is ignored. Underpinning research on safety management techniques was presented by Justin Seward from Navy Command, as well as personality assessments of maintenance engineers by Paul Dickens of Core Aviation Psychology. New research by Andy Evans from Aerossurance on latent error is being undertaken and LOSA, or Line Operations Safety Audit, is still seen as an important way to help develop controls against operational errors.

In his summing up, Barry Kirwan of EUROCONTROL, the convenor of the conference, was keen to point out that the success of the event was due to several factors. These included the diversity of its attendees and presenters who represented both civil and defence aviation in industry, research, consultancy and academia, its focus on current and critical issues in aviation safety via the use of thematic areas such as fatigue, remote towers, etc., and the high quality of presentations by speakers willing to talk candidly about the issues and a realistic appraisal of human factors' ability to resolve them. He thanked the programme committee for doing such a good job in speaker selection, and added that both FAA and NATS are keen to be involved in planning the next event.

We're already looking forward to next year, when we will continue the discussions and focus on new thematic areas. Much has been achieved in human factors work in aviation safety but there is still much to be done. ●

Barry Kirwan works for Eurocontrol and **Will Tutton** works for DSTL

Leading the way in new technologies

The Autumn Budget 2017 document published in November makes it very clear that new technology is high on the Government's agenda. On page one, it reads "The Budget sets out actions the government will take to: establish the UK as a world leader in new technologies such as artificial intelligence (AI), immersive technology, driverless cars, life sciences and FinTech [financial technology]".

That's great news and I'm sure will be encouraging for our members and others working in human factors and ergonomics who are already making great strides in this area. And the work is gathering pace as evidenced by the increasing amount of research in new technologies we're hearing about at our events. As an example, we are extremely pleased to say that following many submissions on this topic for the CIEHF's Ergonomics & Human Factors 2018 conference next April, this will be a theme running throughout the entire three days of the event.

Our 'Life in the Smart Age' theme includes demonstrations, workshops, presentations and discussions on Virtual Reality, intelligent mobility, autonomous vehicles, contactless technology, tactile navigation, the Internet of Things and Augmented Reality. One workshop will ask the question: What value could Virtual Reality and Augmented Reality bring to human factors research and design?

As this is a multi-stream event, we also feature a wide range of other topics that are just as important such as terrorism disruption, submarine command, incident investigation, behaviour change, suicide analysis, risk assessment, safety climate measurement and professional competence.

Case studies are a great way to demonstrate the positive impact that ergonomics and human factors can have, and the number of case study submissions is growing each year. Many have been accepted for the conference in April, and will feature in presentations and posters.

The event will take place at an easily accessible venue in Birmingham with the promise of interesting keynote speakers, good food and wine, entertaining social events, and of course, great networking opportunities where you can chat with fellow professionals and make new connections. For full programme details and to book, visit **events.ergonomics.org.uk/event/ehf2018/**.

The new Smart concept autonomous car Vision EQ fortwo model

Simulation used for expert testimony

In 2016 blind adventurer Mark Pollock received compensation after falling 25 foot out of a third floor window at his friends' home, leaving him paralysed and confined to a wheelchair. Mr Pollock was the first blind man to reach the South Pole and had just returned from the 1,400-mile Round Ireland Yacht Race.

During the legal case, CIEHF Chartered Member John Lovegrove, Managing Director of Canary Designs, was brought in as an expert witness. He had used Siemens' Simulation Solutions JACK digital human modelling to explore whether or not the fall was the result of an accident and presented his findings during the case.

"I was instructed to provide objective evidence relevant to the assessment of the level of risk. I reproduced an accurate reconstruction of the bedroom, determined the shape and size of the claimant, established the location of his centre of gravity relative to the height of the window sill, and modelled the mechanics of the fall through the window," he said.

In a presentation, organised by Red Bull, to companies including Bentley, Land Rover and Ford, John explained his approach of taking measurements at the scene of the accident, the development of a CAD model, the digital human model, and the simulation of a loss of balance and fall through the open window.

"This was a rare case and one that required a lot of detail and investigation, so it was vital I used the software to illustrate the key principles of the biomechanics that contributed to the fall," he said.

IMAGES: REUTER/ISTOCK

CHIEF EXECUTIVE'S PERSPECTIVE

Greater investment in R&D

Many ergonomists will be heartened to have heard the Government's recent announcement of increased research and development (R&D) investment, including an extra investment of £2.3 billion in 2021/22. Ours is a science-based discipline which views research as a key element in supporting its wider and greater impact upon society, so we should be rightly pleased. Perhaps at last the Government is beginning to match long-term ambition with real concrete investment.

The Campaign for Science and Engineering (CaSE), of which CIEHF is a contributing member, lobbies and campaigns for developments like this, in a way that we as a body are unable to do on our own. CaSE responded to the announcement by the Government of increased R&D investment towards its aim of spending 2.4% of GDP on R&D by 2027. CaSE Executive Director, Dr Sarah Main, noted in a press release:

"Government have set in train a generational shift in R&D investment. This announcement makes an incremental one year increase to the four year block of R&D investment announced at the last autumn statement. This gives confidence that the Government's plan is to keep rising public R&D investment on target over the next ten years to reach parity with our international competitors.

The Government's ambition and delivery is admirable. It is a public duty to ensure this investment is spent well. It is notable that large sums of new investment are being directed to strategic programmes through new and untested modes of funding. It will be important to both monitor their success and to ensure that the UK's tried and tested research funding mechanisms are also set to grow. After all, the UK needs a thriving research base to provide the stream of ideas that turn the wheel of innovation to create products and services.

To reach the Government's target, the industrial strategy must provide specific and effective mechanisms to attract additional private investment of over £8bn of globally-mobile R&D budgets. To continue to invest here through the uncertainty of Brexit, research-intensive companies are clear that the UK must provide a competitive economy with a healthy research base and immigration and regulation systems that support international R&D.

Research is a key element in supporting our discipline's greater impact

We look forward to working with Government to ensure the long-term target is met and delivers benefit for the UK and society."

A good example, I believe, that by putting funding into partnering with expert bodies such as CaSE, the leading independent advocate for science and engineering in the UK, CIEHF can punch above its weight in making more people more aware than ever before of the differentiating value of the discipline. That is, making a discernible difference to life or work and for the public at large to recognise that ergonomics and human factors has made that difference.

Read more about the CaSE analysis on R&D investment at **www.sciencecampaign.org.uk/our-work/investment.html**. Read the Government's full announcement at **https://goo.gl/jw1DNx**.

Steve Barraclough
Chief Executive of the CIEHF
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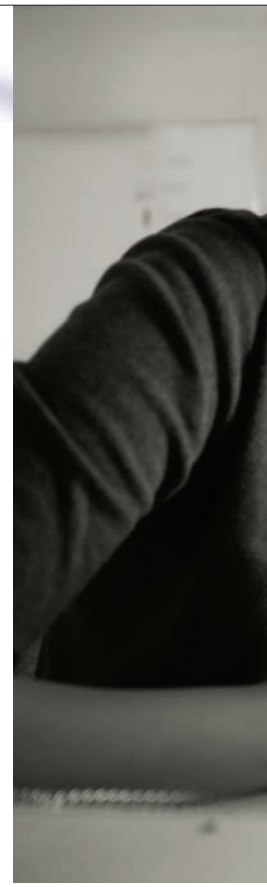

A DAY IN THE LIFE OF AN...

ACADEMIC

Rebecca Charles, teaching and research fellow

My days are usually pretty varied, as my job involves aspects of research, teaching and supervision. This week is particularly busy as the two-day conference celebrating the 40th Anniversary of the Cranfield Safety and Accident Investigation course is happening at the end of the week. It's also my first full week back at work after five months on maternity leave, so after dropping my daughter off at the childminder, I start jotting down some details on the speakers and topics for the conference session I've been asked to chair. It's my first time chairing at a conference, but the confidence of my colleagues and managers is helping me feel prepared for the role.

I move on to sorting out paperwork and making arrangements for guest speakers on a course that I will be running in March. The module is called 'Work and Job Design' and focuses on individual, team, and organisational aspects associated with designing jobs for people including job characteristics such as shift work and workload. This will be taught as part of our Safety and Human Factors in Aviation MSc course but it's also a standalone short course.

Along with teaching, another aspect of my role is supervising students. I've received some individual research project proposals, so I spend a while reviewing and commenting on these, as well as emailing students and arranging meetings.

By mid-morning it's time for a coffee and catch up with my colleague, Jim. We're working on several journal papers and we've received feedback from editors with comments that require addressing. With the Research Excellence Framework assessment of university research edging closer, the quality and impact of our work is coming under closer scrutiny and our publications are a large part of this. Jim and I have been working on a large European project called Future Sky Safety focusing on pilot performance. More specifically we're involved with a package called the 'Human Performance Envelope' and so have been carrying out research relating to mental workload and physiological measures associated with cockpit operations. It's important for us to publish our work in appropriate publications, but we also discuss how we can use more of our new research as part of our teaching.

We also have a chat about the CIEHF's Doctoral Consortium that will be held on the first day of the Ergonomics & Human Factors conference next year on 23rd April. This is a mini one-day conference for doctoral students to present and receive feedback on their work in a supportive environment. I found it incredibly useful when I was a student, so I'm keen to keep it going, and Jim helped with the event last year and feels the same way.

I've been heavily involved with the Institute in many different guises for about eight years now, so I'm not shy about persuading other people to join in too. This leads into completing my allocated review work for the Ergonomics & Human Factors conference as part of my responsibilities as co-chair of the event's Programme Committee. John Wilkinson and I are guiding the programme content, and will ultimately edit the proceedings for the conference.

When that's done, I look at the paperwork for the CIEHF's next Council meeting. I was elected onto Council this year for my second term. It's really interesting seeing the Institute from the 'other side', and especially learning about the intricacies of running a charity. I note down a few things I want to talk about, including recruiting secretariat for the conference. 2018 will be my eighth year of being part of the secretariat, and for the past few years I've also been responsible

As the assessment of university research gets nearer, the quality and impact of our work will come under closer scrutiny

for recruiting the rest of the team. The secretariat is a vital part of the conference, and it's a great way to experience the conference from an organisational perspective. Plus, when I started out I found that having a purpose made it easier to start conversations with the heads of companies, research groups, and industry leaders at the event. Some of the past secretariat have successfully found jobs by doing this.

My research centre is launching a blog at the end of January 2018, so we're all getting involved and developing appropriate content. We want to demonstrate the diverse research and teaching that we carry out in the centre from work with drones to maritime and aviation safety. I've decided to write a piece on experiential learning, or learning through experience, following a lecture using a hands-on bridge building group exercise to demonstrate the concepts of team cognition, so I spend some time before lunch working on this.

The people I work with aim to have lunch together as a group once a week. We're all so busy it's nice to have some time to catch up with everybody and talk about what we are working on, anything we need help with, and just life in general; recently I've had lots of useful parenting tips! This week we mainly discuss the 40th anniversary celebrations and making sure everyone knows which workshop, talk or tour they are responsible for.

After lunch, I return to addressing the comments on one of the journal papers we've submitted. One positive aspect to waiting a few months for review comments is that you have a complete break from the paper. This means that when you start to address the comments, you do so with fresh eyes, and often a different perspective, having worked on other things in the meantime. Having spent a couple of hours on this, I check my emails again and find I have received some notifications about the Cranfield Step Up group, which is a group for women where we can obtain career guidance and support from other women within the University. I have been part of this since its inception at Cranfield and feel it's an important initiative to use and support across the University.

I've also received some ethics applications as I'm a reviewer on the University ethics system. All of our research carried out by both staff and students needs to obtain ethical clearance. This means a lot of applications and a lot of reviewers. I have to review the applications in accordance with our ethics guidelines. This means I'm able to better advise our students relating to ethics issues, and it also gives me an excellent overview of the different research that is being carried out across the University. So, although it's a lot of extra work, I really enjoy it.

Finally I have just enough time to sort out some last minute details for a meeting I'm attending next week in Cologne, as well as planning childminding and dog-sitting arrangements with military precision! ●

Dr Rebecca Charles is a teaching and research fellow at Cranfield Safety and Accident Investigation Centre.

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OPINION

Never say never again

Richard Simcock believes we need to re-evaluate our perspective on what constitutes an achievable level of human performance, particularly with respect to Never Events. Here he explains why.

Don't start with an apology, I know, but I'm sorry. Why? Because I'm going to reference a few things that I have read and heard from human factors professionals over the last couple of years which cause me concern. First though, let me say that these are not personal slights as I'm confident these people are doing excellent work. However, I need to air my concerns because it's essential that we understand the limitations of human performance, and the resultant limits of the potential impact of human factors interventions.

In The Ergonomist No 549, there was an article 'Anatomy of a Never Event' which proffered that there is the potential to "remove" human error should human factors recommendations be put into place. More recently, in No 561's 'Who's Got Time for a Never Event?' article, we see similar language, where the author explains: "Wrong site surgeries should never happen; if they do occur it's due to systemic failure..." – well that's one explanation. Another explanation is that due to the sheer number of medical procedures completed each year - over 11 million - when operating within a system reliant purely on correct human actions, a number of serious incidents, however they are classified, will always be expected to occur, given what we know of the limitations of human performance. Of course, we all want there to be no Never Events but wanting something doesn't necessarily make it achievable.

My opinion is that the term 'Never Event' should never have been used, because it's a completely unachievable state for a high risk, high frequency system reliant purely on correct human actions. In particular, just because the NHS definition "Never Events are serious incidents..." is followed by the assertion "...that are entirely preventable as guidance, or safety recommendations providing strong systemic protective barriers, are available at a national level, and should have been implemented by all healthcare providers" does not mean that the assertion (perfect performance myth) is achievable or is something that as human factors professionals we should be propagating. Hopefully I can make this argument clear as we go on.

Anyone who has battled over the years in whatever high-risk industry they are in, with non-human factors professionals demanding that we "shouldn't be having incidents" because operators "just need to follow the procedures", will no doubt get the same chill up their spine as me when they read this.

A little perspective

The reality is, serious events as a result of errors within medical procedures will never be completely removed because healthcare is a complex system with myriad human interactions occurring each and every hour of the day. Whilst it's undeniably important to strive to improve reliability and safety, to believe we can eliminate all serious harm resulting from human action in such a system is pure folly.

Yes, 'failures' rather than 'successes' will generally hold most sway in people's minds. However, I believe as a discipline, we should be able to have a more balanced view. At the moment, I'm not seeing this. In addition to the articles mentioned previously, at the CIEHF's Ergonomics & Human Factors 2016 conference, more than one presenter stated: "Never Events should never happen", and across both the articles and the conference, the perspective appears to be that there is a problem and that the system is underperforming. Well is it? I'm not so sure. People might have looked at the numerator, but have they also looked at the denominator? Look at the table of statistics from the NHS on the following page.

What does it mean? It means that actually we get about one Never Event per 31,144 procedures. It should be noted that these events are spread far and wide across around 150 Trusts, and are certainly not isolated. They are distributed pretty consistently, as you would expect with undesirable but predictable adverse events within a series of complex systems.

In terms of Never Events, the healthcare system is demonstrably operating very near to the limits of human reliability

So does this sound like a lot? Let's look at it another way. On average 31,143 operations are performed 'without a hitch' for every one where a serious or potentially serious situation occurs. So, 99.997% of all medical procedures go without serious incident. Wow! How impressive is that? So 99.997% of the time, when someone is being anaesthetised, manipulated, cut open, bits removed, repaired or replaced, put back together, stitched back up, held in a state of 'near death' (at least where a procedure involves general anaesthetic) and brought back round again, no serious mistakes are made? Now that is very impressive.

I believe a look over the fence at what's considered to be achievable in terms of human reliability in other sectors is helpful. The Office for Nuclear Regulation (ONR) states that "... Where a value approaching $1x10^{-5}$ is offered, the dutyholder should provide a robust, modern standards qualitative substantiation to support such a value, and there should be a clear and rigorous demonstration of task feasibility and *optimised conditions for human performance*..."

Therefore, ONR need to be seriously convinced of optimised conditions for human performance in order to even approach a human reliability of $1x10^{-5}$. So, given that the Never Event values are demonstrably already →

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NEVER EVENT STATISTICS

Year	Number of procedures	Number of Never Events	Probability of a Never Event per procedure
2013/14	11,029,758	338	3.0×10^{-5}
2014/15	11,341,913	306	2.7×10^{-5}
2015/16	11,606,488	447	3.9×10^{-5}
Total	**33,978,159**	**1091**	**~ 3×10^{-5}** (1 per 31,144 procedures)

From the annual 'Hospital Episode Statistics' and 'Never Events Reported' NHS publications.

Note: In 2015/16 significant changes were made (including a number of 'new' Never Events) which is likely to have resulted in the sharp increase in the number of events.

approaching $1x10^{-5}$ (being currently at $3x10^{-5}$), then should we not at least be recognising that the system is operating reliably? Almost as reliably as you would ever model in a quantitative safety case ($3x10^{-5}$/99.997% versus $1x10^{-5}$/99.999%).

If we do this, rather than taking the negative perspective that the system is unreliable, we can then, healthily, move to make improvements to an already reliable system, which is demonstrably what we have, rather than promulgating the rhetoric that because someone has ill-advisedly called something a 'Never Event' the current situation is somehow 'bad'.

Importantly, if we keep propagating the myth (and that's what it is) that Never Events can be removed completely, then it doesn't matter what improvements are made as a result of human factors interventions, because they will only ever be considered unacceptable when compared to the mythical figure of 'zero'.

The poisoned chalice of medical care

Most high-risk sectors benefit from having a hierarchy of control which they are regulated against. Even within well-designed systems with highly trained operators working within good environments, generally two levels of engineered protection are preferred for preventing significant consequences before placing reliance on human action to do so. The healthcare sector doesn't have this luxury. Why? Because the controls are all on a human level, without the benefit of engineered protection.

Monitoring a hospital patient

We do this not because we want to, but because we have to. There is no alternative, because our interventions, at least for now, are human. That is, humans identify and diagnose conditions, evaluate potential responses, decide what action to take, and then take that action. Yes, there might be some support along the way, such as an alarm if a patient's pulse drops too low, but a medical procedure will always require correct human performance for the procedure to be successful.

So, to achieve the level of reliability already being achieved with a purely human system is actually pretty impressive in anybody's book. In terms of the probability of Never Events, the system is demonstrably operating very near to the limits of human reliability that other high hazard sectors would ever claim.

Therefore, whilst it's essential to always strive to reduce the number of adverse events within any high-risk system, we also need to recognise the level of reliability at which the system is already operating. We might be able to chip away at the number of events but they are more likely to reduce by small degrees rather than by significant amounts, and certainly will not be removed altogether.

Realistic expectations

When 11 million complex operations take place, and are solely controlled by human intervention, undesirable events will occur, even within a system that has optimised conditions for human performance.

The healthcare sector is in the unfortunate situation that 'do nothing' is not an option and never will be. There is no option to wait until engineered systems are available, or wait until a passive safety feature can be designed. Healthcare has a unique demand placed upon it, that is, the need to perform an intervention for the benefit of continued health, and doing nothing is never an option. Therefore, we need to recognise this as a burden which is unique to the healthcare sector.

I believe we need to start recognising the high level of human reliability that is currently being achieved, consistent with what would be expected in any other high-risk sector, rather than a skewed and unhelpful perception that the system is broken, failing or particularly error prone. If we do this, we can convey realistic expectations of the improvements that can be made with human factors interventions, rather than reinforcing mythical expectations of perfect human performance.

Richard Simcock is a Chartered Registered Member of the CIEHF who specialises in risk management, human reliability and interface design. Richard has around 20 years' experience applying human factors within nuclear, defence and other high risk industries and is currently working in the field of medical device development.

Further reading

https://improvement.nhs.uk/resources/never-events-policy-and-framework/
ONR GUIDE, Human Reliability Analysis, NS-TAST-GD-063 Revision 3

Ergonomics & Human Factors 2018

Chartered Institute of Ergonomics & Human Factors

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Commodore David Bartlett – Safety Director, Royal Navy

Todd Conklin – Human and organisation performance consultant, Los Alamos National Laboratory

Graham Braithwaite – Director of Transport Systems and Professor of Safety and Accident Investigation, Cranfield University

A wide-ranging programme

This three-day conference is the largest of its type and showcases the very latest developments, achievements and challenges in all areas of ergonomics and human factors. The packed programme features presentations, workshops, discussions and posters covering exciting new themes: life in the smart age; autonomous control; physiological measures and vigilance and fatigue. The emphasis will also be on cross-sector learning, establishing human factors in new domains, and we will be considering what works and doesn't work in practice.

You will be able to connect with people from all sectors to exchange ideas and information from an academic, practitioner and customer perspective, as well as to enjoy lively and fun social evenings.

Register

For details about the programme and to register please go to events.ergonomics.org.uk

events.ergonomics.org.uk

Smart ships: the end of the seafarer?

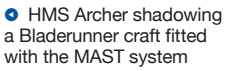
Maritime autonomy is coming quicker than driverless cars. **Freyja Lockwood** and **Richard Westgarth** examine the key factors in its development including the economic benefits, coupled with technical feasibility, and how human factors can influence its development – provided it can keep pace.

In the commercial maritime and naval sectors there is a drive to provide services and capabilities at lower cost. There is also a lack of skilled people willing to enter the industry. The potential for change was seen in a highly successful Royal Navy exercise, Unmanned Warrior 2016, which convincingly pushed the boundaries of how autonomy could be used.

Crewless or unmanned vessels with increasing levels of autonomy will disrupt how the industry operates, forcing it to reshape in ways seen in other sectors, for example, Uber. Small crewless vessels are already operating in ocean science, naval, surveying and exploration applications. Major companies such as Rolls Royce and Kongsberg will have crewless cargo and ferry vessels operational by 2020. We see 2017/2018 as a turning point in the maturity of autonomy as companies start to implement larger scale unmanned vessels for freight and other open ocean operations. This marks a departure from previous small-scale applications.

Key challenges

Technology is advancing rapidly and this presents both opportunities and threats. As in other sectors, companies that adopt emerging technology and embrace alternative business models to realise efficiencies and cost


HMS Archer shadowing a Bladerunner craft fitted with the MAST system

savings have grown, whilst businesses that do not evolve decay. These changes will be truly disruptive.

We believe the key challenges are not technological and that wider factors will need to be considered during implementation:

- How do you build a safety case when the equipment will be developed, validated and verified in new ways that will challenge established engineering processes?
- How will we regulate and legislate, whilst supporting innovation?
- Will society accept and trust these 'ghost ships'?
- How will people interact with autonomous vessels – other seafarers, operators and maintainers, and across the supply chain?

Technology driving development

Five of the key technologies driving development of autonomous systems are not specific to maritime; in fact, many will emerge from other sectors such as automotive, aerospace and more diverse areas such as healthcare.

Artificial Intelligence (AI): covers a series of entwined technologies such as neural networks, machine learning and cognitive computing. Autonomous ships will look to exploit AI on board a vessel, to control it, make decisions on collision avoidance, for efficient route planning and on-board condition monitoring.

Sensors and situational awareness: looking at how vessels will sense and perceive the world around them and the impact that has on their decision-making. Technologies are available from other sectors, driven by consumer technology such as mobile phones, which are driving down cost, size, and power consumption.

Connectivity: a key challenge to maritime vessels in the open ocean. Existing solutions operate at relatively low data rates and SATCOM is seen as expensive. Developments such as the Internet of Things, 5G telecoms and small low-cost sensors will increase connectivity and digitise the sectors.

Cyber security: as the sector becomes more reliant on connected digital systems, the cyber risk will increase. Operators will need to protect against this through implementing barriers to software hacking, prevention of physical access which would enable unauthorised control of vessels, protection from the 'insider threat' of disgruntled employees, the hacking and spoofing of GPS and the theft of data to enable piracy.

Energy management and sustainability: a critical area as systems will need to operate unmanned for extensive periods of time. We will need to look toward new, cleaner technologies for propulsion. For the future we expect improvements from other industries such as automotive, as they develop similar solutions and move to greener energy sources.

Regulation and legal challenges

Autonomous technology will bring regulatory challenges. Often regulation lags behind technology but with highly dynamic technology, such as AI, proactive risk management rather than avoidance should be encouraged. Future regulation should provide safeguards against poor quality systems, support the reduction of both real and perceived risks, but not prevent innovation in technology, its application and in future business models.

There are legal challenges to be addressed. As future unmanned systems are implemented, new areas of responsibility will need to be defined. For example, who is responsible for the vessel when there may not be a 'traditional' Master who bears the responsibilities for overall safety and operation? Ethical considerations include the definition of 'acceptable' levels of safety, public perception of autonomous technology, and the development of decision-making solutions that reflect human rather than machine ethics. These challenges are just the tip of the iceberg and are not unique to maritime. Opportunities exist to learn from other sectors.

Small crewless vessels are already operating in ocean science, naval, surveying and exploration applications

Re-shaping the sector

Autonomous systems will have significant implications on the nature of work in the maritime sector and the people doing the work in the future.

Impact on the nature of work

The cost of labour, and a shortage of skilled people, particularly officers, is accelerating the adoption of autonomous technology. The pressure to significantly reduce operating costs is also a factor in some sectors. Safety is another driving factor, underpinned by a need to remove people from hazardous work environments.

Different market pressures will influence what technology solutions are adopted across the sector. However, we predict that roles, organisational constructs and responsibilities will shift from operating at-sea platforms to on-shore management and supervision of these systems. This will require new concepts for traditional tasks, such as those associated with collision avoidance and ship safety at sea (watch keeping).

The adverse impacts of new technology are widely discussed. However, these technologies could improve working conditions and make the maritime sector a more attractive employment proposition by eliminating many of the more negative aspects of life at sea.

People and machine collaboration

Few occupations will be entirely eliminated by workforce autonomy and intelligent systems. Deployment will be at a task-level rather than replacing entire roles. A new relationship between people and machines will emerge with people increasingly working alongside automated systems. Their ability to do so effectively will be crucial to realising →

The UK's Maritime Autonomy Surface Testbed (MAST), an unmanned surface vessel (USV) based on the innovative BLADERUNNER hull shape, has undergone trials in the tidal Thames

the benefits this technology can bring.

This will present new challenges to be overcome. The integration between people and machine will be critical to effective maritime operations and should be a primary concern. Integration needs to be carefully considered from a user-centred design perspective underpinned by close collaboration between technology providers and seafarers along with human factors, behavioural scientists and design specialists.

Future seafarers may not actually go to sea

Skilled seafarers of the future

As a growing sector, the maritime industry is already struggling to find adequately skilled seafarers with significant shortfalls of key positions predicted over the next decade. The adoption of advanced technology and increasingly complex digitised vessels will exacerbate this issue. Maritime roles are going to look very different in 2030; technology will change what work needs to be done, how, where and by whom. Future seafarers may not actually go to sea.

Overall smarter ships will require smarter people. When we look at future skills, we see a greater emphasis on digital and technical skills, new ways of working collaboratively with autonomous systems, and remote working as the norm. We anticipate that these skills will continue to change and evolve as the technologies continue to develop and working with machines becomes routine. Workforce and organisational planning needs to take this into account, complimented by a detailed understanding of how emerging technology and trends in ship design will shape future operations.

A human factors perspective

These are some of the human factors issues we believe should be considered during development and implementation.

Technology is not destiny: The evolution of work facilitated by technology development is not new and we have an opportunity to consider some of what history has to teach. Autonomous systems and AI have immense potential. Active engagement from the maritime sector will shape whether this phase of technological advancement will have a positive or negative impact.

Autonomous systems and trust: The dynamics of trust between people and autonomous systems are poorly understood. People have an innate tendency to mistrust things they do not understand or cannot control. This influences adoption though early stage design choices that can help mitigate this risk. The move towards greater collaboration with technology means that human-machine interaction good practice needs to inform the development of autonomous systems to design trustworthy systems.

The ironies of autonomous systems: Automation commonly aims to replace people, this however, can have unintended consequences. There are valuable lessons we should learn from other sectors, especially aviation. Autonomous systems have made flying safer by reducing human error, but reliance on automation makes it harder for pilots to maintain the skills they need to cope when the systems fail or do not behave as expected in extreme and challenging situations. The irony is that the more advanced (and reliable) autonomous systems are, the more highly skilled and trained operators need to be.

User-centred design should inform the overall development of autonomous systems to ensure that systems are easy to use and safe. It will also make it more likely that seafarers will trust the technology.

A view of the future

The socio-economic implications of maritime autonomous technology suggest extreme change with radical changes to labour markets and operating models. Future ship systems will be more dynamic to rapidly exploit emerging technologies. Interactions with intelligent systems will be commonplace. Most roles will change and many will move ashore.

The indications are that we are collectively unprepared. Opportunities will favour those individuals, companies and countries who adapt quickly to changing skill needs and industry obsolescence. We will need to address ethical issues and manage public perceptions. Trust is hard won and easily lost but the benefits in accessing ocean resources safely and working toward a more prosperous world are there to be taken. Ultimately it is up to us to shape our future.

Freyja Lockwood is a Chartered Human Factors Consultant who brings a people-centred perspective to technology-driven change and organisational development. She is currently investigating how the Fourth Industrial Revolution is fundamentally re-shaping the nature of work.

Richard Westgarth is a Strategic Planner and Technologist working on future maritime autonomous systems and related technologies. They co-authored the original report with Lloyds Register, QinetiQ and the University of Southampton. Contact NFLOCKWOOD@qinetiq.com or REWESTGARTH@qinetiq.com.

Further reading

This article is a summary of The Global Marine Technology Trends 2030 Autonomous Systems insight report, the latest of a series of publications from Lloyds Register, QinetiQ and the University of Southampton addressing the future of the marine and maritime sector, published in August 2017. Download it here: www.qinetiq.com/GMTT2030.

BOOK REVIEWS

Byron Edwards, a Human Factors Engineer specialising in manufacturing, talks us through this introduction to industrial workplace design.

Production Ergonomics

Adoption of ergonomics principles in the design and operation of production facilities has been shown to result in marked improvements in aspects such as workplace safety, efficiency, and product quality. Despite this, adoption of ergonomics principles is not consistent throughout industry, and the level and type of ergonomics integration is largely dependent on the organisation. *Production Ergonomics* aims to provide engineering students (particularly future system designers and production engineers) with a foundation knowledge in ergonomics and human factors in order to support the design of better industrial workplaces.

The authors split the book into three parts. In Part One *Understanding the Human in the System*, readers are introduced to the scientific principles of ergonomics including physical, cognitive and organisational aspects of the discipline. With each subject area worthy of a textbook of its own, the authors have done a good job in providing a succinct overview of relevant theory and application for each.

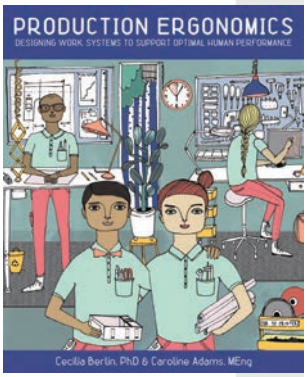
Part Two *Engineering the System around Humans* introduces methods of assessing human work and workspaces, and economic and social arguments for integration of production ergonomics. Readers are provided with a high-level overview of a number of common assessment methods including task analysis, human modelling and environmental assessments. Readers will discover the benefits of these analyses, in what circumstances they are appropriate, and the associated pros and cons for each. Additionally, this section provides budding system designers with methods to cost ergonomics interventions and a brief overview of social arguments which can be used to support the business case for inclusion of ergonomics in the scope of work.

Part Three *Workplace Design Guidelines* provides useful design checklists for each of the topics discussed. Whilst by no means exhaustive, these checklists prompt designers to ask appropriate questions and seek further guidance where necessary.

Much of the book is focused on the assessment of the physical tasks and workspaces in order to minimise issues associated with discomfort or injury, and improve productivity. These areas are addressed well with adequate overview of theory, assessment methods and design guidance presented throughout the book. Cognitive and organisational aspects of ergonomics are, however, covered in less detail. Given the significant safety and productivity benefits associated with consideration of cognitive and organisational ergonomics during the design phase, readers may benefit from an overview of the methods used for assessing these aspects in a future edition of this book.

Whilst aimed at students, this would also be a suitable reference book for early career system designers. It covers a range of relevant topics, presenting the key aspects of each and directing the reader to further sources of information. Throughout, the book is presented in a way which is accessible to those without an ergonomics background and readers are frequently reminded why the information being presented is relevant to engineering.

In providing a foundation knowledge in ergonomics, this books largely meets its aims. The reader is provided with a brief, yet informative overview of ergonomics as a discipline and its importance in the engineering context. Overall, this free downloadable book is a good resource for raising awareness of ergonomics amongst production and system engineers, supporting the design of better production systems for the operators that use them.



Book reference

Adams C & Berlin C. 2017. Production Ergonomics: *Designing Work Systems to Support Optimal Human Performance*. London: Ubiquity Press. DOI: https://doi.org/10.5334/bbe. Available as a free download.

Ergonomics perspective from Serbia

With its turbulent past, Serbia has had to battle hard for independence. **Aleksandar Zunjic** describes the challenges that ergonomics has faced throughout those times.

Serbia is a landlocked country situated at the crossroads of Central and South Eastern Europe. Its population numbers around 7 million and its capital, Belgrade, is among the oldest and largest cities in the region. Following World War I, Serbia, which had been a separate state, co-founded Yugoslavia with other Southern Slavs, and this then existed in various political forms until its break up the 1990s. Serbia eventually re-established its independence in 2006.

Initial activities of ergonomists in Serbia date from the 1970s. Ergonomics approaches at that time were not yet widely used in industry, mainly due to a lack of recognition of ergonomics as a scientific discipline. However, there were examples of its application in some sectors. For example, anthropometry was used in designing the interiors of passenger cars. Some models from the car factory Zastava in Kragujevac were exported to the US market at that time. Today the plant is run by Fiat. Ergonomics was also being applied in defence, primarily in the design of aircraft and armoured vehicles. The company, Electronic Industry Niš, at the time a producer of television sets, was also applying ergonomics.

Development of the ergonomics society

In 1972 an international ergonomics conference took place entitled 'Human - Machine and Environment System'. The organisers of this conference were the Association of Mechanical and Electrical Engineers of Yugoslavia and the Faculty of Mechanical Engineering at the University of Belgrade. This event was organised by Professor Vuksan Bulat from Serbia and Professor Alain Wisner who was director of the Laboratory for the Physiology of Labour and Ergonomics at the National Conservatory in Paris. At that time, Professor Wisner was very interested in the implementation of ergonomics in Yugoslavia, and during the preparation for this conference, the idea of establishing an ergonomics society in Yugoslavia was born.

On 14 April 1973, the founding assembly of the Yugoslav Society for Ergonomics was held at the Faculty of Mechanical Engineering in Belgrade, the statute was adopted, and the Executive and Supervisory Board were elected. Fittingly, the first President was Professor Bulat. The Yugoslav Society for Ergonomics became a federated society of the International Ergonomics Association (IEA) in 1974. Initial activities of ergonomists in Serbia were directly related to the emergence of the Society, which boosted motivation and led to many achievements of ergonomists in Serbia.

In 1993, following the break up of the former Yugoslavia, the Society evolved into the Ergonomics Society of the FR Yugoslavia, and in 1995 Professor Stanisa Miloševic from the Faculty of Transport and Traffic Engineering in Belgrade became President. The headquarters of the Society was in Belgrade.

Along with the Yugoslav Society for ergonomics, several republican societies for ergonomics were also formed, one of which was the Society for Ergonomics of SR Serbia. It was formed in 1974, at the end of the first ergonomics symposium in Serbia. Its first president was Professor Ivan Stajnberger, former Dean of the Faculty of Philosophy in Belgrade, but by 1995 the Society had ceased to operate.

In December 2007, the Ergonomics Society of FR Yugoslavia became the Ergonomics Society of Serbia (ESS) and was formally accepted as a federated society of the IEA the following year. However, in 2012 the ESS faced a new problem. A new law was passed in Serbia, equalising the tax obligations of non-profit organisations with those making a financial profit. This has largely limited the capabilities and activities of the Society as it neither has permanent employees nor regularly makes a profit.

In 2016 Professor Aleksandar Zunjic from the Faculty of Mechanical Engineering, University of Belgrade was elected President. He is a member of the working group of the IEA Work With Computing Systems. In addition, the ESS is a member of the International Engineering and Technology Institute (IETI), an organisation that brings together scientists from all over the

IMAGE: GETTY

Workers operate sewing machines to make car seat covers at a manufacturing plant in Odzaci, Serbia

world. A new international journal in the field of ergonomics called *IETI Transactions on Ergonomics and Safety* has been launched with Professor Aleksandar Zunjic as Editor-in-Chief. This year, the ESS submitted a formal application for membership of the Federation of European Ergonomics Societies.

Ergonomics education

Whilst not taught at universities in its own right, ergonomics had been included in many allied subjects before the formation of the ergonomics societies. In 1958, Professor Tomislav Tomekovic started teaching the psychology of work. In the textbook for this subject published in 1965, he dedicated a chapter 'Man's work in the machine system' to this new scientific field.

The process of implementing ergonomics in the educational system in Serbia has continued and has been extended to several faculties, and higher and vocational schools. At the Faculty of Mechanical Engineering in Belgrade, ergonomics was introduced as an elective subject at the Department of Labour Organisation, not long after the establishment of the Ergonomics Society. Since 1992, industrial ergonomics has been taught over two semesters at the Industrial Engineering Department of the Faculty of Mechanical Engineering in Belgrade and continues today. The journal *Ergonomija* ('ergonomics' in Serbian) has been published regularly for about 15 years by the Institute for Documentation of Occupational Safety and Health.

Ergonomics in Serbian industry

Due to economic isolation after the disintegration of Yugoslavia, Serbian industry experienced collapse. Most successful companies either went out of business, were significantly changed, or sold. These effects are still being felt in Serbia. This is the main reason for lack of significant investments in ergonomics in Serbian industry. In many companies, ergonomics is still treated as a luxury, not as a requirement.

However, many foreign companies now operate in Serbia. One example is Siemens, which has excellent relations with the Faculty of Mechanical Engineering in Belgrade. Siemens employs engineers with ergonomics knowledge and engages students in solving various issues using an ergonomic approach. Some Serbian firms have also begun to apply ergonomics more widely in business, for example, in the IT sector, which is currently on the rise in Serbia.

The effects of economic isolation are still being felt

Ergonomics is also being applied in the Serbian health system, specifically in medical device design. A parent education project has been launched which, among other things, includes a number of topics related to ergonomics for newborns and children. It is one of the first ergonomics courses of its kind in the world and is led by Professor Zunjic.

Future challenges

The ESS recognises two basic challenges. The first is how to grow appreciation of the discipline of ergonomics in Serbian society as a whole. New products need to be created that contain innovative ergonomic design solutions, accompanied by good marketing that can help to explain the benefits of these products.

There is also the issue of valuing and financing ergonomics solutions, especially for example, in public transport, in furniture manufacture and other industries. Companies need to realise that good use of ergonomics can differentiate products of the same or similar purpose and performance, and if they are willing to implement ergonomics solutions in their products, they can achieve significant market advantage.

The second challenge is how to increase the use of ergonomists and the number of ergonomists employed by companies. The scope of many jobs needs to be expanded to include ergonomics, with occupational safety being one area that could benefit. There are examples of good ergonomics applications in the paper industry, which has led to improved production, without injury and without errors.

Further international initiatives are being launched by ESS to overcome these issues in Serbia and we look forward to progress in this area. ●

Aleksandar Zunjic is a professor at the Faculty of Mechanical Engineering, University of Belgrade and President of the Ergonomics Society of Serbia. He is Editor-in-Chief of two international journals and an editor of three further international journals.

Ergonomics & Human Factors
Careers Day

28 February 2018 | Birmingham

The very best of careers guidance, options and opportunities

What can I do at the Careers Day?

This is the only event in the UK dedicated to providing information about careers in ergonomics and human factors. At this event, you can:

- Visit the Jobs Fair with stands from leading organisations looking for new and enthusiastic talent.
- Listen to presentations from those already working in ergonomics and human factors about what they do and how they got there.
- Network with other professionals, new graduates and students from across the UK.
- Talk to the team from the Chartered Institute of Ergonomics & Human Factors who will answer your questions about:
  - The career options open to you, including those in academia, industry and consultancy
  - The best route to get from where you are now to where you want to be
  - How to demonstrate your professionalism through membership of the CIEHF
  - How to advance your career through continuous professional development

Who can attend?

This event is aimed at anyone looking to find out more about a career in ergonomics and human factors. It would particularly help:

- Undergraduates, new graduates and postgraduate students.
- Those whose jobs require them to upskill and take on responsibility for human factors work in their organisation.
- Those who are already established in a field such as engineering, design or psychology but who are looking to change career.
- Those who have already taken their first steps in their ergonomics and human factors career but are looking to find out about work in other sectors.
- Careers advisors who want to guide people towards an exciting and rewarding career.

Jobs Fair

ATKINS Member of the SNC-Lavalin Group

babcock

Cambridge Consultants

greenstreet berman

NATS

team

and more to come

Event sponsored by

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How much does it cost?

The attendance fee is £30. This includes unlimited access to all activities throughout the day, refreshments and lunch, and a copy of the CIEHF's new careers booklet. Anyone joining us as a new member on the day gets their attendance fee refunded in full!

How do I book?

If you want to find out more about future career options, book your place now at this unmissable event at **events.ergonomics.org.uk** or **email sally@ergonomics.org.uk** if you have any questions.

Organised by

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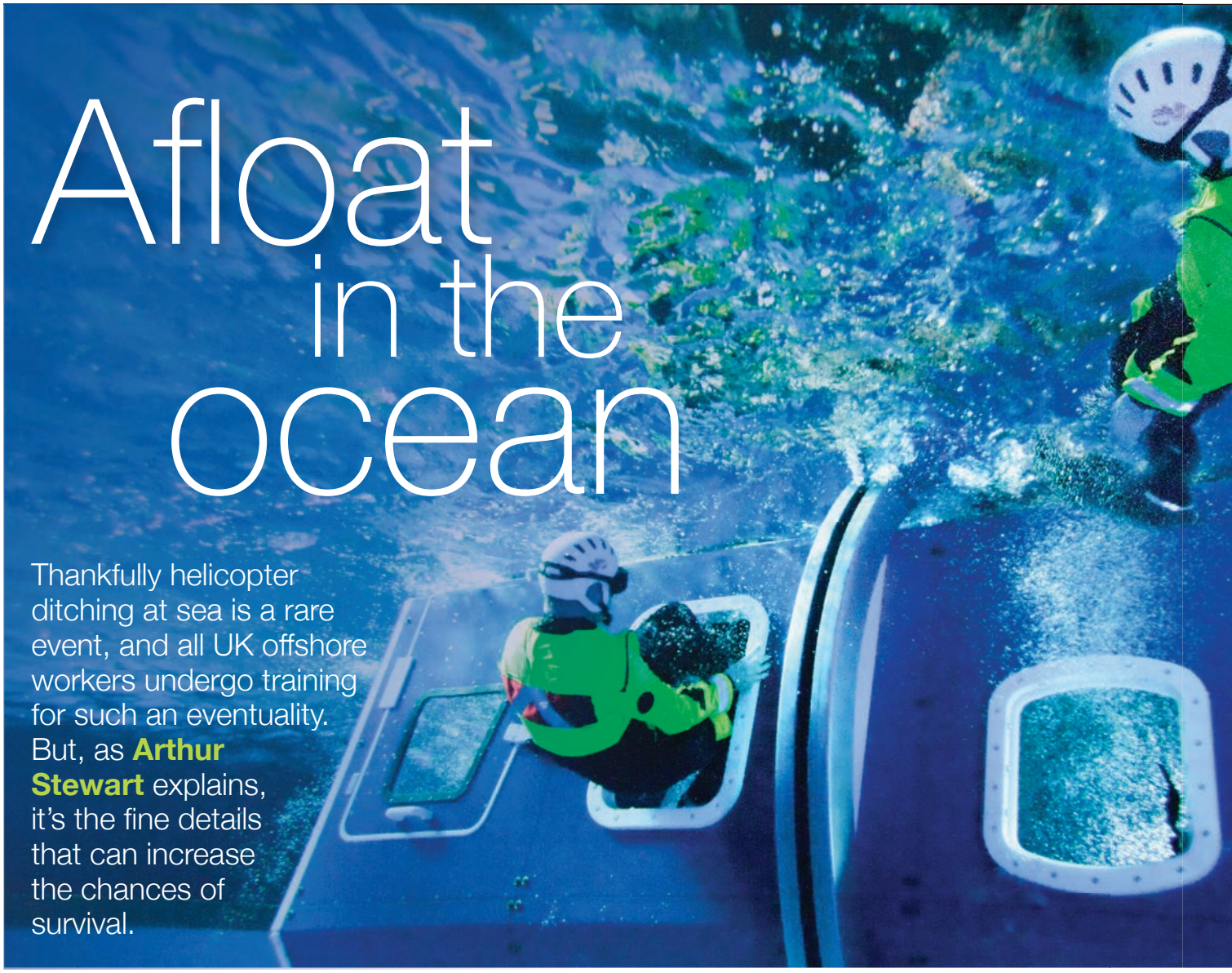
events.ergonomics.org.uk

Afloat in the ocean



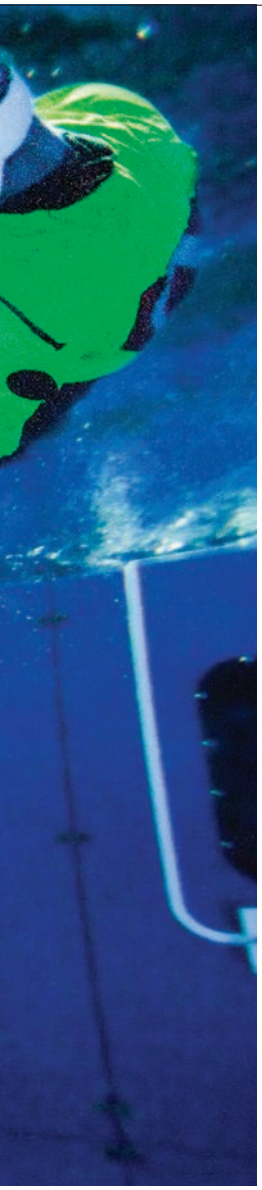
Thankfully helicopter ditching at sea is a rare event, and all UK offshore workers undergo training for such an eventuality. But, as **Arthur Stewart** explains, it's the fine details that can increase the chances of survival.

With hundreds of helicopter flights taking place each day over the North Sea, safety is of paramount importance for those being transported to and from offshore installations. Much research has been carried out to understand the risks to life of ditching at sea. Because its engine is above the fuselage and centre of gravity is high, a ditched helicopter will frequently invert and subsequently sink. With the helicopter in this position, it may be necessary for the occupants to initially swim downwards to escape. Special training is designed to acquaint an individual with such an inevitably disorienting environment in a controlled fashion.

The offshore workforce operating in the UK continental shelf undergoes helicopter underwater escape training (HUET), which forms part of bi-annual testing. It involves wearing a survival suit and lifejacket, and escaping through the window frame of an inverted and submerged helicopter simulator in its pool, commonly referred to as 'the dunker'. This process prepares workers physically, procedurally and psychologically for the unlikely eventuality of a sea ditching, and optimises the odds of surviving such an incident. As well as offshore workers themselves, medics, health professionals, survival specialists, aviation ergonomists and the occasional academic have been dunked.

The offshore safety training providers offering the HUET have banks of well-used survival suits for those to be dunked, under which a boiler suit is customarily worn. The tapered seals at the wrists and neck are sufficiently snug to ensure virtually no water enters. By contrast a well-worn or ill-fitting suit's seal may be less than perfect, resulting in an exchange of the pool's warm water for body-warmed dry air.

For flights to and from the UK continental shelf, a raft of regulations affects not only the specification of survival suit material, but a range of other things including its ability to vent trapped air through shoulder valves, visibility of reflective materials and also the insulation clothing worn



Helicopter underwater ditching and escape training in Aberdeen.

IMAGES: ALAMY

under it by passengers. The rules for summer and winter insulation clothing worn under the suit differ, and this affects the amount of buoyancy experienced by offshore workers. This is important because the performance of a suit has to attempt to meet two conflicting objectives: 1) to preserve the body's temperature when immersed in cold water; and 2) to avoid being too buoyant. Herein lies the problem: a well-insulated suit will be great at keeping you alive for long periods of time floating in cold water awaiting rescue, but risks making the wearer critically buoyant, especially in those who have a tendency towards being naturally buoyant. In other words, the buoyant force pushing you up could exceed your ability to swim down below the water surface and out of a submerged exit.

Emerging onto the damp poolside after successfully completing my HUET training, my thoughts were on finding a hot shower and not on the biomechanics of buoyancy. However, safely back at work the following week, I postulated how the amount of trapped air may relate to body surface area as well as clothing, and that the vents to purge the air may be obstructed by an ill-fitting suit or harness straps for instance. Back in the 1980s I had completed my MPhil research on underwater weighing and understood how difficult and expensive it would be to measure buoyant force in living humans accurately. And so the idea for a study was born using 21st century technology and at low cost.

Rather than measure buoyant force, we would calculate it based on measured volume, knowing the mass of the body, and the density of water. Even better, we had convenient access to the pool in the university's sports centre, as well as numerous industry safety representatives, who most helpfully came in all shapes and sizes. First, we weighed all participants in their clothing that would be worn under the survival suit. We then weighed them again with the survival suit on. After a 'dry venting' manoeuvre to expel all possible air whereby the participant squats down and folds their arms across their chest, each person was scanned using a portable 3D scanning device. Scans were processed and rendered into a 3D object which measured volume.

Next, participants jumped into the deep end of the pool, ensuring they achieved full submersion, so that the shoulder valves would expel the remaining air. Once afloat, they then completed a further full immersion by sculling or swimming below the water surface. This proved difficult for some of the participants. Most of them had not noticed this buoyant force during their HUET training, or realised just how problematic swimming down against it can be, without solid objects to hold on to. Newer helicopter designs have grab handles at exits to assist this.

After the second submersion, participants exited the pool up the steps and were towelled dry as they walked back along the poolside for a follow-up scan. In all but one case, the survival suits performed extremely well, showing the typical 'shrink-wrapped' appearance of the suit clinging to the body. Most participants emerged dry or almost dry from the endeavour, except for one individual whose torso zip had failed to close fully, resulting in several litres of pool water finding their way into the left leg. (That was his story anyway, and he's sticking to it!).

If a suit is not properly vented, the buoyant force pushing you up could exceed your ability to swim down and out of a submerged exit

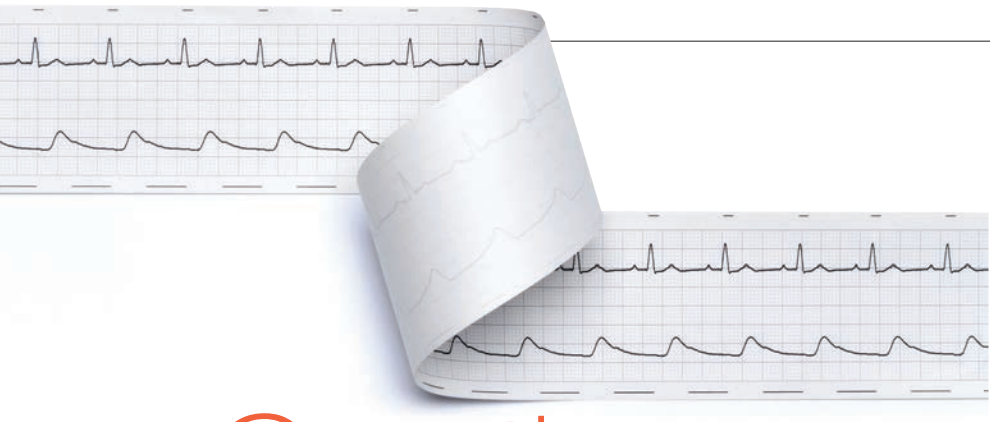
After all the shenanegans it was time to look at the data (excluding our damp participant) and, as often is the case in science, we discovered the exact opposite of what we expected! The more dense a person was, the greater the volume loss on immersion. There was some scatter in the data, but a significant relationship prevailed.

We subsequently applied this to the 588 offshore workers' data from the scans we had already acquired. It clearly showed heavier individuals have greater buoyant force in salt water until around 125kg or the 98th percentile, after which it decreases slightly. The better a suit fits, the less the scope for trapped air and water ingress on immersion, but the pitfall is tight seals which may not be comfortable for a long helicopter flight.

This small study highlighted the size-dependency of buoyant force and why larger individuals approaching 125kg must take particular care to ensure a snug fit and adequate venting. And of course, whether flying offshore or visiting the dunker, make sure the zip is fully closed!

Dr Arthur Stewart is a senior researcher in ergonomics and health at Robert Gordon University, Aberdeen, with interests in body composition and functional performance. He has recently been made a Fellow of the CIEHF, and since 2003 has been a criterion anthropometrist with the International Society for the Advancement of Kinanthropometry.

Stewart, A, Ledingham, R, Furnace, G,Williams, H & Coleshaw, S. 2017. Survival suit volume reduction associated with immersion: implications for buoyancy estimation in offshore workers of different size, *Ergonomics*, 60, 844-850. DOI: 10.1080/00140139.2016.1188219



Creating a focal point for improvement

Fran Ives and colleagues describe the progress one human factors faculty has made in the 12 months since its formation. They describe a case study showing that quick and simple changes can be made easily and effectively using human factors approaches

In September 2016 University Hospitals Birmingham NHS Foundation Trust (UHB) launched a Human Factors Faculty in response to the growing awareness of adverse events in healthcare and the key role for human factors in the improvement of system performance and human wellbeing.

The initial invitation to apply for Faculty membership was distributed to all members of the organisation and many of the Faculty's strengths and successes have been as a result of its diversity. We encompass both clinical and non-clinical staff from different roles roles within our organisation and this has given us expertise in, and awareness of, a wide range of potential areas in which a human factors approach could bring benefit.

One of our first projects was the development of a human factors framework that offered the potential to be incorporated into the electronic systems the organisation uses and to be an operating framework for the Faculty itself.

Operationally the Faculty is chaired by, and reports to, the Executive Chief Operating Officer who is the senior responsible officer within the Trust and represents the Faculty at the Chief Executive's Advisory Group. Formal meetings are held quarterly, minutes taken and actioned to support specific projects as they progress. We have developed a central database of projects and resources that is accessible to all Faculty

CASE STUDY

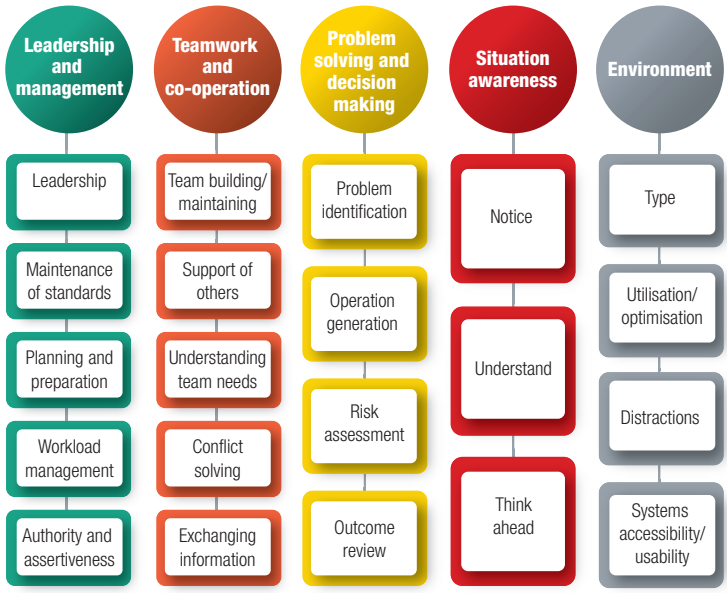
Process improvement for chest pain patients

In 2016, the Emergency Department (ED) at the Queen Elizabeth Hospital Birmingham treated over 115,500 patients and around 3.2% of those presented with chest pain. When a patient attends ED with these symptoms, it's essential to determine quickly whether the chest pain signifies a heart attack. If so, prompt diagnosis and early treatment for these patients is vital as delays could result in complications or ultimately death. The aim for all suspected heart attack patients is for an electrocardiogram (ECG) to be conducted within 15 minutes of their arrival in ED. If the ECG indicates that the patient is suffering from a true cardiac event, timely interventions can be carried out.

A longstanding patient process for suspected heart attack patients arriving at ED by non-999 means was in place. Once at reception, patients were booked in by the reception staff and handed an A5 size red card to enable any ED staff member to recognise that they had chest pain and were therefore a priority. They were then given verbal directions by the reception staff to go along a corridor to the ambulance entrance where they could enter without a security pass. Once in the ED, patients had to make themselves known to the Registered Nurse (RN) in charge of co-ordinating the busy department, who would direct them to the other side of the department to the assessment area where again they had to make themselves known to staff. Once in the assessment area, the patient would be directed to a vacant cubicle or assessment room where an ECG would be carried out. See the red arrows on the diagram opposite.

A human factors review identified clear areas of risk. Patients may fail to enter the department through the ambulance entrance because they do not understand or hear the verbal directions given, or they forget them. They may fail to identify themselves to the RN Co-ordinator because the RN has moved away from their workstation, the patient is unsure who the RN Co-ordinator is or they decide not to approach the RN Co-ordinator, perhaps because the patient perceives them to be too busy. The process may fail in the assessment area if the patient does not find a member of staff or they feel that staff are too busy to be interrupted.

Options were discussed with all levels of ED staff to develop a new process which would reduce risk and be practical and simple for staff to adopt. A new process was agreed which could be implemented straight away, without cost and would facilitate a better patient journey from ED reception to ECG. See the green arrows on the diagram.



University Hospital Birmingham, human factors framework

members to track different projects and outputs.

During the past year the Faculty has been joined by the Lead Simulation Trainer, a Consultant Cardiac Anaesthetist, a Practice Development Nurse and the Head of Inclusion, Engagement and Wellbeing. We are delighted that key people in the Trust can see the benefit of human factors and are keen to incorporate it further into their own areas of influence. Developing and maintaining human factors expertise is a challenge the Faculty faces, so we are fortunate to have two human factors professionals within the group and hope to build on this is the future.

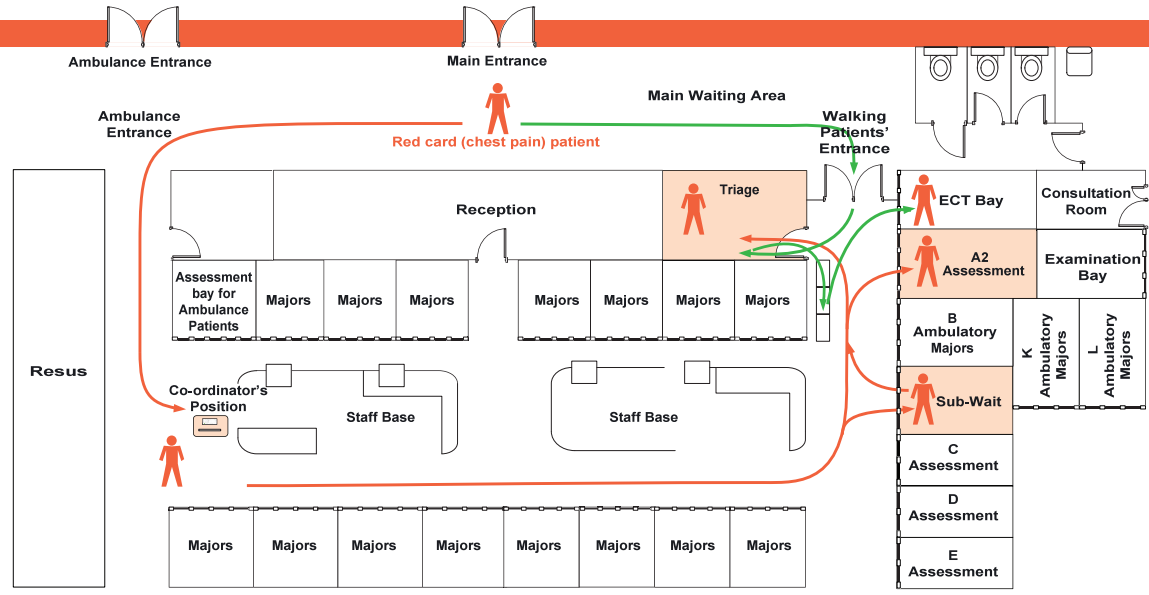
Influencing change within healthcare is notoriously difficult and one of our challenges is increasing awareness of the benefits of human factors at all levels of the organisation and, where possible, supporting staff to apply human factors to their own practice and departments. Our organisation employs over 9000 people and over the past year members of the Faculty have delivered presentations to just over 130 staff; a start, but a drop in the ocean. We use social media (@UHBHumanFactors) to spread ideas and resources and we have recently launched a monthly 'Pop-Up HF Lab' which we are opening to all staff as a forum for discussion, idea sharing and continuing professional development for the Faculty.

Human factors is in the Trust's new consultant induction programme and the faculty has supported the Trust's Simulation Team in their own work to incorporate human performance elements of human factors into high fidelity simulation training within the organisation. We are in discussion with the Trust's governance leads about the inclusion of human factors into the Trust's reporting systems, and we are highlighting the benefits of a 'safety reporting system' as opposed to an 'incident reporting system'.

We have been operational as an internal Human Factors Faculty in a large acute NHS trust for just over 12 months and have been able to contribute to systems performance, patient safety and staff wellbeing. Our challenges include developing our own expertise, integrating into the organisational structure and finding enough resources for projects – especially staff time. Despite this, we are increasingly being approached by different parts of the organisation to offer input to projects and have made a positive contribution to our Trust.

Frances Ives is an ergonomist, **Deborah Jackson** is a Practice Development Nurse and **Peter Isherwood** is a Consultant in Critical Care Medicine & Anaesthesia. All are members of the UHB Human Factors Faculty at University Hospitals Birmingham NHS Foundation Trust.

IMAGE: ALAMY



1. Patient checks in at reception
2. Patient is directed through Walking Patients Entrance into ED (on swipe card access so not used before)
3. Patient knocks on triage door and holds red card
4. RN directs patient to new 'red card chairs' outside triage room
5. ECG carried out

The aim of the study was to improve safety, care and patient experience. By changing the process, the distances patients had to walk were significantly reduced and the simpler route reduced the risk of patients becoming lost or not making themselves known to the appropriate person in the chain. The patient being directed to knock on the triage door and display the red card ensured timely access and quick identification of the suspected heart attack patient. A new designated seating area, immediately outside the triage room ensured they were visible to staff which encouraged timely ECG and assessment. The new process continues to be used in ED and as result of the human factors review, ED staff felt empowered to make immediate, no-cost and sustainable improvements.

Beware of exotic animals within data

Just because statistics might predict a high rate of success in the majority of instances, each situation is unique until proven otherwise, as **Bernie Masters** explains

The diligent professional combats entropy by studying the results of analytical trials based on statistical responses from a selected population. In contrast, problem solving focuses on a solution that fits a single condition or situation.

Whether ergonomic, clinical, medical or industrial situations, the individual tasked with finding a solution to a problem has no idea where the problem is placed within the normal distribution curve. Is it 5th percentile? 50th percentile? 95th percentile? Or is it an outlier? Analytical studies provide cold data but offer little insight. Within this environment, despite ignorance, by employing intuition and even sometimes counter-intuitive reasoning, these tortuous processes eventually lead to understanding.

In medicine, randomised inert placebo-controlled trials were seen as the Gold Standard, but according to probability theory, the placebo must have an opposing evil nocebo twin. Not recognising the placebo/nocebo effect, such trials were unwittingly fundamentally flawed.

Beware the creatures hidden within analytical studies: "We should have a dislike for theories that are extremely complicated and are held with extreme simplicity."*

Understanding is dominant, analysis is subservient, judgment is difficult, opportunity is elusive, and experiment is dangerous. It is not enough for the problem-solver to perform, but the client and their attendants must also contribute and circumstances must be favourable.†

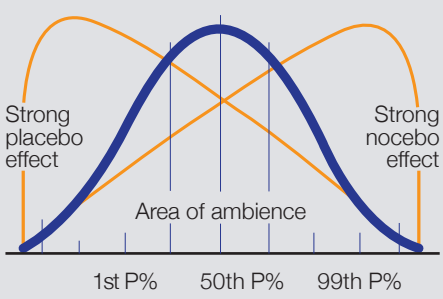
Factual analysis is limited ('know-that'), whereas designed problem solving ('know-how') develops intuitive understanding furthered by experience. Statistical analysis may offer apparent insights, but true solution-finding demands a comprehensive understanding. ●

* With apologies to G.K. Chesterton, (1914) "The Mistake of the Machine"
†With apologies to Hippocrates' First Aphorism.

Bernie Masters began his professional life in design engineering education that focused on ergonomic values. He applies the same principles to functional medicine and his PhD examined the neuro-biomechanical factors that correlate to athletes' body shapes as predictors of health and performance.

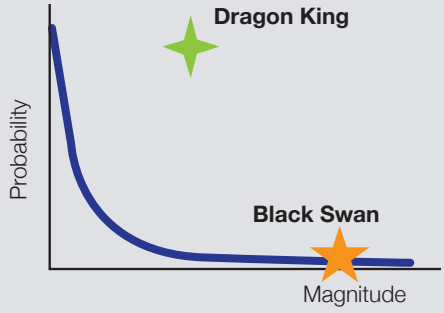
The Cheshire Cat

Like Lewis Carroll's 'Cheshire Cat' smiling benignly, the central area of ambivalence is where the beneficial/detrimental effects are minimal. Stochastic judgment, or clever guesses, offers a proposed solution that could also veer unexpectedly and inappropriately in either direction. Distribution of the placebo/nocebo could be skewed either way, confounding results.



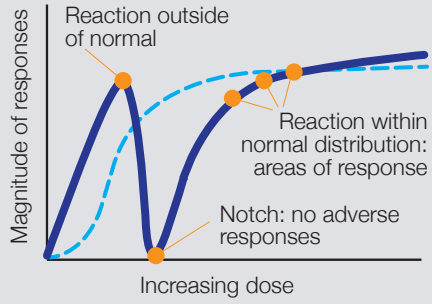
The Black Swan and Dragon King

Problem solving should involve both prediction and prevention. A Black Swan is the name given to a predicted calamity while a Dragon King is totally unexpected and is represented as an outlier on a graph. Black Swans sit on the line of best fit, whereas the Dragon King confounds prediction and can be totally outside the norm, for example anaphylactic shock from a bad reaction to food or medication. However, a Dragon King might even be seen as a miracle, kick-starting a new belief system.



The Salamander

Like the eye of the storm, the notch in this graph appears to show no adverse effect. However, this is a Salamander, which has the potential for producing misleading conclusions. We must remember that conclusions drawn from a set of given data are only true for that sample.



Experiencing the unthinkable

Steve Barraclough describes a Regional Group event that gave a pilot's-eye view of a real-life incident

Human factors has a heritage of contributing to improving many aspects of aviation operations and aircraft design – as evidenced by the report from the Human Factors in Aviation Safety event in this issue. For a day, ten members of the CIEHF's Midlands Regional Group stepped out of normal working life and became pilots themselves.

Under the guidance of Captain Chris Rigby, Chief Pilot and MD of Flight Simulators Midlands Ltd and his colleagues, all members of the group were to take part in a challenging and highly interactive day, including taking turns at the controls of an aircraft training simulator.

The group studied video of the preparation and actual flight of a Ryanair aircraft flying from Birmingham to Dublin, which brought together many aspects of working and interacting with people and complex equipment in a reasonably confined environment. The next part of the day however, was a unique insight into a miraculous escape for the passengers and crew of a doomed flight.

You may remember Captain Chesley 'Sully' Sullenberger, now retired, who, on 15 January 2009, successfully landed US Airways Airbus Flight 1549 on the Hudson River in New York. The aircraft had become disabled in both engines after striking a flock of geese immediately on take-off. The crew acted together using what information was available to them in six and a half minutes to land the aircraft safely. All 155 people on board survived.

The crew had no direct training for this eventuality. All major airline manufacturers offered guidance and training on what they believed to be the likely scenario, which was the loss of one engine and at a cruising altitude, a situation that allowed the crew much more time to think, review, decide and act. In fact, the crew and ground support had very little time to act together on that day, and Sullenberger has subsequently helped develop new protocols for airline safety.

Back at Flight Simulators Midlands, equipped with the information they had learned earlier, the group looked specifically at Flight 1549 using a combination of modelled experience, actual footage and transcripts of the flight itself to depict what had happened in real time against a timeline, including the decision-making process of the crew.

After lunch, split into three, one group took charge of an Airbus 320 simulator (the actual variant within the incident), another a Boeing 737 and the last a Boeing 747. Each group had the basic briefing from an allocated and qualified 'Captain' and then each member of each group attempted, under supervision, the actual routing. This was followed by the return to La Guardia option (that Sullenberger rejected very early on), followed by the alternative landing site option at Teterboro (that Sullenberger calculated he could not reach) and lastly the upriver landing option (rejected by the crew in favour of landing down river and closer to support and emergency services).

The fact that no lives were lost was due to many factors. The weather was benign, visibility good, the river clear, communications effective and the aircraft equipped with life vests, something not required by law for aircraft flying internally in the US at the time. The design of life vests in particular was thoroughly examined after the incident, as the majority of passengers struggled to put them on successfully, if at all.

Overall, a fascinating look into an extraordinary accomplishment by ordinary people under intense pressure with lives at stake, both in the air and on the ground and we were lucky enough to get a real insight into it. ●

A fascinating look into an extraordinary accomplishment by ordinary people

If you have any ideas like this for Regional Group events, please contact us.

IMAGE: GETTY

Q&A

MEMBER PROFILE

Tina Worthy talks to **Roy Cochran-Patel** about the path his career has taken so far.

How did you get into ergonomics?

It's fair to say I am an accidental ergonomist... although it's turned out to be a very interesting and enjoyable accident!

My undergraduate degree was in Information Systems Design. One of my modules early on was human computer interaction. This was my first introduction to ergonomics and putting the person at the centre of design. I was fascinated by the process that went into designing an interface that would be intuitive to use and took into account the thought processes of people when they use a system.

I didn't really dwell on ergonomics much after that and my career took me down an unexpected route. Moving from London to Manchester after I graduated resulted in stop-gap work while I looked for a 'proper job' in IT. Thirteen years later I'm still there.

So what exactly do you do?

I work for Bupa, a private healthcare company. Bupa are widely known as a private health insurance provider with around 70% of its revenue coming from health insurance, and the rest from health and care provision. We fund healthcare around the world and run clinics, hospitals, dental centres, care homes and retirement villages in a number of countries.

I joined Bupa's Occupational Health Department as a case manager in 2005, working closely with corporate clients to support employee return to work following illness or injury. During this time I worked within a number of sectors including manufacturing, offices, contact centres and healthcare.

Since 2014 I've worked in Bupa's internal Health, Safety and Wellbeing Department where my focus is on improving the work environment for Bupa's own employees.

Who influenced your early career?

During the initial stages of my career I was very much influenced by my manager at the time. She had such a passion for improving people's lives that it was infectious. Early on she encouraged a holistic approach and introduced me to the biopsychosocial model which, it turns out, was a fantastic introduction into the principles of ergonomics.

Attending a seminar by Kim Burton on tackling musculoskeletal disorders in the workplace was fascinating and his approach really resonated with me. I was still in the early stage of deciding in which direction my career was going but this further cemented my passion to reduce musculoskeletal disorders.

How did your career progress?

I fell into case managing individuals who had been injured in road traffic accidents. My job was to

A distance learning course in health ergonomics worked perfectly for me

link injured parties with a practitioner; this could be a physiotherapist, surgeon or mental health specialist. This prompted a real interest in health and I quickly took an internal promotion into the occupational health risk management team.

Within that role I was working as a non-clinical case manager supporting employees and employers in managing health risk at work. It was during this work that I became particularly

interested in musculoskeletal health. We had an ergonomist on the team and I started to shadow her display screen equipment (DSE) assessment work. I soon decided to take a DSE course and started picking up internal assessments. When she left the business, I was offered the opportunity to take over completing DSE assessments on site, and to re-train to become a specialist case manager. Whilst researching I came across the Health Ergonomics MSc at Derby University. The content immediately caught my attention so I applied. As a distance learning course it worked perfectly for me as I was able to study part-time whilst still working so I didn't have to take time off to study. I'm now using my skills to improve the health and wellbeing of our staff. As well as the hands-on stuff, working for a global organisation enables me to influence our ergonomics programme throughout our different market units which is great for promoting ergonomics.

What's the most challenging aspect of your work?

Much of the work I do is reactive; an accident happens or an employee complains of discomfort and I'm asked to review the case and make recommendations. Often the challenge can be convincing an employer that my recommendations will give them a return on investment. This is somewhat less difficult (although not all plain sailing) for me in my current role as I provide internal support. However, when engaging with an external client, who has already paid for my time, making recommendations that may cost them both time and money can be really challenging!

Before moving into my current job role, I set up and managed an ergonomics services department for my employer. This involved going to client sites to carry out a variety of ergonomic assessments and reviews. One particular client, a packing and distribution centre, called me in as they had a number of employees complaining of upper limb discomfort which had resulted in absence and reduced productivity. They were quite up front with me and advised they didn't want to spend lots of money and it was their opinion that the issue was with staff, not their processes or the environment.

It was a fascinating piece of work and gave me a real insight into the impact the attitude of supervisors can have on employees. Interviewing workers and supervisors, carrying out observations and task analysis, all pointed towards poor task design, a number of physical issues with equipment and a lack of support from management.

How did you tackle that situation?

I was able to put recommendations together that were cost effective and would improve the situation. As the equipment changes would cost money, I tackled this by providing the client with current risk exposure scores against expected scores. We agreed that if they ran a trial of the new equipment I would return to carry out a comparison assessment so they could see the improvement before committing to purchase. As well as studying equipment, we also worked on improving task design and job rotation which helped further reduce exposure and had the added benefit of increasing productivity.

I worked very closely with the HR department, supplying anonymous feedback comments from both staff and supervisors to highlight the need to improve relations. This resulted in the client delivering more training and coaching for supervisors to support them in their roles. Many had been promoted due to being good at their job, not because they would make good supervisors, for which they had received limited management training.

Where do you see your career going in the future?

I am in a fortunate position where I really enjoy my job and have a great relationship with my employer. My work is both varied and interesting, so for the time being I see myself continuing to develop in this role. That said, I'm keen to get back out looking at issues in different work environments and would love to set up my own consultancy. That's one for later, I think, but it's in my plans! ●

REGIONAL NEWS

SOUTHERN ENGLAND

An in-depth look at safety management

The Southern Regional Group event at Winchester in July 2017 tackled the thorny issue of taxonomies (see 'Comparing and classifying safety management data' in *The Ergonomist* No 561). The challenge for human factors practitioners and military staff at the follow up event at RAF Odiham in November was to apply the Rail Safety and Standards Board (RSSB) taxonomy to a variety of incidents.

The day was hosted by Warrant Officer Class 2 Kevin Hayes who arranged a visit to the Chinook Maintenance Flight and the Chinook Maintenance School. The Maintenance Flight is a joint partnership between the Ministry of Defence and Boeing to ensure through-life customer support for 66 Chinook helicopters. The maintenance of the fleet is demanding with 'MOTs' required every 200 flying hours but many efficiencies have been achieved through close collaboration with Boeing.

The Chinook Maintenance School provides training using a representative part-task trainer within a synthetic environment. The analogue control systems on the Mk 4 and Mk 5 models have been upgraded on the Mk 6 with a Digital Automatic Flight Control System which has a significant impact on workload and handling qualities. Chief Technician Jamie Pearce demonstrated the ease of use with complete novices flying the simulator.

After the visit, Jordan Smith and Charlotte Kaul of RSSB gave an overview of the RSSB taxonomy which comprises four human performance metrics and ten incident factors. This taxonomy is currently used to classify railway incidents and aims to provide a consistent approach to the rail industry. The taxonomy allows RSSB to provide guidance based on detailed analysis of the underlying causes of different incidents. One key example of this is a training package RSSB has developed for safety-critical communications based on a breakdown of the different communications issues that contributed to incidents:

A Not communicating.
B Communicating with the wrong person.
C Person who is talking leaves out important details, says something that is vague, wrong or overly complex.
D Person is talking too quietly, or with strong accent or dialect which is difficult to understand.
E Person receiving the information doesn't hear, mishears or misunderstands.
F Rule book communication protocols are not followed (identifying who they are, repeating back, etc.).
G Problem with communication method (e.g. mobile phone, radio, face to face etc. not appropriate for type of message, doesn't transmit message clearly, etc.).

If one of the above is present:
H Is there evidence of a problem with how communication is managed in the organisation?

The taxonomy is intended for use by non-human factors specialists and provides categories which can be used in communications and workshops with staff at all levels of the organisation. The goal is, ultimately, for incident investigators across the rail industry to use the taxonomy as they are investigating incidents to classify underlying causes. This would support the consideration of wider organisational issues in the incident investigation process, and would provide the rail industry with a wealth of useful data about underlying incident causes. All safety data needs to be in a format that can be correlated to enable trends to be identified. The taxonomy framework provides the breadth and depth to meet this need.

The taxonomy is intended for use by non-human factors specialists

The group were provided with the taxonomy and a flow chart, and sub-groups then discussed the possible causal factors of example incidents and classified them

IMAGES: GETTY

accordingly. A video of a rail maintenance incident was shown and the groups discussed and classified the root causes. The results were compared to see where there was consensus. As the classification of incidents is a fundamentally subjective task, interpretation of incidents was influenced to a certain extend by the attendees' background and experience. However, the taxonomy prompts you to think beyond the individual closest to the incident, and provides a framework for you to consider the broader organisational factors, as well as the human performance element.

This process was repeated with an air incident investigated by the Air Accident Investigation Branch and presented by Jo Davies of ESE Associates Ltd, and a helicopter maintenance incident presented by Flight Lieutenant Jasper Pritchard of the RAF Odiham Air Safety Team. This activity highlighted how three different incidents in three different areas all have similar underlying causes, and that a generic taxonomy such as RSSB's could be tailored for each of those domains. This event was great opportunity for human factors specialists from these different domains to meet and share good practice.

Jo Davies, Regional Group Lead

LONDON & SOUTH EAST

Resilience engineering in shipping

At the end of November, Martin Shaw from the Human Element Working Group of the Institute of Marine Engineering, Science & Technology gave an informative and interesting presentation to the London and South East Regional Group. It provided some background to the shipping industry before highlighting the opportunities for improvement through the integration of good human factors and resilience engineering.

It was encouraging to see the Human Element Working Group place a heavy focus on understanding the positive role humans can play in a system rather than more negative aspects such as human error.

Brendan Hazlett

CIEHF events at a glance

Eligible for CPD Lifelong Learning

For more details of all CIEHF events, see our website at **events.ergonomics.org.uk**

EVENT	WHEN & WHERE	DETAILS
Ergonomics & Human Factors Careers Day	28 February 2018, Birmingham	The only careers event focusing on ergonomics and human factors for students, graduates and career changers.
Ergonomics & Human Factors 2018	Mon-Wed 23-25 Apr 2018, Birmingham	The CIEHF's flagship learning, discovery and networking event covering all sectors of research and practice.
Future Transport	25-26 June 2018 (date tbc), location tbc	An investigation into new technologies including the human factors issues surrounding the design and control of autonomous transport.
Learning from Incidents	15-16 October 2018 (date tbc), location tbc	A cross-sector look at understanding and learning from incidents including those from rail, air, maritime and healthcare.
Human Factors in Aviation Safety	12-13 November 2018 (date tbc), Gatwick	Presentations, discussion and debate on human performance issues in military and commercial sectors.

Please note that some events details may be subject to change after publication. Please check the events website for up-to-date information.

ATKINS

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Atkins are proud to Sponsor the Ergonomics & Human Factors Careers Day 2018

Atkins Human Factors Team is growing, and we have roles available at all levels to join our brilliant team. Come and visit our stand on 28th February 2018 to find out more!

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Find out more about the Human Factors roles we currently have available at **www.careers.atkinsglobal.com**

Chartered Institute of Ergonomics & Human Factors

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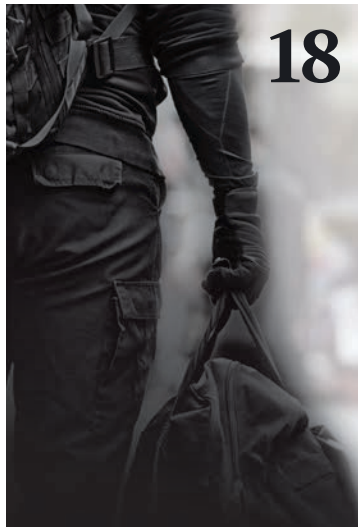

RESEARCH MATTERS

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FROM THE PRESIDENT

Taking an active role as a volunteer

Claire Dickinson
CIEHF President

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Institute activity benefits enormously from a legion of volunteers. Thank you to the trustees on Council, our Events, PR & Media, GDPR and International Champions, our PAB and Membership Chairs and our Regional, Sector and Special Interest Group Leads for all your activity in these areas. Thanks to our assessors who valiantly process membership and training course applications and CPD submissions. The Honours Committee have been busy judging the submissions for the Institute awards; my congratulations to all nominees. I'm grateful too for those involved in reviewing papers and generally preparing for the CIEHF annual conference, this year being held in Birmingham at the end of April. The AGM is held during this event too and it's open to all members whether or not they are attending the conference, so come along and get involved. Everyone doing a little bit goes a long, long way.

I have learnt a tremendous amount as President for 2017/18, and feel very grateful to have been given this opportunity. Would I recommend taking a role in a professional institution? Absolutely yes; my advice would be to review the CIEHF website to find out more about what we do and the roles open to you. As I sign off as your President and pass the baton to the President Elect, Neil Mansfield, my final thank you is to the staff of CIEHF, and all CIEHF members for your massive support throughout the year. May we all continue onwards and upwards.

Everyone doing a little bit goes a long way

FROM THE EDITOR

Invaluable applications of ergonomics

Whilst ergonomics can help us understand and optimise complex systems, it can also be used to identify ways in which to prevent systems from achieving their goals. With this in mind, Paul Salmon explains how systems ergonomics can be used to disrupt terrorist cell activity; an invaluable application of our discipline with public safety and security at the top of national security agendas.

Following rising awareness of the impact of wellness on worker motivation and business success, Jim Taylour asks why we don't apply the same principles to children's learning environments. He describes initiatives to encourage 'well learning' in classrooms to help better prepare our young students for life after school.

The UK's position as a world leader in health and safety is well-deserved and many organisations are playing their part. One example is Highways England who are undergoing a programme to bring about effective improvement in health and safety behaviour at all levels of the company, as Claire Philp explains. In the high-hazard sector, Ayodamola Ojo tells us about his day-to-day work as a process safety engineer, Rob Miles gives us his thoughts on his career in this sector and John Lovegrove describes his approach to ensuring human factors is seen as an integral part of complex projects like nuclear decommissioning.

Waldo Cervantes-Solis examines the implications of an increasingly connected world via the Internet of Things and an interesting insight into life in a developing Jamaica rounds off the issue.

Tina Worthy
editor@ergonomics.org.uk
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An ergonomics perspective from Jamaica

Jamaica may be only a fraction of the size of Britain and have a population of less than half that of London but it's busy developing its industries and services. An appreciation of ergonomics and its positive impact on workers is also growing, as **Sejae Burey** explains

Bob Marley, Usain Bolt, beaches, rivers, tourism, sunshine, food and fun are a few things that come to mind when Jamaica is mentioned in the international sphere. With a population of almost three million, Jamaica is the largest country in the Caribbean with a history progressing from slavery to a freedom with post-colonial influences.

Jamaica has immense natural resources that have sustained its economy and development over the years. These include its plants and wildlife along with its beaches, rivers and other geographical sites that bring tourists flocking to the island. Jamaica boasts a rich history of bauxite mining and export of commodities such as sugar and perishable food items. The country's primary industries are

Workers in the cane field with a truck and heavy machinery, harvesting sugar cane in Jamaica

agriculture, animal husbandry, mining, forestry and fishing. Its secondary industry is manufacturing and tertiary industries include tourism, logistics and, more recently, information communications technology and business process outsourcing. Nationally, a myriad of services is provided to the public through private and public sector entities with overall regulation through the Government.

Much like anywhere else, a general search of the term 'ergonomics' in Jamaica will generate responses predominantly related to office furniture and consumer items marketed with this tag line. My personal experience of ergonomics prior to higher studies was at the secondary level where the term was used in the IT syllabus but only with regard to the design of computer workstations. However, ergonomics is more widely understood in Jamaica than this would indicate, especially in occupational health and safety where there is a greater general understanding of the core principles of ergonomics. This is evident in manufacturing and mining and even in the tourism sector where safety and hazard management are seen as critical for employee wellbeing. The concept also spans the public sector where there are many laws and policies regarding employee wellbeing and organisational structure.

In Jamaica, many studies have been undertaken regarding organisational development, especially in private sector entities with international parent companies where there is a shift towards greater efficiency through effective systems and organisational design. Core to this shift is an increase in profits brought about through greater engagement of staff and improved design of systems that facilitate productivity whilst also encompassing employee wellbeing.

Whilst international programmes related to ergonomics incorporate both systems and psychological elements, opportunities for study in Jamaica vary. Major universities and colleges offer courses in occupational health and safety and public health programmes that prepare professionals to manage physical hazards in both the workspace and the environment. Programmes like these cover physical, biological and chemical hazard management and safety, and are often augmented by certification in areas such as 'Hazard Analysis and Critical Control Points'.

There are many programmes available in human resource management with varying majors and modules on organisational design, worker psychology and performance. Programmes have been designed to support the pursuit of management studies in conjunction with psychology, and there has been an emergence of business psychology programmes in recent times providing a greater depth in workplace psychology. There are also doctoral and research programmes in organisational behaviour that have resulted in theses being developed that span our post-colonial society to the present day.

The application of physical ergonomics, with an emphasis on hazard management, has been more widespread over the years, especially in the manufacturing and mining industries where it's understood that interventions can help protect workers, maintain the integrity of processes and avoid legal issues. In recent times, the emergence of public sector transformation initiatives and private sector growth and expansion has meant that psychological ergonomics is becoming more important as it's increasingly recognised that employee engagement and wellbeing has an effect on business success.

There is a shift towards greater efficiency through effective systems and organisational design

Initiatives in organisational psychology are being piloted at a national level and will eventually filter down locally. Through this, it's anticipated that the Government is aiming for a more efficient public sector, better job design and redesign, and increased performance management. Organisational design and development will be more methodical, statistically-driven, and will incorporate international and local best practice whilst taking into account the local culture. The health and safety of administrative workplaces have also improved with the majority of imported consumer goods, for example, furniture and tools, being selected with ergonomic considerations in mind.

Jamaica may seem to lag behind in many legal aspects compared to more developed nations with laws covering display screen equipment and so on but progress is being made here under the Factories Regulations 1961, The Building Operations and Works of Engineering Construction 1968, The Ships and Dock Regulations 1968 and most recently, the Occupational Safety and Health Act 2017. The latter is comprehensive and its main objective is to prevent accidents and injury arising from, linked with or occurring in the course of work. It protects against discrimination and promotes employee wellbeing and industrial relations amongst other provisions not previously covered.

Having worked in both the education and health sectors in public service, I can see there is evidence of progress both systematically and organisationally. Given factors such as the economic climate, socio-political systems and a nation gradually rising from post-colonial influences, the progress is evident. We can be optimistic that the shift will continue until Jamaica, 'land of wood and water', has expanded legal provisions for workplace health and safety and has integrated programmes targeting system design from a more holistic perspective.

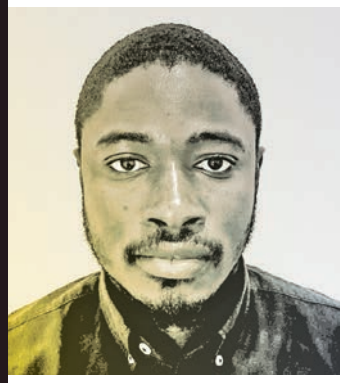
Sejae Burey is currently an Administrative Officer with an internationally-funded programme at the Ministry of Health in Jamaica. She is studying ergonomics via an online MSc course with the University of Derby.

IMAGE: GETTY

A DAY IN THE LIFE OF A...

PROCESS SAFETY ENGINEER

Ayodamola Ojo, Risk, Safety and Human Factors Engineer



I work for Monaco Engineering Solutions Ltd, an international consultancy group that specialises in risk, safety, environment and reliability engineering for the oil & gas, and transport industry. Like many, the first thing I do on a typical day is to check my emails. As I work with a lot of clients in the Middle East and Asia, the time difference means I wake up to several emails. Typically, these would be centred around issues such as data input on current studies I'm working on, comments or clarifications on issued study reports and requests for proposals.

At the early stages of my time at Monaco, I was involved in asset integrity studies such as Reliability Availability and Maintainability and Risk Based Inspections. However, I'm now more involved in the safety and human factors side of the business. Over the years, I've carried out several types of studies which include Quantitative Risk Analysis, Escape Evacuation and Rescue Analysis, Safety Critical Task Analysis, Human Error Analysis, Valve Criticality Analysis, Control Room Assessments, Human Factors Screening Workshops, Hazard and Operability (HAZOP) workshops and Layers of Protection Analysis (LOPA).

This may be too much information but what it means is that on a typical day I might be involved in several studies, all at different stages of completion. Depending on the phase of the project, I could have client meetings to agree on the project deliverables, I could provide clarification on questions regarding the study or provide support on how to implement recommendations from the study in the process design. I could also be involved in executing a study. Depending on the type of study, I could be reviewing the 3D model of a process plant to ensure human factors requirements such as valve location, facility layout, access routes and escape routes are met. I could also be involved in assessing the layout, heating and ventilation, lighting and noise levels of a control room, identifying hazards scenarios, performing frequency analysis to determine the probability of having a loss of containment event, or running software simulations to determine the consequence and risk of several scenarios.

Presenting the client with cost-effective solutions to issues identified within the design is usually the most rewarding part of carrying out these studies. Here's a quick example: I was recently involved in simulation and risk analysis for a petrochemical facility. I realised that the risk at most of the substation buildings close to the process area were very high and explosion was the top risk contributor. This was because these substation buildings were elevated, thereby creating a confined space for accumulation of flammable gas in case of a leak which could result in an explosion if ignited. My recommendation to the client was to provide gas barriers at these substations to prevent accumulation of released flammable gas. This suggestion was immediately implemented in the design and a sensitivity case was performed to confirm the risk was reduced to acceptable levels by these barriers.

Once simulations and analysis have been completed, the next activity is to prepare a study report which gives a background to the project, standards and specifications referenced, methodology adopted, input data considered, detailed results, discussion of the results and recommendations. I'm a firm believer in the saying "A picture is worth a thousand words", so I tend to have several figures and graphs in my reports. Submission of reports is usually followed by a review cycle which could involve meetings to clarify any concerns that the client may have or to provide support or suggestions on how to resolve issues identified in the design.

Presenting cost-effective solutions to design issues is one of the most rewarding parts of my job

A significant part of my job involves travelling to clients' offices to attend workshops for studies such as HAZOPs, LOPA and Human Error Analysis, which would normally range from a week to about 12 weeks.

Oil refinery at dusk

On average, I spend 30% of the year out of the office, and sometimes out of the country, in such workshops. These studies are round table discussions feeding on the experience and knowledge of a diverse range of attendees. Recently, I was in Madrid for just over a month for an Alarm Optimisation Analysis workshop. The aim of the study was to prioritise all alarms within a process unit and identify primary and secondary operator actions required on activation of each alarm in order to ensure safe and efficient operation of the facility. This involved a systematic review of all alarms within the unit. We identified the function and pre-conditions for each alarm, primary and secondary actions required on activation of the alarm and the consequence if the required actions are not performed correctly or not performed at all. Based on these inputs and with guidance from international standards, the priority of the alarms were specified. Apart from being a good source of input for preparing operator work procedures, this study helped to ensure that exposure of the control room operator to nuisance alarms is reduced or eliminated. Redundant alarms were identified too and deleted from the design, providing cost savings.

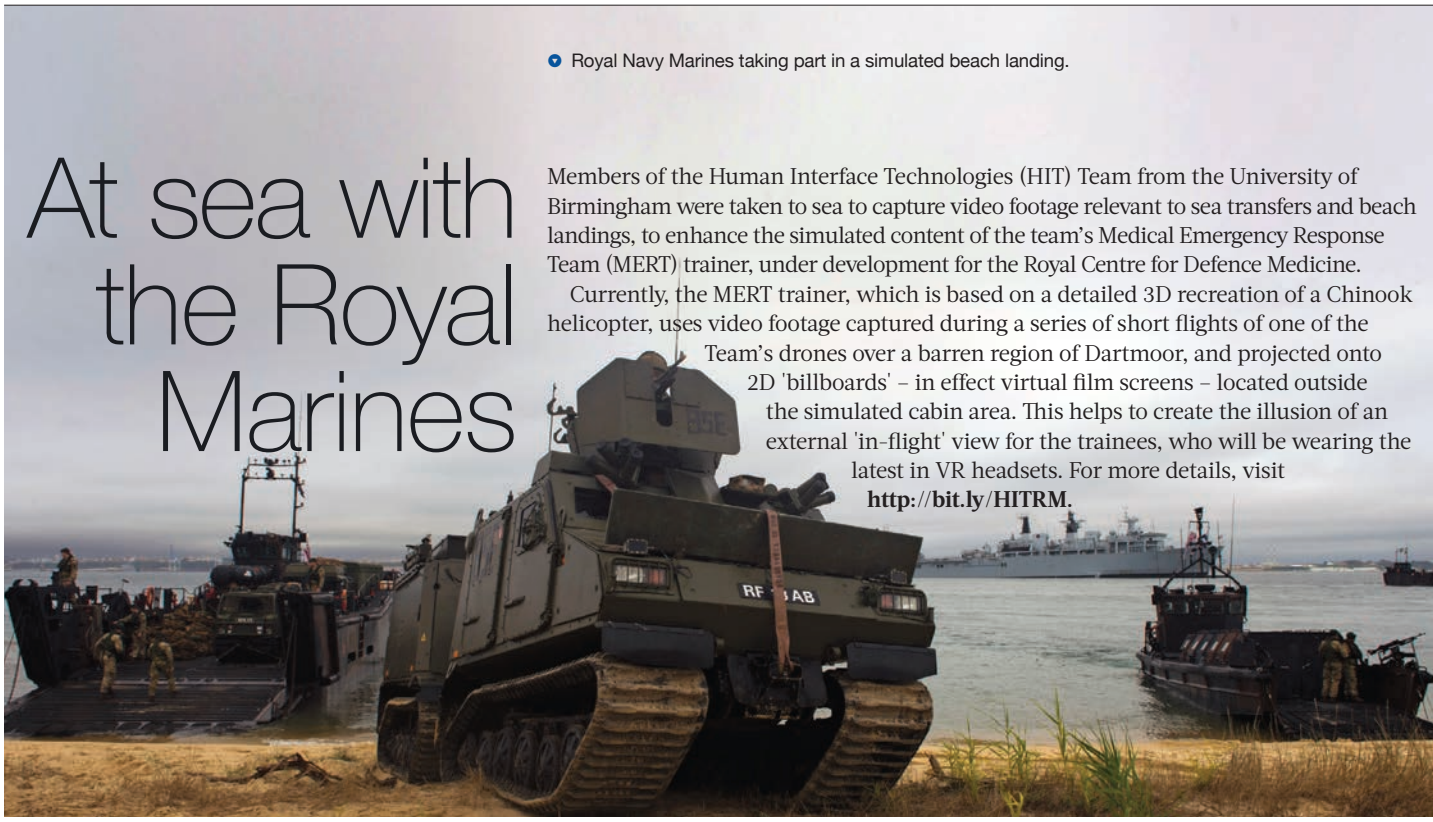
Having knowledge of human factors and being able to combine it with other safety studies has been a big plus for me. I initially came across human factors during my MSc course in Sheffield. When I started working on safety studies, especially HAZOPs, I realised that many incidents identified could be traced to some form of human failure and many identified safeguards require some form of human intervention. This sparked my interest and pushed me to get involved with the human factors team and attend human factors training. During HAZOPs, I can now apply my knowledge of human limitations to assess the validity of certain safeguards which require human interventions. For scenarios with high severity, in terms of impact on safety or environment, and which one or more of the safeguards require human intervention (such as when an operator acts in response to an alarm), I suggest a quick, high-level human error analysis. This identifies how the operator could fail to perform these actions, performance influencing factors which may cause this failure, and recommendations to minimise the likelihood of these failures. These could be in the form of improved communication, regular training and certification or even automation of these actions if the cost is proportionate to the risk reduction.

My day may also involve participating in Lunch and Learn sessions within the office. We share our knowledge and experiences on different subject areas and discuss lessons learnt over the course of carrying out different studies. This helps improve the overall knowledge of the team and leads to an improved and more efficient service.

Human factors engineering is a very interesting area that I'm passionate about. Proper integration of human factors in projects and process design minimises the potential for human failure, resulting in a safer and more efficient process. I'm considering taking an MSc course in Human Factors & Ergonomics to build and improve on my current knowledge. I'm excited to see what my typical day will be like in a few years' time.

Ayodamola's background is in electrical engineering and he has an MSc in Process Safety and Loss Prevention. He is particularly interested in exploring the relationship between process safety and human factors engineering.

IMAGE: GETTY



Royal Navy Marines taking part in a simulated beach landing.

At sea with the Royal Marines

Members of the Human Interface Technologies (HIT) Team from the University of Birmingham were taken to sea to capture video footage relevant to sea transfers and beach landings, to enhance the simulated content of the team's Medical Emergency Response Team (MERT) trainer, under development for the Royal Centre for Defence Medicine.

Currently, the MERT trainer, which is based on a detailed 3D recreation of a Chinook helicopter, uses video footage captured during a series of short flights of one of the Team's drones over a barren region of Dartmoor, and projected onto 2D 'billboards' – in effect virtual film screens – located outside the simulated cabin area. This helps to create the illusion of an external 'in-flight' view for the trainees, who will be wearing the latest in VR headsets. For more details, visit **http://bit.ly/HITRM.**

Shared experiences of air traffic controllers

HindSight is a magazine produced by the Safety Improvement Sub-Group of EUROCONTROL. It's produced for Air Traffic Controllers and is issued by the Agency twice a year. Its main function is to help operational air traffic controllers to share in the experiences of other controllers who have been involved in ATM-related safety occurrences.

The 26th edition entitled 'Safety at the Interfaces: Collaboration at Work' was published in December 2017. It follows the previous edition called 'Work-as-Imagined & Work-as-Done', published in June 2017. The latest edition includes articles entitled 'Communication and technology at the interface', 'Human-machine collaboration: fight or fly?' and 'Interfacing notes for the incident investigator'. All editions and articles are freely available at **www.skybrary.aero/index.php/Hindsight_26.**

Recognition of ergonomics practice

The US Foundation for Professional Ergonomics (FPE), a non-profit organisation dedicated to advancing professionalism in ergonomics, proudly announces a redirection of its newest award, which includes a US$1000 prize, in recognition for a current project that best demonstrates the beneficial outcome of ergonomics practice in real-world applications.

The award is a continuation of the Ergonomics Practitioner of the Year awarded during the previous two years to four of our colleagues who have demonstrated a lifetime of achievement in ergonomics practice: Andy Imada and Tony Andre of the US in 2016 and Tom Stewart and Peter Buckle, both from the UK, in 2017.

Nominations are open to all practising ergonomics professionals anywhere in the world, regardless of their tenure, who, however, are no longer students but rather have completed their last academic work at least three years previously. Submissions can be made individually or as a group.

The FPE also offer the Dieter Jahns Student Award, established in 2010, which is given to a student (or group of students) for a project that demonstrates the major practice areas of ergonomics: analysis, design, implementation and validation. The award is open to Masters and Doctoral students in ergonomics and ergonomics-related programmes.

The deadline for nominations for both awards is 31 May 2018. Please go to **www.ergofoundation.org** for further details.

Managing safety in the Royal Navy

CIEHF Fellow Bob Bridger and colleagues from the Institute of Naval Medicine have authored 'A guide to understanding human factors and human behaviour in safety management and accident investigation'. It's published by the Royal Navy as part of the Navy Safety Improvement Programme 'NAVYSAFE' to help develop their understanding across the Naval Service of the human factors and behaviours that contribute to accidents, incidents and near misses.

The guide is in three parts: An Introduction to Human Factors and Human Behaviour; Classification of Human Factors within Accidents: Errors and Violations; and Identifying Human Factors and Human Behaviours after an Accident. It is freely available at **http://bit.ly/RNSafetyManagement**.

Providing comment and insight

I was the first Technical Member of the CIEHF and I'm currently the Technical Member Representative on Council. Alongside that, I've recently taken on the role of PR & Media Champion. This means working with our PR partner, McOnie, and our social media partner, Lou Boulden, to develop and deliver an effective PR and media strategy for the CIEHF. This includes raising the profile of ergonomics and human factors by increasing visibility and recognition of the profession.

I'm particularly keen to focus on our integration across different media outlets, and our reactiveness which is where we need the support of our members. You can help us amplify our message, by telling us if you've seen an ergonomics-related article in the news, or providing comment and insight on emerging stories.

If you've got a good story to tell, we can help you increase the impact of your work and reach a bigger audience by developing messages, articles and other content with you, and we'll find the right outlets for the story.

Over the past two years, we've focused on several topics including aviation, manufacturing and, more recently, virtual reality, as well as highlighting our events, and our reach and following has increased as a result.

Contact me by email at E.Hubbard@lboro.ac.uk, follow me on Twitter @DrEllaMae or meet me at Ergonomics & Human Factors 2018 to see how we can support you and take your ideas further.

Dr Ella-Mae Hubbard
Senior Lecturer in Systems Engineering at Loughborough University

CHIEF EXECUTIVE'S PERSPECTIVE

Keeping up communications

Many will be aware that the most significant change in 30 years since the Data Protection Act of 1988 will come into being in May. The EU General Data Protection Regulations (GDPR) have a significant impact on the way any business, including yours if you run one, can acquire, hold and use personal information. Membership organisations, like ours, are particularly in the spotlight, and rightly so.

The Institute has been preparing for GDPR for over a year. Although a body of our size is not required by law to appoint a Data Protection Officer, your trustees have made a good choice by doing so, and it is one of their number. Dr Samantha Porter has been working alongside me in the run up to the introduction of the regulations, and I thank her for her efforts. Sam sits on Council as a trustee, and I would encourage members to contact her (details via our website) if you have any queries on how the Institute will continue to handle your personal data in the appropriate and sensitive fashion that it has deployed to date.

A major part of the value of your membership lies in the ability of the Institute to communicate details of news, events and activities of interest to all members. You have a part to play in ensuring that information about the things that you would like to hear about and enjoy provided by the Institute can be communicated to you. The new membership engagement system that the Institute has sensibly invested in over the last six months on your behalf enables you to set and change individual communications options. By default, they are set to opt out, so if you haven't done so already, please help us to ensure that the communications that you receive are right for you by visiting your **MyCIEHF accoun**t via our website at **www.ergonomics.org.uk** and setting preferences that reflect your interests. We will be bringing your choices into effect very soon, so don't miss out.

Steve Barraclough
Chief Executive of the CIEHF
s.barraclough@ergonomics.org.uk

Well learning classrooms

Whilst the adult world of work is protected by health and safety legislation and benefits from emerging proactive wellness initiatives, there is next to nothing in place for children, who are considered 'visitors' to schools. Encouragingly though, there is a secret weapon for better health and attainment, as **Jim Taylour** explains

Life in the classroom arguably remains ergonomically 'hostile' and more so for our increasingly sedentary tech-dependant Generation Z students (born from the year 2000) who are now feeding into work and higher education with an increasing array of special requirements to deal with, such as musculoskeletal disorders, weight-related health conditions and psychosocial symptoms associated with an over-dependency on technology.

This is not a new topic of conversation but with even more worrying concerns being raised by the Mayor of London amongst others about the state of health of our youngest students at reception age, there's never been a more challenging, and exciting, time to deploy ergonomics, and that's before we discuss the health and happiness of teachers!

Green shoots

With this backdrop in mind, a few years ago a sizeable bunch of enthusiasts responded to an invitation to share their experiences and professional know-how on subjects of design, health and ergonomics in schools. From this, the suggestion of a CIEHF Special Interest Group for Children's Ergonomics was first floated.

Since then a core group of volunteers, myself included, have developed a Well Learning Charter, engaged with practitioners and charities at the front-line, and started dialogues with regional bodies such as Healthy Schools London, who have 190 schools already engaged in healthier practices such as nutritious meals, more routine exercise and cyber safety.

The Group's aims over the next 18 months or so are to develop a resource pack and literature review to encourage specifiers and decision-makers such as architects, health practitioners, designers, schools and parents to seriously consider the merits of human-centred design principles when refurbishing or building new schools.

We believe ergonomically-designed learning environments, to support a more robust education wellness strategy which develops good habits for our young students (and their teachers), will positively contribute to their health, wellbeing and learning capacity. It will put them in better shape when they eventually hit the job market and will help fuel the sweeping gains being enjoyed today by corporates who are attracting the best talent with their wellness strategies and healthier buildings.

In the longer term we need more research and resources to help challenge the lack of health and safety legislation, guidance and awareness protecting children during this essential part of their physical and mental development. We also need to raise awareness of the role of ergonomics in protecting and enhancing children's physical and mental development.

The wellbeing challenges facing schools today are many and varied. Some of these are related to restrictive and inadequate furniture which cannot hope to accommodate the increasing variety of sizes of children. School furniture is not designed to support most school-related tasks and many products are too general-purpose. This is particularly evident in school chairs with seats and back rests angled away from the table. Children are getting back problems at a younger age and more frequently. We all know that discomfort affects concentration and studies have shown a link between wellbeing and

educational attainment. Rising levels of child obesity are adding to the issues and problems can manifest themselves later in children's development with the onset of irreversible back pain, for example.

Another issue is the rapid increase in the use of technology in schools, with which comes more sustained awkward postures leading to fatigue and discomfort. There is the danger of eye strain and potential hearing impairment, sleep deprivation leading to more serious long-term illness outside school, and psychological issues such as impaired social skills, low self-esteem, addiction and attachment disorders.

Physical risks still include the long-recognised issue of manual handling challenges associated with lack of storage for school bags and gym kit.

How schools can help

Schools can help in many ways, some of which will mean financial outlay, but several include simply raising awareness and, undoubtedly more challenging, changing behaviour.

- Raise awareness about the issues and carry out a self-assessment using an ergonomics checklist currently being developed by the Special Interest Group.
- Ensure classrooms are equipped with standards-compliant furniture and schools are supported to manage a better size fit that reflects the ages and activities of its children. Ergonomic furniture is one of many classroom design factors that can benefit children's learning rates in school.
- Increase teacher awareness of the signs of discomfort (such as fidgeting) and make positive adjustments towards a more active and agile learning experience to improve collaboration and alertness.
- Provide standing work stations and give children the option to choose where they work.
- Be aware of children-furniture mismatch and make provision for very small or very tall children.
- Provide personal storage areas for children to put their heavy books, PE kit, musical instruments etc.
- Be more inclusive and deploy best practice for spaces and equipment to support children with special needs.
- Design school spaces to incorporate the emerging social and collaborative requirements of employers, as well as technological needs.
- Draw on the tools and support services already available to monitor and improve the ambient environment in classrooms.
- Inform parents so ergonomics can be applied at home for study, screen time and recreation.

IMAGE: SIMON REGAN

Building demand for change

There is scope to change perceptions at the Department for Education if schools and teacher training colleges put forward good pedagogic arguments that can be linked to the need for flexible wellness-centred spaces and strategies in schools. There is a danger that the DfE will remain focused on replacing old school building stock with environmentally efficient replacements, but with little thought for the occupants, especially if there is no appetite for exploring alternative ways to deliver the curriculum from the teaching profession.

Designing with the users' health, wellbeing and social enrichment at the centre of refurbished and new constructions, in tandem with robust environmental improvements to the fabric of the buildings and loose fittings, are the catalysts behind the wellness revolution in the adult workplace. It's still difficult to pin down the return on investment but the value of investment is undisputed when it comes to attraction and retention of new talent, as well as perceived gains in productivity, health, happiness and engagement. The same can apply to schools if there's a demand for change and evidence to back it up.

How you can help

We'd like to accelerate our understanding of some of the challenges and possible solutions outlined here and connect with more ergonomists who have carried out research in this area.

We'd also like to specifically appeal for assistance from any student readers who might feel inspired to major on this topic for a thesis or postgraduate study and help set up a 'Well Learning Exchange' where we can share our findings. Some suggested thesis topics can be found on the CIEHF website.

Both Orangebox and the Furniture Industry Research Association are hoping to create a shared internship opportunity in the near future for anyone interested, so please email me at the address below. ●

Jim Taylour is Head of Design and Wellbeing at Orangebox, he is a trustee for a charity called Leca exploring design for children with autism, and he is an ergonomist. Email jim.taylour@orangebox.com.

Further reading

British standard for school furniture: BS EN 1729-1:2015 Furniture - chairs and tables for educational institutions.

For more details about the CIEHF Children's Ergonomics Special Interest Group, visit www.ergonomics.org.uk > Get Involved > Sector Groups & SIGs > Children's Ergonomics

Ergonomics & Human Factors 2018

Chartered Institute of Ergonomics & Human Factors

Learn. Meet. Discuss. Be inspired.

23 – 25 April 2018 / Birmingham

This year's Ergonomics & Human Factors 2018 conference features topical themes, such as 'Life in the Smart Age', with talks on intelligent mobility, driver-autonomous vehicle interaction and augmented reality. We'll also discover how to identify strategies for disrupting terrorist cells, effect behaviour change in large organisations and carry out human factors investigations. We have keynote talks by five leading speakers.

Nancy Cooke is Professor of Human Systems Engineering at Arizona State University. Her research interests include the study of individual and team cognition and its application to cyber and intelligence analysis, remotely-piloted aircraft systems, human-robot teaming, healthcare systems and emergency response systems.

Commodore David Bartlett is the Safety Director for the Royal Navy. He joined the service in 1987 and is now responsible directly to the Fleet Commander for the transformation and assurance of safety across the whole of the Naval Service, including the development and delivery of the Maritime Safety Strategy.

Dr Todd Conklin is a human and organisation performance Advisor to the Los Alamos National Laboratory. He's a specialist in reliability management and training and has recently focused on Human Performance Safety Theory which encourages a collaborative look at systems that lead to accidents.

Graham Braithwaite is Director of Transport Systems and Professor of Safety and Accident Investigation at Cranfield University. He is involved in the development and delivery of training for transport accident investigators including the use of simulations in teaching and the development of new techniques for investigation.

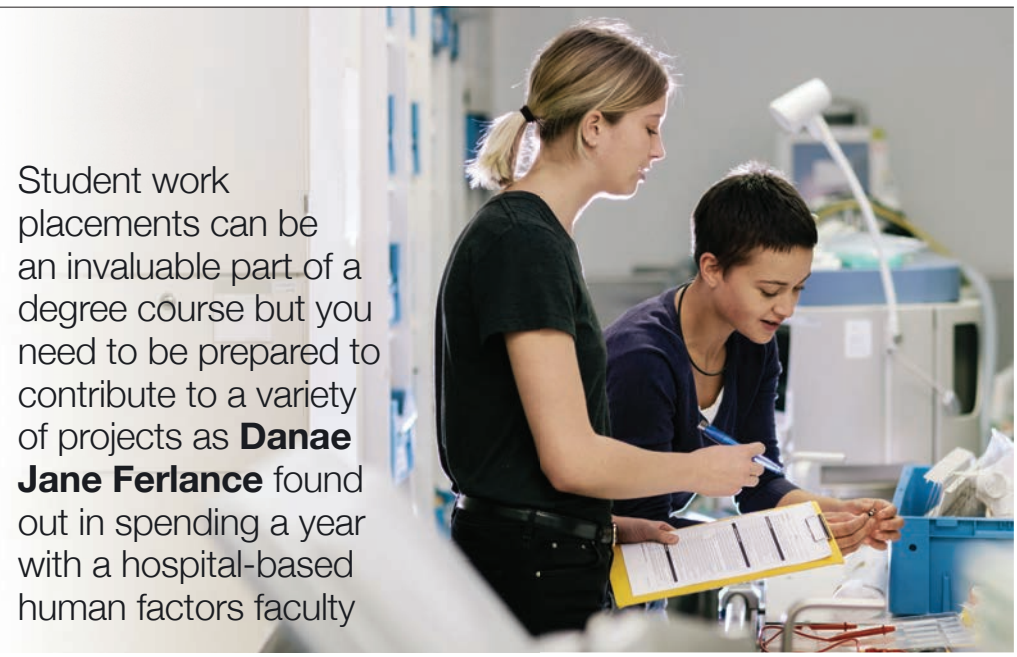
Dr Ann Mills is Professional Head of Human Factors at RSSB. Her team ensures the integration of human factors knowledge and approaches into standards, undertakes research on behalf of the rail industry and leads analysis of data to better address human error in incidents. Ann also has a background in aviation safety.

Location

The Hilton Birmingham Metropole. The hotel is next to Birmingham International train station and Birmingham Airport.

Don't miss out on our convenient fully-inclusive Gold Package with accommodation at the venue. Book now:

events.ergonomics.org.uk



Student work placements can be an invaluable part of a degree course but you need to be prepared to contribute to a variety of projects as **Danae Jane Ferlance** found out in spending a year with a hospital-based human factors faculty

Work experience is time well spent

My prior experience of a hospital environment came solely from the US TV drama *Grey's Anatomy*, so when I learned I had secured my ergonomics placement in a clinical setting, it's safe to say it was always going to be something of an eye opener.

I've completed two years of the BSc Ergonomics (Human Factors Design) course at Loughborough University and am now half way through my placement with the Human Factors Faculty at Queen Elizabeth Hospital Birmingham.

The Faculty was formed in Autumn 2016 and I joined them in July 2017 as their first placement student. My preconception of the team was that it would be made up entirely of people with ergonomics expertise, working together to integrate its principles in their work. However, I soon realised whilst the latter is true, it's actually a multidisciplinary group with vastly differing specialties and ergonomics expertise; what unites them is shared enthusiasm to see successful application of a beneficial discipline.

I quickly found the advantage of a multidisciplinary Faculty, with its connections in different areas, is that is provides access to a wide range of projects. For example, the Resuscitation Team is working on a Trust-wide redesign of the current process for a patient having a suspected cardiac arrest. I've been able to apply my knowledge and offer insights throughout this on-going development.

Additionally, I've collaborated with the High-Fidelity Simulation Education Team who are responsible for training staff and students. It was felt the feedback forms for the training sessions needed more appropriate questions in order to elicit more valuable feedback from participants. I was introduced to Appreciative Inquiry (AI), an approach built around learning from what goes right rather than what goes wrong. By incorporating AI into the form, participants were encouraged to reflect better on their learning experience at the end of their session and produce a richer source of data which could be used by the team to make improvements to future courses.

The form has also demonstrated to the Trust the impact simulation-based education can have on individual knowledge and clinical practice. The form is now being used across the Trust for this year's programmes and will serve as a direct comparison for closed loop candidate feedback between past and present forms. If successful, the new version will be submitted to the Association for Simulated Practice in Healthcare as a generic feedback form for High-Fidelity Simulation.

Both within the Trust and externally, I have presented the Faculty's work and my own contributions at conferences, such as the Mid Trent Critical Care Network Annual Conference, which has provided a real boost to my confidence in public speaking. This has helped raise awareness not only about what we are accomplishing but also about the value of ergonomics and human factors in healthcare.

In the time since its creation, I have had first-hand experience of the Faculty working towards successfully combatting misconceptions about ergonomics and human factors, leaving people more aware of the discipline and its meaning and scope.

Observing surgery and coming into direct contact with patients on wards seemed very alien when I first started, and working on projects that will directly affect people's lives is quite overwhelming at first and not at all what I expected to experience. But it's all been beneficial. So far, I've learned that people are apprehensive towards change, not all positive outcomes have measurable evidence, and solutions to problems can't always be found by the lead character at the end of a 40-minute hospital drama.

I've been able to apply my knowledge and offer insights

Danae Jane Ferlance is ideally looking for a career where the work she does has a direct positive impact on those she'd be working with in technology, design or healthcare.

IMAGE: GETTY

Bringing about effective change in health and safety behaviour in a large organisation, especially one whose workers are spread far and wide, provides many challenges. **Claire Philp** explains one approach involving a long-term leadership programme at Highways England

Turning a corner towards safer working

Complexity, remote working, and human–machine conflict all present challenges for organisations wishing to overhaul the health and safety behaviours of their people. After receiving a Crown Censure in 2015 following the tragic death of a Traffic Officer in 2012, these challenges were exactly what the then Highways Agency (now government company Highways England) was faced with. The censure highlighted failures of supervision and embedded unsafe behaviours as major contributors to the incident. It was clear that organisation-wide change was necessary to prevent another tragedy.

An ambitious five-year plan was launched in 2015 with the intention to affect innovative change in the practices of the organisation. Now at its half-way point, we reflect on the implementation of a key component: the Health & Safety Leadership Programme.

The accredited programme, developed by Highways England in conjunction with Human Applications and with the support of Arup, aimed to tackle the shortcomings of safety management cited in the censure. In particular, it comes as one of a number of interventions aimed at improving supervision in practice for peripatetic staff. It targeted leaders at all levels within the organisation and offered a variety of tools which could be used to tackle a range of health and safety challenges within the organisation. It was launched in April 2016 and almost 400 leaders have completed the training as of January 2018.

The programme comes in the form of a three-day course, where Days One and Two are followed by a break

of at least four weeks before the third and final day. This break allows the delegates to digest the behavioural concepts and novel approaches to traditional health and safety tasks. The break gives them the opportunity to apply the ideas introduced on the first two days and their accompanying tools to their day job. Day Three then offers the opportunity to reflect, share triumphs and challenges, and explore three final modules before ending the course with new actions.

Measuring the impact

The very nature of an intervention requires analysis of its effect. As a long-term programme, it was important that its impact was captured throughout its lifespan. This allowed for the adjustment of training materials and trainers' approaches in response to delegates' needs.

Assessment of the course's impact has involved a multi-faceted approach and the training has so far been evaluated against reaction, learning and behaviour. The evaluation of results will come later as data becomes available. Feedback forms, provided to all delegates at the end of Days Two and Three, capture the delegates' learning. Learning objectives and a wealth of activities throughout the course allow the trainers to assess understanding throughout the modules.

Action plans, formed on Day Two, are written by every delegate. These answer the question 'What will I do differently to deliver effective health and safety leadership?'. The plans are photographed by the trainers and followed up between Days Two and Three by a phone call or email. Delegates are able to ask for support, talk through problems or sound out ideas with somebody external to the organisation who is able to answer questions effectively. These follow-ups allow the assessment of behaviour change as a result of the course.

At the start of the course, delegates complete a short 'Leadership Quiz'. Developed with Highways England, it contains ten topics covered throughout the course, and asks delegates to rate their own confidence in each topic out of ten. Delegates are also asked to provide evidence through an example or supporting comment. The quiz is then repeated on Day Three to assess progress. Data recorded so far demonstrates a significant improvement in the scores of all ten statements between Days One and Three. These figures are encouraging as they show that delegates' perceptions of their understanding have improved across all ten areas during the course. The areas that showed the greatest improvement were leading risk management and knowledge of own risks, understanding accountability and leading culture change.

Informed by psychology

The course design is informed by concepts from psychological literature to support learning and encourage behaviour change. One example of this is the use of 'implementation intentions' which describes the act of forming a specific goal and an accompanying plan of action to realise it. Numerous studies have shown that those who form specific implementation intentions are significantly more likely to be successful in their behaviour change goals than those who don't. Research has also shown that the act of sharing these goals makes them even more likely to be attained, for two contrasting reasons: the perception of peer pressure as a result of others knowing your committed actions, and the perception of social support to reach your intended goal.

All action plans made on Day Two are followed up before Day Three, because on-going support has also been found to encourage and sustain behaviour change. This could be through the mechanism of social pressure (stemming from the individual's knowledge that they will be asked what they have done), or simply by coaching the individual in their goal attainment when they might otherwise have given up. Follow-ups after Day Two seem to have had an instant effect in encouraging action between Days Two and Three when compared with before the follow-ups were implemented. However, after Day Three delegates were able to opt in or out of receiving follow-up support.

This project is now entering its third year, and the programme is now embedded within the organisation. Going forward, the legacy of the course will be measured through Highways England's organisational health and safety metrics. It has shown that employees of a large, diverse and complex organisation are willing and able to make tangible behaviour changes. When provided with tools and on-going support, leaders demonstrate an improved ability to be proactive and positive in their health and safety roles. The action plans show that these leaders are able to offer a valuable source of ideas for making improvements, and do not appear to show signs of inertia or aversion to change. The secret to tapping into this resource may prove to be the use of publicly shared implementation intentions, the on-going support or both. Alternatively, the very action of spending three days out of the business, may put health and safety in the spotlight in a way that these leaders have not experienced before, and provide the nudge to act. This approach could be replicated as Highways England's ambitions to drive behavioural change and improve health and safety are shared by many complex organisations in a range of industries. ●

The very nature of an intervention requires analysis of its effect

Claire Philp is a Behavioural Safety Consultant at Human Applications. Trained as a psychologist, she specialises in the human behaviour and cultural aspects of health and safety.

Claire will be presenting this work at Ergonomics & Human Factors 2018 on 24 April in Birmingham. For more details see page 14.

IMAGE: GETTY

Breaking bad systems

As we continue to fight in the war against terror, **Paul Salmon** and colleagues demonstrate how ergonomics can be used to identify the weak points in the activities of terror cells and help develop strategies that disrupt their activities

Terrorism represents a major global issue. It's been reported that since 1970 close to 400,000 people have lost their lives worldwide as a result of terrorist attacks. Notably, the nature of terrorist attacks is highly variable, ranging from hijackings, mass shootings and stabbings, to car and suicide bombings, attacks on critical infrastructure and more recently, the use of vehicles as weapons in ramming attacks. The agility, breadth and reach of terrorist groups is such that it is becoming increasingly difficult to prevent new and emergent forms of attack, so new approaches to prevention are needed.

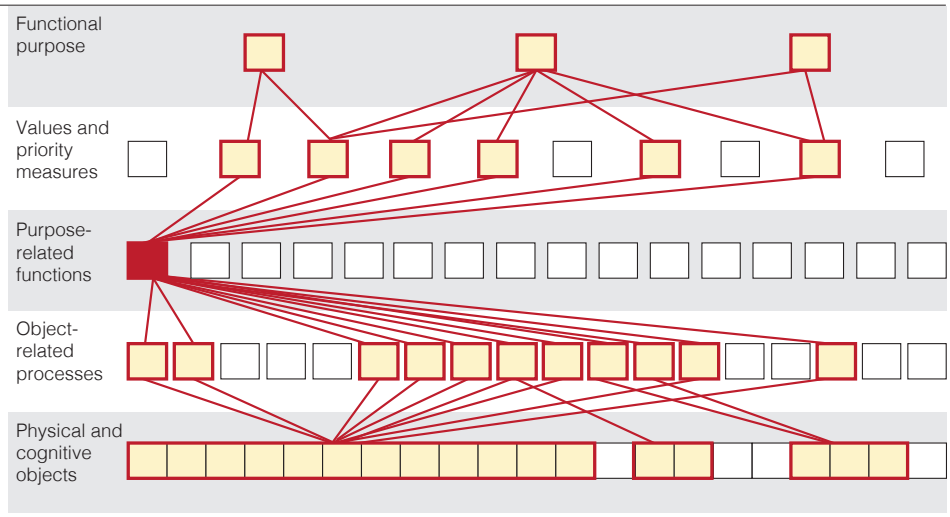
Systems ergonomics is most often used to describe, understand, and ultimately optimise complex systems and human wellbeing but it's apparent that the very same methods can be used to identify ways in which to disrupt performance and prevent systems from achieving their goals. This opens up various areas in which ergonomics can be used to disrupt systems designed to support illicit behaviours or to create adverse outcomes such as terrorism, child abuse, the production and trade of illicit drugs, fraud, and illegal activity in the dark net.

Cognitive Work Analysis is a systems analysis and design framework that has been used extensively in ergonomics both to analyse and to design complex systems. In the case of terrorist cells, it can be used to identify ways to disrupt their activities or ways to strengthen existing constraints designed to limit their ability to create terror.

In an exploratory study, Cognitive Work Analysis was used to identify strategies designed to disrupt terrorist cells operating in 'infidel' cities. This was achieved through using the first phase of Cognitive Work Analysis, called Work Domain Analysis, to develop a model of an Islamic State-style terrorist cell. Work Domain Analysis uses the abstraction hierarchy method. This is a multi-level representation that describes the functional structure of a particular system, in this case, the terrorist cell, across five conceptual levels:

1. The overall functional purposes of the terrorist cell.
2. The values and priority measures the terrorist cell and those associated with it use for measuring progress towards the functional purposes.
3. The general functions necessary for the

Abstraction hierarchy



terrorist cell to achieve its functional purposes.
4. The physical capabilities of the objects within the terrorist cell system that enable the general functions.
5. The physical objects within the terrorist cell system used to undertake the general functions.

The abstraction hierarchy was constructed using publicly available information such as websites, news reports, academic literature, journalistic commentary and publicly available jihadi writings.

Each of the 'nodes' in the bottom three levels of the abstraction hierarchy were then systematically broken and the resulting impacts on the terrorist cell's values and priorities and functional purposes was determined. For each broken node deemed to have an adverse impact on the terrorist cell's functioning, analysts then brainstormed ways in which the node could be forcibly broken through counter-terrorism strategies.

Various potential counter-terrorism strategies were identified, many of which may be well known, others less so. For example, for the *Plan attack* function, one strategy was the proactive identification of new and emergent targets (that is, targets that terrorists have yet to identify) and subsequent modification to reduce their vulnerability. This appears particularly pertinent in known target areas such as cities, airports, shopping centres and stadiums but it should also apply in areas not previously subjected to attacks.

Another strategy was the consideration of terrorist attacks during the early design phases of artefacts known to represent weapons and targets, such as vehicles and urban spaces. Other strategies identified related to the proactive disruption of propaganda and education activities, introducing restrictions around the use of social media, improved monitoring of terrorist activities and disrupting the ability to acquire or construct weapons.

The findings confirmed the ability of systems ergonomics methods to identify ways in which to disrupt system performance. We encourage further use of ergonomics to break bad systems and hope that our discipline can play its role in the fight against society's major problems such as child abuse, identity theft, and even climate change. ●

Professor Paul M Salmon, **Tony Carden** & **Nicholas J Stevens** all work at the Centre for Human Factors and Sociotechnical Systems at the University of the Sunshine Coast in Queensland, Australia. For further information contact psalmon@usc.edu.au.

Paul will be presenting this work at Ergonomics & Human Factors 2018 on 23 April in Birmingham. For more details see page 14.

Further reading

National Consortium for the Study of Terrorism and Responses to Terrorism (START). (2016). Global Terrorism Database: www.start.umd.edu/gtd.

Navarro, J M B, Villaverde, J C (2014). The future of counter-terrorism in Europe. The need to be lost in the correct direction. *European Journal of Futures Research*, 2:50.

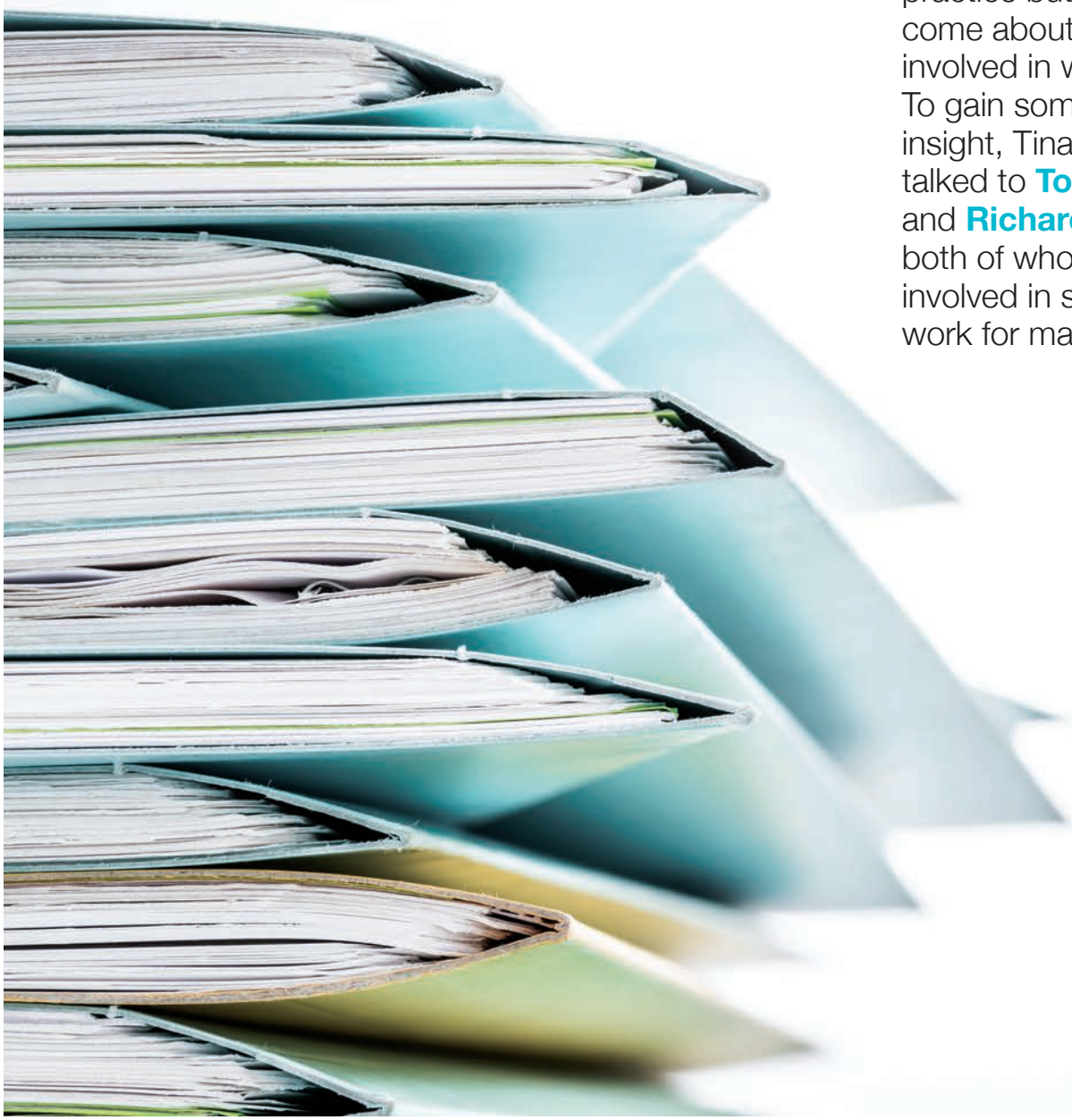
EXTRACT OF A BROKEN NODE ANALYSIS

Broken node	Functional purposes and values and priorities adversely impacted	Example strategies designed to break node
Purpose-related function: Propaganda	*Functional purposes:* Create fear and terror, Global Caliphate, Heavenly redemption and rewards. *Values and priorities:* Exposure, Membership of IS, Vilification and division, Uncertainty, Disruption, Cell capacity, Number of converts.	1. Carry out counter-propaganda/disinformation campaign conveying alternative/ confusing messages around collective vision and commitment to scripture. 2. Create new leadership persona designed to create uncertainty. 3. Disrupt sources of education e.g. social media. 4. Mount multifaceted counter-propaganda campaign via social media. 5. Directly restrict propaganda sources e.g. shutting down websites. 6. Place restrictions around use of social media platforms e.g. WhatsApp. 7. Compromise publishers of propaganda materials. 8. Remove/corrupt on-line propaganda materials.
Purpose-related function: Plan attacks	*Functional purposes:* Create fear and terror, Global Caliphate. *Values and priorities:* Fatalities and injury, Exposure, Uncertainty, Disruption.	1. Monitor planning activities e.g. WhatsApp, mobile phones, email. 2. Remove known vulnerabilities by minimising targets and opportunities to attack. 3. Proactively identify new and emergent targets along with appropriate counter-terrorism strategies. 4. Monitor acquisition of products known to be used in attacks. 5. Use big data analytics to identify groups engaged in planning. 6. Better coordinate restriction of targets and removal of vulnerabilities. 7. Consider potential terrorist attacks when designing known targets e.g. cities, airports, vehicles, road networks. 8. Disrupt the ability to acquire or construct weapons.

IMAGES: GETTY

Setting the standard

Standards play a vital part in health and safety and in good workplace practice but how do they come about, and what's involved in writing them? To gain some valuable insight, Tina Worthy talked to **Tom Stewart** and **Richard Graveling**, both of whom have been involved in standards work for many years



Formal standards are published documents containing technical information that represent widely agreed best practice in their particular domain. Standards exist at different levels and include international standards (prefixed by ISO or EN, or sometimes both), national standards (for example, British Standards prefixed by BS), industrial or sector standards and in-house standards.

With regards to the legality of standards, the Health & Safety Executive's website states: "Normally the use of standards is voluntary and they do not impose legal responsibilities. However, in some cases legislation may 'call-up' a specific standard effectively giving it legal force, or their use by a manufacturer may be declared, effectively binding that person and their product, to the requirements of the standard."

Some European standards have a special legal status and define minimum acceptable levels for health and safety. Standards may deal with broad general principles or common aspects of safety, or they may be more specific.

Tom, have standards changed much over the years?

Early standards were product specifications, which allowed different components to work together, no matter who made them or where. For example, the first International Standards Organisation (ISO) technical committee dealt with screw threads (ISO/TC 1). Other specifications guarantee safe and effective performance, for example BS 2037 for ladders. The next generation of standards were process standards, for example the ISO 9000 series, to guarantee high-quality work processes. Third generation standards aim at 'hearts and minds' to encourage organisations to take specific issues more seriously, for example ISO 26000 Corporate Responsibility and ISO 27500 The Human-centred Organisation.

How do standards come about?

Standards start life as a new work item proposed to the relevant body. This is a formal statement of the scope and purpose of the proposed new standard, often with an initial draft attached. Using ISO as an example, the proposals usually come from a national member body, which has a structure of national committees, mirroring the international committees. There are many committees dealing with topics as diverse as Ergonomics, Quality Processes and the Safety of Machinery. Initial proposals get circulated for voting to national mirror committees and if the topic is approved, then there are numerous iterations of working drafts until eventually an agreed International Standard is published. One reason why the process is slow is that time is required for national bodies to circulate documents and collate comments from national committees. Experts spend their time reviewing documents and agreeing improvements via a structured process, sometimes by document, sometimes via the internet and sometimes face-to-face.

How did you get to join a standards body?

I first got involved on behalf of the Ergonomics Society, as was. Visual displays were causing all manner of workplace problems and there was much misinformation around. BSI agreed that the UK would lead the ISO committee to address this topic, which had already been proposed. The topic was originally called 'Visual Information Processing' but, as is the way with standards, it really meant something slightly different: 'the ergonomics of work with visual displays'. The new committee, ISO TC159 SC4 met in Manchester in 1983 and work began on what became the ISO 9241 series addressing topics as diverse as keyboards, screens, workstations, environments, software and design processes. I got hooked because, as an ergonomics consultant, I knew that many organisations were much more likely to listen to us with the weight of an ISO, EN or BS behind us. I've now retired from that committee but have been pleased to pass on the chair to Susan Harker who has been a stalwart of international standards and is a veteran of that first meeting in 1983.

My standards work has given me a valuable insight into the status of ergonomics

Richard, how did your involvement start?

My involvement started when my employer, the Institute of Occupational Medicine (IOM), was part of the coal industry. As a major nationalised industry, the National Coal Board (NCB, later British Coal) had a seat at the table and ergonomics was just one of the areas where NCB/IOM staff contributed, so I became a member of PH/009 (Applied Ergonomics). My involvement really took off when I provided support for the chair, the late Paul Branton, in revising ISO 6385 – then the top level ergonomics standard. After Paul's death I was told that as the UK provided the chair of that working group, that was now me! More than 25 years later I remain part of the same working group (not as chair) and contribute to several others, such as a CEN (European Committee for Standardisation) working group on the ergonomics of personal protective equipment, helping to ensure the incorporation of ergonomics principles in a variety of different standards fields.

How much time does it take up?

It really depends on the extent of your involvement. It starts with being on the British Standards Institution (BSI) committee (PH/009) as most representation on CEN and ISO working groups is as a nominee from this committee. This meets around twice a year with a day meeting at BSI HQ in London, although this can vary depending on need. Naturally you should keep up with the papers for such meetings and others distributed between times although, given the diversity of topics covered, you might give more attention to some than others.

Most standards are drafted by CEN or ISO working groups and you can be nominated to those depending on your expertise. The committee does sometimes co-opt someone →

IMAGES: SHUTTERSTOCK

with particular knowledge to contribute on its behalf. Meetings vary in length from, I would say, one to three days (early afternoon to mid-afternoon the following day is a common timing on some of my CEN groups making for a two day trip). Again, you will need to keep up with documents emerging and the frequency depends on the amount of business. Some of mine meet once a year, others a couple of times. ISO meetings may go on for longer, especially if much travel is involved. More time commitment is needed if you get involved with actually writing all or part of a draft (first drafts are not usually written 'in committee'). Obviously if you become a chair then this will entail more work, but again measured in days across the year rather than weeks.

What sort of personal attributes do you need?

Aside from the obvious professional attributes of knowing what you're talking about, you need to be able to communicate clearly and good social skills are helpful. You will often be the only native English speaker, so a good knowledge and understanding of English and English grammar can help as you may well be looked upon as the expert in this respect in honing drafts. It's surprising sometimes how many different ways you can say what, in English appears to be the same thing, but they turn out to have different meanings when translated. In this respect meetings are always in English, even when you are outnumbered by speakers of another language.

It helps to know when and how to compromise and when to stick to your principles. I would also say that you need to have a degree of self-confidence (but not too much). There is little point in you flying half way round the world to be a wallflower at a meeting but sometimes you have to know when to let others talk.

BSI provide a number of training courses for new members that can help in various aspects of their work.

Tom, has your work in standards helped your career?

I wouldn't have been able to devote time and energy to standards if I didn't believe that they were important. As standards have become more embedded in regulation, it's been important to be able to use them in our work at System Concepts. Of course, although colleagues can see the value of standards, it's not always been easy to persuade them that meetings, in what appear to be exotic locations, are really justified! But the point about helping to develop standards is that you have advance warning of what's coming and, if you're lucky, also to be seen as a bit of an expert in a specific field.

Richard, would you agree?

Yes, Tom's last point is important; there's a certain cachet in saying that you're the UK expert on a CEN or ISO committee, which helps both you and your employer. It can also help support your credibility with clients and colleagues from outside the ergonomics discipline in providing a degree of validation of you as an ergonomist or human factors expert. I also think that my standards work has given me a valuable insight into the status of ergonomics (and ergonomists) in other countries as well as a view of the different perspectives on this complex field of ours. If, when you meet other ergonomists you are struck by how diverse our discipline is, you'll find this even more the case when you meet those working in the area in other countries. This has proved to be of benefit in the EU research I've been involved with over the years. Finally, it provides networking opportunities and, if you stay involved for long enough, it can provide a network of friends too.

So how can someone get involved?

Contact the national standards body which is a member of ISO or CEN; in the UK that's BSI. Each body that is active in an international committee will have a national mirror committee with representatives of key organisations. Make contact with the secretary of the national mirror and they will tell you what you need to do, for example, you may have to be nominated by your professional body. Although individuals might be co-opted to contribute to a particular project, membership of PH9 is as a representative, not as an individual, but there is always scope to explore new openings and liaisons. ●

Tom Stewart is a retired Fellow of the CIEHF and a Past President. After research work with HUSAT in the 1970s, he moved into consultancy and was one of the founders of System Concepts, a human factors, health and safety and user experience consultancy. He founded the journal *Behaviour and Information Technology* and is currently Deputy Chair of the Council for Work & Health.

Richard Graveling is a Fellow of the CIEHF and a Past President. He is Principal Ergonomics Consultant at the IOM which he joined in 1978, where his work encompasses a mixture of research and consultancy. He has been involved with the journal *Work and Stress* since its inception and is currently a member of its Advisory Board.

Further reading

Find out more about British Standards at www.bsigroup.com/en-GB/standards. For details of how to join a standards committee, contact Sarra Cheyne, secretary to PH9 at Sarra.Cheyne@bsigroup.com.

Human Factors in Future Transport

18-19 June 2018 | Birmingham

Exploring common issues in the future transformation of transport systems

With the push to move to electric cars and the introduction of autonomous vehicles, can our existing infrastructure and social systems keep up with the pace of change required to accommodate them?

The CIEHF is organising a new event which aims to explore these and other wider-ranging user issues and to raise awareness of the critical role of human factors in the successful future transformation of transport systems across all sectors. We will highlight the issues of people coherently using multiple services to reach destinations and identify the issues around the integration of different multi-modal transport systems using the same space.

This event will be of interest to practitioners and researchers from human factors, as well as end users, organisations with vested interests around accessibility and inclusivity, transport solution providers, technology developers, transport planners, infrastructure planners, developers, transport service providers, consultancies (especially those developing mobility as a service offering), regulators, emergency services, the leisure sector and motoring organisations.

The event will include talks, posters, panel sessions, debates and discussions, and will centre on the following six themes common across all transport sectors:

- **Transformation of mobility:** What could the future of transport look like and how will it affect commuting patterns and where people live?
- **Autonomy:** How can human factors enhance the development of autonomous transport solutions?
- **Accessibility:** How can we ensure future transport solutions don't leave us stranded (in the widest sense of people, communities, industry sectors and regions)?
- **Behaviour, acceptance and ethics:** How can we ensure future transport is sustainable in terms of power generation, air quality, climate change and waste management?
- **Design:** How do we ensure integrated transport systems are based around human-centred design?
- **Big data:** How will we integrate distributed data from multi-model transport systems and provide an holistic view for strategic planning and real-time monitoring?

Submit an abstract

If you are interested in speaking or presenting a poster at this event, please submit a 300 word abstract by 9 March 2018. Each submission will be reviewed by the programme committee representing the University of Nottingham, the Transport Systems Catapult, QinetiQ, RSSB and Coventry University.

Further details

For latest programme information, a link for abstract submissions and details about how to book, visit events.ergonomics.org.uk.

The right approach

In complex projects like nuclear decommissioning, human factors must take its place among many other competing disciplines. This can be challenging but **John Lovegrove** describes the issues and approaches to ensure success

A human factors specialist involved in a nuclear decommissioning project has their work cut out in trying to review an operational design and produce a report that confirms that all human factors issues have been identified and addressed by the design team.

In trying to assist, the nuclear decommissioning industry has adopted methods first used in the defence industry for the management of human factors tasks on large projects. They include the Human Factors Integration Plan, Human Factors Requirements Compliance Matrix, Human Factors Issues and Assumptions Registers, and analytical reports that link back to all three.

But from my observations in nuclear decommissioning, it's not a case of one size fits all. The onus is on the human factors specialist to tailor their approach based on the available budget and the risk of human factors to the safety of the operator and the public, in other words, to take a proportionate approach. I've spent the last ten years focusing on methods that ensure timely and relevant human-centred design support in the form of demonstrable schemes that account for the conclusions of the different disciplines that make up the project team. But before we get to that, let's look at what's involved in decommissioning projects.

Nuclear decommissioning projects appear complex from the outside but they share the same core principles: the business requirement, the characteristics of the waste, where it's currently stored, the space available for a new facility, the disposability case, the safety case, Ionising Radiation Regulations 1999 principles, and the reliance on people to design, manufacture, install, commission, operate, maintain and recover the decommissioning system.

Different approaches are used to design a nuclear decommissioning facility. There is the self-perform approach that uses engineers with site-specific knowledge and there is the sub-contracting route of asking an engineering consultancy to act as the design house. The scale of a project can be extremely large, with 500 or more people involved to extremely small with just one or two. Irrespective of size, the common design approach is as follows:

- Survey the potential locations for the facility.
- Create a 3D model of an early concept for the facility.
- Search for equipment and suppliers.
- Make the equipment fit into the space available.
- Review the detailed design with a view to engineering, safety, environment and health physics.
- Set-up procurement contracts.
- Manufacture and carry out factory testing and functional testing.
- Incorporate any redesigns.
- Install on site.
- Carry out site testing and inactive and active commissioning.
- Put the facility into operation including maintenance and recovery.

Dungeness nuclear power station

In the background the schedule determines the pace and thoroughness of the work conducted, with evidence in many cases of an 'Efficiency-Thoroughness Trade-Off'.

The company standards for human factors contain prescriptive information borrowed from the 200 or more human factors standards. The human factors specialist in a decommissioning project must try and produce an analysis that accounts for all the standards in a timely and concise manner. It can be overwhelming for the project manager and the human factors specialist, but there is an approach for providing project-relevant human factors support and it's set out in ergonomics standard BS EN ISO 26800:2011:

- Define the purpose of the system.
- Define the characteristics of the intended target population.
- Set out the goals to be achieved and tasks to be performed.
- Identify any existing constraints such as legacy equipment or processes, or legal requirements.
- Identify relevant factors of the physical, organisational and social environment.
- Describe the life cycle and any dynamic changes within it.

This approach contains elements that the project manager recognises well and must work around, for example, 'existing constraints' and 'life cycle and dynamic changes'. Recognition of these elements by the human factors specialist and inclusion in the approach they adopt aids integration with the project team. In my opinion, integration starts and ends with the relationship the human factors specialist has with the project manager and interfacing disciplines.

The approach forms the skeleton of the Human Factors Integration Plan. The number of human factors tasks required and when these tasks will be delivered is negotiated with the project manager and interfacing disciplines. If the interfacing disciplines understand why a particular set of human factors tasks is necessary, it aids integration and opens up communication pathways.

The human factors specialist must familiarise themselves with the deliverables of their project team colleagues. Safety case authors, mechanical engineers, process and instrumentation engineers, and health physicists all produce a description of the tasks they expect the operators to perform as part of their job. The human factors specialist must make sense of the different discipline deliverables and present their conclusions in terms of the purpose of the system and whether or not the inferred work goals are achievable by the target population.

The human factors specialist must make sense of the different discipline deliverables

The following information must be captured and communicated:

- Lessons learnt from similar facilities such as those involving human-centred focus, operability, maintainability and recoverability.
- Indisputable evidence of human-centred design issues such as through video observation or incident reports.
- Demonstrable examples of good human-centred design, for example control panel layouts and inclusive physical layouts.
- How the target population will interact with the design to complete tasks using for example, anthropometric data, goal-based task analysis and virtual user trials using digital human manikins.

Using this approach, human factors specialists will have a greater chance of providing timely, relevant information to the project team. In order to support this, we must continue to work together to ensure that the advice and methods used are deemed relevant to the designers and engineers within the nuclear decommissioning community.

John Lovegrove is a human-centred designer with an education in ergonomics. He has 17 years' experience across multiple industries and has worked in nuclear decommissioning over the last 10 years, including at Sellafield and Magnox.

Further reading

BS EN ISO 26800:2011 Ergonomics. General approach, principles and concepts.

IMAGE: GETTY







Human Science Research

- Human Factors Research and Engineering
- Cultural and Behavioural Analytics
- Cyber Influence
- IoT, Smart Cities and Smart Communities Impacts
- Social Media Effects

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SHARP
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Queuing for water in Cape Town

JOURNAL EXTRACTS

The CIEHF's membership package incorporates instant online access to all issues of seven leading journals, including those highlighted here

Having an impact on global challenges

1 At the time of writing, the countdown had started to 'Day Zero' when engineers in Cape Town were to turn off the water supply to a million homes, that is 75% of the city, in a bid to ensure what little amount of water is left is distributed fairly to everyone. The crisis was caused by a one-in-384 year drought according to the authorities.

Water scarcity is one of seven global challenges that were predicted by ergonomist Neville Moray in a keynote address in 1993 to the International Ergonomics Association congress. He urged fellow ergonomists to face up to these challenges and consider how ergonomics might help find some of the solutions. The challenges also included pollution, terrorism, energy supply, urbanisation and healthcare, all of which have indeed become major issues today.

In their comprehensive *State of Science* article, just published in the journal *Ergonomics*, Andrew Thatcher and colleagues critically evaluate what our discipline has achieved in the last 25 years to help create a secure future for all of us. They cite Moray's keynote address and attempt to evaluate how far we've come in realising his interpretation of the future and how the ergonomics discipline has attempted to meet his challenges.

The authors examine published work in each of the seven areas Moray highlights. They argue that only the energy and health issues have been addressed with any degree of rigour over the last 25 years: "Even the responses to these two problem areas have largely focused on the simple human–human and human–technology interaction systems. Very little work has been published that empirically examines the significant, complex, dynamic systems that underpin these problems. This is not to say that no work has been done, but rather that the response has been weak, largely theoretical and uncoordinated."

The authors recognise the interdependency and complexity of the challenges described by Moray and argue that: "Significant progress has been made in the ergonomics field on understanding and appreciating the need to consider complex systems… However, the required extent of our detailed understanding of complex systems exceeds our current understanding in the discipline."

So, we have a challenge ourselves in developing our discipline sufficiently to make a significant impact in tackling global issues. But the authors strike a note of optimism in that they argue that some of the dire predictions may "ultimately turn out to be unfounded. Exact predictions about the future are almost always wrong, especially with regard to timing and details."

They admit that micro-ergonomics has had an important role to play in addressing global challenges as evidenced by significant numbers of studies on energy efficient systems, for example. They agree that more examples of micro-ergonomics are needed, but also argue that what is now required are systems ergonomics and macro-ergonomics approaches that "are even greater in scale".

Our discipline needs development if we are to help tackle global issues

There are moves in this direction. The authors note that university training programmes have started to consider how ergonomics applies to global problems rather than limiting systems applications to single organisations. And they recognise that: "addressing global challenges is not an endeavour that can be achieved by ergonomics alone" and that our multi-disciplinary approach should develop into a transdisciplinary approach that combines theory and practice from different disciplines if we are to make the impact we believe our profession can deliver.

A Thatcher, P Waterson, A Todd & N Moray, State of Science: ergonomics and global issues. Ergonomics Vol61, Iss2, 2018

IMAGE: GETTY

Making life smarter not harder

As more and more things we use become 'smartified' and increasingly connected, understanding the implications of these interactions becomes more important, especially to device designers. **Waldo Cervantes-Solis** guides us through his research in this area

As technology has advanced, so the number of items embedded with electronics, software, sensors, actuators and network connectivity has increased. These items, enabled by the technology to connect and exchange data, include mobile phones and other devices, vehicles and home appliances, all of which are now known collectively as the Internet of Things.

In recent years the Internet of Things (IoT) has become a hot topic, in which many different industries and companies aim to develop and commercialise solutions. Examples can be found in applications ranging from industrial automation, city infrastructure monitoring and management, to healthcare and consumer electronics. Notably, in the case of consumer electronics, in which human interaction is very likely an important feature, it could be argued that many such applications have been developed with a heavier focus on the business case they aim to support, and less on the human factors. As such, it's not uncommon to find 'IoT-enabled' devices that don´t fulfil the requirements of their users.

In a world in which the IoT enables the so-called 'smart' objects, failure to consider people's expectations and experience in their design creates misunderstandings about the object's purpose which ultimately affects its successful adoption. IoT devices such as a smart salt grinder, for example, arguably fall flat due to it being an unnecessarily smart device that disregards the user's goals.

So, we should ask why someone would need a smart device in the first place. As user experience expert Don Norman noted, we have many things that make us smart (from shopping lists to clocks to diaries) but just because the technology allows for their 'smartification' through embedded sensing, processing and communication capabilities, it shouldn't necessarily imply that an object would benefit from it, nor that having the object do the thinking for us would make life easier for people. Many of us well remember the early days of the Personal Digital Assistant when these devices would begin beeping to remind you to attend a meeting just as you were sitting down in that very meeting. The problem might well be that intelligence without understanding can be just plain annoying.

IoT system modelling has been approached from different perspectives, from semantics and ontology to the services they can provide. However, these models often overlook the experience that people have when interacting with

such objects, a factor that becomes a crucial aspect for their adoption. Devices such as those found in the IoT often rely on their digital representation and data exchanges between the objects and supporting applications, usually through communication channels undisclosed to the user.

Data being sent back and forth from a server is used by IoT objects to achieve the goals defined by their makers or by the company that wants to harvest the data they produce, and in some cases baffling users, hindering their engagement with the system. A well-researched example is that of the smart thermostat, which commonly has the basic goal of controlling temperature settings within a household. However, they often also provide energy optimisation by analysing patterns on room occupancy, comfort settings, energy tariffs, energy consumption, etc., and they also seek to collect data from many households to profile energy usage generally. When setting a temperature level, someone would expect an immediate reaction by the system but they might receive no apparent response because the system is optimising for a parameter of which they are unaware, so the system appears to be malfunctioning. For these reasons, a human factors-based analysis of how to provide better engagement is paramount.

Just because an object thinks for us, it doesn't necessarily mean it makes life easier

Our research provides a framework in which IoT systems can be modelled to provide meaning, based on the concept of identifying and characterising the purpose of interactions, and by analysing how tasks and goals are achieved using an object. Our research focuses on the use of Task Analysis for Error Identification (TAFEI) as a tool for IoT systems modelling, with the goal of predicting user intent and promoting meaningful interactions. In particular, Hierarchical Task Analysis (HTA) has been used as a means of defining system requirements through a representation of the system's sub-goals, and applying them to user interface design, workload design and error prediction.

With the system's goals at its core, TAFEI provides a very interesting and suitable approach to modelling meaningful interactions, focused on the collaboration between the person and the system to achieve specific goals. In the context of the IoT, TAFEI provides a frame of reference in which interactions between the person and the object are analysed from the perspective of the system's goals and sub-goals. This enables a system to be designed and developed by providing useful meaning, not only to the owner of the business case the object supports, but also more importantly to the person using the system.

By repurposing TAFEI's original aim of modelling systems by focusing on errors as users attempt to carry out their main goal, it's possible to see how the system's functionality could be extended and more importantly, how intelligence could be embedded in the system. When devices that traditionally were not considered 'smart', such as a coffee machine, become IoT-enabled, they can possess extended capabilities and present opportunities for proactive and intelligent behaviour. These scenarios could allow a system to predict a user's intent and to provide them with additional information.

The application of TAFEI would allow the consideration of human factors in the design of IoT systems and smart objects, alongside machine learning techniques. By allowing people to become more aware of the system's goals, meaningful interactions and engagement would be increased, enhancing successful adoption of objects in the Internet of Things.

IMAGE: SHUTTERSTOCK

J Waldo Cervantes-Solis is a researcher at the School of Engineering, University of Birmingham. His main interests are in distributed systems, the Internet of Things, the 'smartification' of objects and their relationships with users. He was assisted in writing this article by Professor Chris Baber.

Waldo will be presenting this work at Ergonomics & Human Factors 2018 on 25 April in Birmingham. For more details see page 14.

Chartered Institute of Ergonomics & Human Factors

Notice of Annual General Meeting

The AGM will take place at 17:45 on Monday 23 April 2018 at the Hilton Birmingham Metropole, Pendigo Way, Marston Green, Birmingham B40 1PP for the following purposes:

- To receive the minutes of the 2017 Annual General Meeting.
- To present the Annual Report and approve the year end Accounts.

Elections are held at the AGM for vacant positions on Council and PAB. These bodies sit four times per year and all terms are for three years. Roles are unpaid but travelling expenses are available.

Nominations are sought for:
- President Elect
- Up to six Ordinary Members of Council
- One Associate Member Representative on Council
- Up to four positions on the Professional Affairs Board

Nomination procedure

Only Registered Members, Fellows or Honorary Fellows are eligible for nomination, except for the Associate Member Representative which is only open to Associate Members. Nominations must be made on forms available at www.ergonomics.org.uk > About us > Governance. Forms must be signed and posted to the Institute or submitted by email to ciehf@ergonomics.org.uk to arrive no later than 2 March 2018.

Proposals for changes to the General Regulations

Proposals for changes by Ordinary Resolution to the General Regulations should be sent to the Chief Executive no later than 2 March 2018.

Stephen Barraclough, Chief Executive, Chartered Institute of Ergonomics & Human Factors

MEMBERSHIP

Our latest professional members

We congratulate the following members whose applications for professional membership of the CIEHF over the past year have been successful. All have submitted comprehensive details about their qualifications, experience and achievements. Those listed as Registered Members and Fellows also have Chartered status.

Technical Members

- Alex Woolley-Allen
- Danaraj Chandrasegaran
- David McNeish

Registered Members

- Alistair Frizell
- Alistair Weare
- Andrew Blackie
- Elizabeth Rawlinson
- Guy Johnston
- Jess Onslow
- Lucy Broxton
- Lyndsey Murphy
- Mark Aldworth
- Marlene Murty
- Michael Marshall
- Nicola Fairburn
- Pingo Leung
- Roy Cochran-Patel
- Thomas Jun
- Vicky Dunn
- Victoria Valentinova

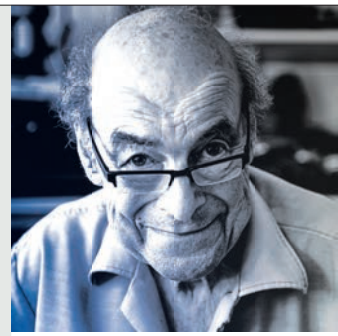
Fellows

- Anna Welch
- Arthur Stewart
- Claire Williams
- David Harrison
- Huw Gibson
- Laura Pickup
- Leonard O'Sullivan
- Mark Young
- Neil Mansfield
- Richard Farry
- Vicki Wall

Obituary

HEINZ WOLFF

A great communicator with an extraordinary enthusiasm for science and technology, 1928 - 2017



Professor Heinz Wolff will be remembered by many for his successful TV appearances, especially BBC's *The Great Egg Race* which ran from 1979 to 1986, in which teams were invited to solve technical challenges with limited resources. His contribution to science and technology undoubtedly inspired thousands of young people to pursue a career in these areas.

With his trademark bow tie, half-moon spectacles, tufts of hair above his ears and characteristic German accent, Heinz was the perfect embodiment of a scientist. Throughout his life, in addition to his regular media appearances, Heinz was a committed and well-respected scientist and bioengineer, a term coined by him in 1954. He had been an Honorary Fellow of the CIEHF since 1991 and a member of the Institute for 20 years prior to that.

Born in Berlin in 1928, he grew up during the emergence of a Nazi government. Following his mother's death in 1938, Heinz and the rest of the Wolff family fled to the Netherlands and then arrived in Britain on 3 September 1939, the day the Second World War was declared.

After attending the City of Oxford School, his scientific career began as a haematology lab technician at the city's Radcliffe Infirmary, where he invented a machine for counting blood cells. Heinz then joined the Pneumoconiosis Research Unit at Llandough Hospital near Cardiff, where he met a nurse, Joan Stephenson, and they married in 1953. He then began working at the Medical Research Council (MRC) at the National Institute of Medical Research Division of Physiology. His work so impressed the MRC that they sponsored him to take a degree, the first time this had been done by the MRC. Heinz graduated from University College London with a joint first-class honours degree in physiology and physics. By 1962 he was head of the MRC's biomedical engineering division.

In 1972, Heinz established the Division of Bioengineering at the MRC, Clinical Research Centre at Northwick Park Hospital, a department of some 70 staff. He left the MRC in 1983 to establish the self-funding Brunel Institute for Bioengineering at Brunel University, allowing him to focus on microgravity bioengineering, ageing and disability, and diving physiology. Heinz was appointed Emeritus Professor of Bioengineering within a building at Brunel named after him.

One of Heinz's great passions was providing solutions to human problems; he was a true pioneer of user-centred design. He believed that 'Man out of context with his environment' was the key disabling factor and that through good design and the provision of an appropriate toolkit this mismatch could be overcome.

Heinz's research into how human beings could survive in hostile environments culminated in his co-founding of Project Juno which, in 1991, led to Dr Helen Sharman becoming the first British astronaut and the first woman to visit the Russian Mir space station, where she spent eight days in orbit. Heinz was also involved in the European Space Agency's research into the 'Design and Human Factors Needs for Long Term Space Missions'.

Although Heinz officially retired in 1995, he continued work to address social care and rehabilitation needs of elderly and disabled people and was appointed Vice President of the Royal College of Occupational Therapists. Heinz was also Founder and a Director of the Give & Take CIC, a £1 million government-funded venture, whose aims included promotion of person-centred care for older adults in local communities.

In providing solutions to human problems, Heinz was a true pioneer of user-centred design

Sir Peter Medawar, Nobel Laureate and Professor Wolff's colleague at the MRC, dedicated one of his books to him with the inscription *'To Heinz Wolff – something of a genius'*.

Professor Wolff was an inspirational leader, to whom I and so many others owe a very great deal. I feel very privileged to have known and worked with Heinz and to be called his friend and *mitarbeiter*. He will be greatly missed.

Chris Ramsden is a Fellow of the CIEHF, a bioengineer, industrial designer and consultant clinical scientist.

Find out more about Chris's work under the mentorship of Professor Wolff in Member Profile Q&A, *The Ergonomist*, issue 559, p32.

Further reading

Professor Heinz Wolff, 2017, Are manual and mental dexterity linked? *The Ergonomist* 559, p30.

Q&A

MEMBER PROFILE

Tina Worthy talks to **Rob Miles**, Technical Director at Hu-Tech Risk Management Services, about his career in human factors engineering

How did you get into ergonomics and human factors?

I originally qualified in aircraft engineering. Aviation has a strong history of human factors dating back to World War 2 so the importance of reducing error by considering the users in design was constantly reinforced. The same goes for maintenance where the possibility of a mistake is always considered and a lot of effort is taken to avoid errors or catch them before they lead to disaster. This leads to a strong 'no-blame' culture with shared belief that preventing an error is everyone's duty; we were always thinking about 'Murphy's Law' (anything that can go wrong will go wrong). At that time, I wasn't considering a career in human factors, but I must have been absorbing the values and importance of human factors that would influence my later career.

What do you like most or find most rewarding about your job?

I really enjoy the 'human' focus in human factors, but I prefer the maritime term 'human element' as I think this better emphasises that everything we are involved in is a combination of human and engineered elements. Often that human element has been written out of the system but it's still very much there and the whole is completely dependent on the humans to keep going. In human factors we put that human element back and enable the role of people to be recognised and properly valued. I get very frustrated when I get shown an overview of a system with no people when it is obvious that without people there would be no system, no outputs and no customers.

What opportunities has working in ergonomics and human factors given you?

For me it's been three things: working in a developing area where it's possible to have new ideas and see them evolve; getting involved in a wide range of industries and activities; and being able to exert influence for positive change. I've always maintained my professional career as a mechanical engineer alongside my career in human factors and I've found that I can create greater change in engineering by applying human factors techniques than I can by applying more engineering. Human factors has given me the ability and tools to look at the whole problem, not just one part, with the benefit that I not only see a bigger picture, but I deal with more senior management who are also concerned to get both the technology and the people right.

How has your job enabled you to develop professionally?

The big professional development in recent years has been my involvement in working groups at a national and international level. I chair one industry committee and I'm on several international groups drafting guidance. These are hard work but you get to meet a lot of really committed people and you know you're creating guidance that will improve the safety and efficiency of many activities. There can be significant cultural differences on international groups but that's part of the challenge – and it also forces you to look again at your own ideas and assumptions. It's been a journey, first learning the science and techniques of human factors, then putting them into practice, then presenting the outcomes (good and bad!) at conferences and seminars, and now bringing all that together to contribute to the next generation of guidance.

What's been the most exciting or interesting project you've worked on?

Perhaps because of my roots in engineering I've always been a hands-on person and I like big machinery. Being 100 miles out in the North Sea standing

(safely to one side!) on a drill floor with 1000 horse power equipment and 500 tons of load is physically and mentally exciting, you get a real sense of where our energy is coming from and the jobs people are doing. I was part of the UK team that looked at the lessons from the loss of the *Deepwater Horizon* and from that I developed a human factors audit for offshore drilling, then I went out and did some of the audits in the UK and other countries. By using human factors questions, we found problems that others had missed, which was a great feeling but it was also a challenge as we had to justify our findings to very busy senior managers who had very little experience of human factors. They learned a new way to look at their activities and we learned how to explain what we did in the most succinct way possible.

How do you divide your time in a typical week?

I now do a lot more writing in relation to site work as I tend to be compiling reports from other people's data gathering. That suits me now but I still like to get some time on site or running workshops with front-line crews, not every week but perhaps once a month, as it's important to keep your feet on the ground. Human factors is a subject that lends itself to jargon, it's not alone, just look at medicine, but jargon gets between us and our target audience and so it's a constant battle to strip it away. I find regular meaningful contact with front-line workers is the best cure. I should add contact with students too as teaching a subject is a great way to expose any weaknesses. I do some lecturing on an MSc course and some of the questions can be extremely challenging; on a number of occasions I've had to go back and look again at how I had interpreted data or events. I also apply human factors outside my day job as an NHS Public Governor and I've recently been inducted as a STEM Ambassador, so I'll be able to go into schools and promote human factors.

What advice would you give someone considering a career in ergonomics and human factors?

I've found it very important to have a strong grounding in an industry or sector to provide a context for human factors. Human factors is not a subject that works in isolation, it's applied to problems people face doing jobs, in an industry, and it's as important to understand that context as it is the human factors. In my experience, once you get the in-depth understanding in an industry and how to apply human factors there, you can migrate that to similar industries and similar activities, and in steps to less similar ones, but always building on practical experience and the credibility it brings. I began applying human factors in offshore oil and gas, then rail and now healthcare, and renewables are sure to be added to that mix too. In the same way I initially applied the human factors techniques at an individual or team level, now I take those same techniques and look at the whole activity, system or organisation, but you have to go a step at a time. ●

I can create greater change in engineering by applying human factors techniques than I can by applying more engineering

IMAGE: ISTOCK

REGIONAL NEWS

A great way to link up and learn

The CIEHF's Regional Group events are diverse, unique and engaging occasions, ideal for CPD learning and for linking up with professionals in your area, although events aren't limited to those that live or work locally.

In 2017, topics included expert witness work, taxonomies, ship operations, device design, Indian ergonomics and cyber security to name a few. Visits included those made to car manufacturers, military bases, air traffic control centres and flight simulators. Many of these visits are difficult or impossible to organise as individuals but are made possible through the hard work and determination of our Regional Group Leads with the backing and support of the CIEHF.

2018 is already looking interesting with events on human factors integration, interactive technologies and ejection seats, with many more in planning. If you've never attended a Regional Group event before, find something that piques your interest and make 2018 the year you get more involved.

Southern Regional Group visit to RAF Odiham in November 2017

SOUTHERN

Ejection seat technology

The Martin-Baker Aircraft Company is the venue for a Southern Regional Group event taking place on the afternoon of 6 June 2018. Martin-Baker is a world leader in the design and manufacture of ejection and crashworthy seats, and you have a unique opportunity to visit their headquarters near Uxbridge.

You will get an overview of the company and details about its history, together with a presentation and demonstration on ejection seat human factors. The visit will also include a factory tour. Places are limited so book your place at **events.ergonomics.org.uk.**

CIEHF events at a glance

Eligible for CPD Lifelong Learning

For more details of all CIEHF events, see our website at **events.ergonomics.org.uk**

EVENT	WHEN & WHERE	DETAILS
Ergonomics & Human Factors Careers Day	28 February 2018, Birmingham	The only careers event focusing on ergonomics and human factors for students, graduates and career changers.
Insight into Volunteering	14 March 2018	Webinar on the opportunities and rewards of getting involved in Institute and standards activities.
Doctoral Consortium	23 April 2018, Birmingham	A chance for PhD students to present their research and their progress so far in constructive discussion with other students and academics.
Ergonomics & Human Factors 2018	23-25 April 2018, Birmingham	The CIEHF's flagship learning, discovery and networking event covering all sectors of research and practice.
Ejection Seat Technology	6 June 2018, Uxbridge	A unique opportunity to visit the Martin-Baker Aircraft Company for a presentation and a tour of the factory.
Human Factors in Future Transport	18-19 June 2018, Birmingham	A new event investigating new technologies including the human factors issues surrounding the design and control of autonomous transport.
Learning from Incidents	15-16 October 2018 (date tbc), location tbc	A cross-sector look at understanding and learning from incidents including those from rail, air, maritime and healthcare.

Please note that some events details may be subject to change after publication. Please check the events website for up-to-date information.

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To find out more about the work we do, services we provide, or experience we might be interested in, please contact NATS Head of Human Factors neil.may@nats.co.uk or visit www.nats.aero and search human factors.

THE ERGONOMIST

No. 565 | May-Jun 2018

Bringing human factors to life

ergonomics.org.uk

DEVELOPMENTS IN DEFENCE

How scientific investigations into human capability have shaped our defence industry

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- Staffing & Manning Levels
- Workload Assessment
- Emergency Response

Organisation

- Safety Culture
- Leadership and Management for Safety
- Compliance Management
- Competence Management
- Organisational Learning

We're delighted to announce that Ben McCaulder is joining the Board as a Director of Greenstreet Berman, to support our continuing growth.

Ben joined GSB in 2015 following over five years at the Office for Nuclear Regulation and before that 12 years in Human Factors consultancy and industry. He now heads up our Manchester Office which we opened last year.

"The importance of Human Factors has never been more widely recognised – it's an exciting time to be a part of GSB, supporting organisations across the high-hazard industries"

To find out more, call Ben:
T: 0161 457 0320
E: ben.mccaulder@greenstreet.co.uk
www.greenstreet.co.uk

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The magazine of The Chartered Institute of Ergonomics & Human Factors

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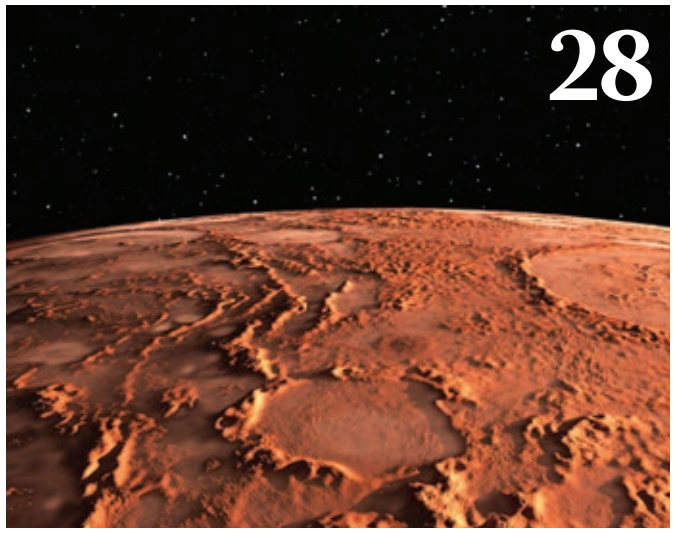

RESEARCH MATTERS

CIEHF NEWS

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FROM THE PRESIDENT

A year of change

Neil Mansfield
CIEHF President

@profnjmansfield

The CIEHF changes its President at each AGM. We actually have three different presidential roles: President Elect, President, and Past President. All of these are voluntary and run concurrently. Members can nominate the President Elect and election at the AGM confirms the appointment. The President Elect then works in a shadowing, supporting and advisory role for a year before moving on to the role of President. During the Presidential year the role becomes more public and responsibilities increase. After this year, the President moves on to the role of Past President bringing an experienced view to proceedings. This system encourages a collaborative working approach as well as diversity in background, vision and focus; I believe that it serves the Institute and its members well.

I've spent 12 months in the role of President Elect and have just started my year-long term as President. As we look forwards over the next year there are key events that will steer the Institute, the discipline, and the country. We are implementing more flexible ways of working with less focus on using an office base in Loughborough, instead using facilities and expertise in towns and cities across the country increasing efficiency and opportunity for members to participate. We're affiliated to the IEA (International Ergonomics Association) who are holding its triennial congress in Florence in August, with a theme of 'Creativity in Practice'; IEA congress always provides a forum for reflecting on the future of ergonomics. Towards the end of my term as President the UK will leave / transition out of the EU which will change working practices and context for the majority of our members.

I'm looking forward to working with you in my term of office, identifying opportunities in this year of change.

There are key events that will steer the Institute

FROM THE EDITOR

From sewers to citizen science

London has often made the headlines over the years with its awe-inspiring infrastructure projects such as the Thames Barrier, Heathrow's Terminal 5 and more recently, Crossrail. But there's a new mega-project underway which faces a huge number of human factors challenges: Karin Boers opens the curtains on the Thames Tideway Tunnel, London's new 'super sewer'. Rail infrastructure is the topic for Richard Bye of Network Rail, who explains how technology is being increasingly used to assist those on the front line, such as signallers and maintenance workers.

In our cover article, Martin Thody looks back at the origins and development of human factors in defence from the first scientific investigations into human capability to the present day.

An interesting ergonomics case study describes steps taken to alleviate motion sickness for workers at Royal Mail who were suffering symptoms from repetitive parcel sorting on a conveyor. Another example of repetitive actions, this time in counting craters on Mars, is the subject of a Citizen Science project. James Sprinks describes the human factors approach being taken to design such research to suit its user population.

This issue also includes two opinion pieces: David Clarke argues that home-grown talent is often overlooked in recruiting human factors specialists, and Ben Tipney asks whether healthcare can ever be error-proof.

Bolivia is in the spotlight in this issue's country perspective, and the challenges faced in this sparsely populated but mineral-rich land.

And finally, a first look at the results from our recent member survey makes interesting reading.

Tina Worthy
editor@ergonomics.org.uk
@ciehf

OPINION

Home-grown talent spotting

An over-reliance on algorithm-based software could spell trouble for the Australian recruitment market. In a world where everything is going global, **David Clarke** is keen to see a return to local. He asks: are recruiters overlooking vital 'soft skill' talent on their doorsteps in favour of recruiting from overseas?

Browse any of the major job advertising boards in Australia and you'll likely see several vacancies for Human Factors Advisors, Human Factors Engineers, Human System Integration Specialists, Ergonomist and so on. Quite often you'll see the same ad re-posted several times over by organisations across the public and private sectors. This suggests: a) the hiring company is too strict on its hiring criteria; b) the organisation has a poor reputation and no one wants to work for it; or c) the in-house 'talent management' team doesn't have a clue on how to 'manage talent' and is relying on cookie-cutter, algorithmic recruitment software to determine the suitability of potential candidates who may have applied for their vacancy.

In the case of the latter scenario, such methods (if you could call relying on algorithms a method) fail to take into account the 'human'. I'd like to think that considering the human is important in human factors-related work! And this approach is rife across big companies; the misguided belief that their brand will see them swamped with the best applicants at the first sign of a vacancy provides them with the notion that automation can quickly and conveniently screen out unsuitable candidates. However, algorithms can't consider (yet) the element critical to humans interacting safely and effectively: non-technical or soft skills.

According to a recent survey of over 2000 businesses in the United States, the absence of soft skills to complement qualifications and hard skills is a significant hindrance to an employee's ability to perform at the level required by their employer. Anyone with even a passing interest in human factors understands that non-technical skills such as communication, conflict management, critical thinking and analysis are fundamental to ensuring the integrity of high-hazard or high consequence environments. So why do organisations' talent management practices persist with focusing primarily on qualifications rather than practical work experience and the soft skills acquired across someone's professional life?

I'm not for one minute suggesting that qualifications aren't important. The field of human factors requires a theoretical basis that can be applied in a practical context. Nevertheless, what if a candidate was mid-way through their qualification in human factors, and had significant experience at the coalface of a high-hazard/high consequence environment as well as demonstrable soft skills attained within a non-hazardous environment? Would the automation screen this candidate out because their degree was incomplete?

IMAGES: GETTY/SHUTTERSTOCK

Or would the absence of the dreaded Australian Certificate 4 in Nothing in Particular see them fail to get past the algorithm? Who is assessing the soft skills of what is a perfectly good candidate?

My own practical and anecdotal experience of the Australian human factors job market suggests that too many perfectly capable candidates who could contribute positively to the human factors function in an organisation are being overlooked. For example, I know a candidate who, at the beginning of his Masters in human factors, contacted a reputable oil and gas consultancy in Australia to get an idea of the demand for human factors candidates at all levels. The HR Manager at the time advised they had to bring everyone in from the UK as there simply wasn't anyone available locally. Yet when he said he had started a Masters, had worked at the coal-face of a leading high-hazard organisation and also had been in client-facing roles for the previous seven years, there was no effort to meet with this candidate and build a relationship. No "here's a candidate that could be of real benefit to us in a year or two sitting on our doorstep", nothing. They preferred to continue sourcing candidates from overseas and spending considerable amounts on sponsorship and visa fees.

It's concerning that organisations in Australia are still sourcing a significant proportion of human factors talent from the UK. You don't have to look too hard to find UK-based third party recruiters promising untold riches and year round sun in an effort to lure talent down under. Is it because there is a genuine dearth of human factors talent in Australia? Or are organisations simply too lazy and inefficient to recognise talent or build relationships with candidates and numerous tertiary institutions that provide undergraduate and postgraduate qualifications in the discipline? I suspect the latter.

If human resource and recruitment departments were properly considering the human, they would realise they have a supply of candidates from Australian-based tertiary institutions on which they could base an assessment of hard and soft skills. And if this channel fails, then look at people who have significant experience in high-hazard industries and can demonstrate good soft skills but might not have the degree. Unfortunately, rigid talent management processes skewed toward hard skill assessment are not only costing them good candidates, but also costing their respective businesses untold amounts of money wasted on third party recruiters and relocation costs. Moreover, the obsession with finding the 'perfect' candidate obscures the reality; there's no such thing.

Soft skills are an essential yet often neglected consideration when recruiting human factors staff

From an IHF perspective, if we were to go to a client and focus purely on their employees' hard skills and not worry about non-technical, soft skills, then we'd be neglecting a critical element of safe working and ultimately reinforcing the very weaknesses a client had engaged us to identify and eliminate. Indeed, we are often engaged by clients to rectify issues that are the result of incompetent employees whose suitability for the job was based purely on qualifications and time served, rather than a balanced assessment of hard and soft skills. Therefore, when IHF is seeking to hire we ensure that prospective employees' soft skills are examined formally and informally to determine competency and suitability. If we didn't, we'd be failing ourselves as an organisation and promoting incompetency.

I often wonder if human factors professionals were involved in the recruitment process at the earliest stages whether this would change, given our understanding of the importance of soft skills and personality within the workplace. Or is the adherence to the process by the internal recruitment team merely a symptom of a wider organisational dysfunction, with the human factors hiring manager being complicit in this failure? Or maybe business processes across the entire organisation are governed centrally resulting in a globalised yet inappropriate recruitment function that results in local inefficiencies and failures?

Whatever the primary cause or contributing factors, it's clear that soft skills are an essential yet often neglected consideration when recruiting human factors staff. Until greater emphasis is placed on the consideration of soft skills in conjunction with qualifications at the initial stages of recruitment, then organisations will continue to complain about non-existent skills shortages and spend and waste considerable amounts of time and money on third party recruiters searching for a capability that may well be buried in a database right under their noses. Or even worse, doesn't exist.

Originally from Melbourne, Australia, **David Clarke** is a Senior Human Factors Consultant with IHF. He spent a significant part of his career working for British Airways as long-haul Cabin Crew based at London Heathrow and Gatwick. He uses his airline and aviation experience to help various industries understand the importance and benefit of human factors in safety and performance.

Further reading

Akintola Benson, 'Needed soft skills for maximum performance', *The Guardian Nigeria*, 26 February 2018

R&D cyber security grant awarded

CIEHF Registered Consultancy CRA has been awarded an R&D grant worth almost £70,000, allowing CRA to make a significant contribution towards improving the integrity of cyber security systems in the nuclear power sector.

Awarded by Innovate UK, the grant will help fund research that will be completed during 2018. CRA will develop a tool that identifies instances of human error within cyber security. The tool will enhance the understanding of the role people play in defending against cyber security attacks in line with the National Cyber Security Centre (NCSC) Strategy 'People: The Strongest Link'. Ultimately the project will improve the range of cyber defensive measures in nuclear power plants, minimising the risk to plant safety and allowing for uninterrupted supplies of electricity.

James Amende, the Business Development Manager at CRA, commented: "It's no longer a big secret that human factors is one of the most significant considerations in the modern cyber security landscape, and something that all security conscious organisations are trying to manage. Evidence of the significant financial and reputational impact caused by mismanagement of the human factor in cyber security is widely reported, however there is still a lack of accessible analysis tools and techniques to support this. Our ambition is to remedy this situation with the development of a tool to help understand and visualise the contribution of human error to cybersecurity risk."

Speaking about the grant, CEO and Founder of CRA Jasbir Sidhu said: "Looking ahead, this project will have an impact on the understanding of cyber security risks in sectors as diverse as global finance to emerging and growing fields such as high integrity data centres."

To find out more about CRA, visit **crarisk.com**.

Supporting research-rich universities

CIEHF Fellow, Professor Sarah Sharples, the Faculty of Engineering's Associate Pro-Vice-Chancellor for Research and Knowledge Exchange at the University of Nottingham, has been appointed to the board of the Engineering and Physical Sciences Research Council (EPSRC). She will join the 12-strong board following the establishment on 1 April 2018 of UK Research and Innovation, which is bringing together the seven Research Councils, Innovate UK and a new organisation, Research England.

Professor Sharples said: "EPSRC invests more than £800 million a year in research and training in engineering and the physical sciences and I'm honoured to take up this role. As a member of the EPSRC Council, I will also be a 'critical friend' of our parent body, UK Research and Innovation, helping to ensure all the Research Councils work together and support our research-rich universities in bold and imaginative ways."

CIEHF President, Professor Neil Mansfield said: "Sarah's selection highlights how human factors and ergonomics continues to be relevant in engineering and physical sciences research, and that there is still much to do to ensure future technology can be fully exploited in order to benefit those who interact with it. This is a significant role and we are confident that she will excel in it."

£800m

EPSRC invests more than £800 million a year in research and training

IMAGES: ISTOCK/SHUTTERSTOCK

Interest from Azerbaijan

Design students from The International School of Azerbaijan have been enlisting help from experts around the globe to support their product development. In March they were given an ergonomics 101 with the CIEHF's Tina Worthy through a lively webinar, where students were able to ask questions about ergonomics and how the discipline relates to their product design projects and their daily lives. Design student Nastassja said: "I thought that was really useful and realising that even in the design of a publication, communicating effectively with people is all part of ergonomics!" Commenting on the careers advice Tina included, student Togrul said: "Wow! So many different potential careers in one job!"

Thanks to the School's Mark Monaghan for arranging the webinar.

Panel member announcements for REF 2021

The Research Excellence Framework (REF) is the UK's system for assessing the excellence of research in higher education institutions. It first took place in 2014 and the next exercise will be conducted in 2021. The criteria phase of the REF will take place in 2018 and will involve the development of the detailed guidance and criteria for REF 2021. The assessment phase of the REF will commence in late 2020 and continue throughout 2021 and will involve the full assessment of submissions made by institutions.

A call for nominations was made for REF 2021 assessors and over 4000 nominations were received. The funding bodies have now made the first set of appointments to the REF main and sub-panels and we are very pleased to announce the appointment of two ergonomics and human factors experts to the Assessment Sub-Panels, alongside the previously announced appointment of Professor John Clarkson (Engineering Design Centre, University of Cambridge) as Chair of Sub-Panel 12: Engineering. CIEHF Fellow Professor Chris Baber from the University of Birmingham has been appointed to Assessor Sub-Panel 12: Engineering. Saeema Ahmed-Kristensen, Professor and Head of the Design Products Programme at the Royal College of Art has been appointed to Assessor Sub-panel 32: Art and Design, History, Practice and Theory.

Emoji insights

A feature on Canada's CBC News "Emojis are everywhere and they're changing how we communicate" explains how emojis are profoundly changing the way we communicate, from breaking down language barriers to accelerating human interaction.

Citing a recent speech at Mobile World Congress from DJ Koh, Samsung's head of IT & Mobile Communications Divisions, Koh explained: "Clearly, the social media generation has revolutionised the way people communicate" and noted that 5 billion emojis were sent in the past year alone.

Using emojis and emoticons helps add emotional depth to our written communication and provides context in the same way body language does in face-to-face interactions. It can however, also give us insight into contemporary human behaviour.

Edge Hill University and the Australian Catholic University released a report last year that revealed more than 90% of online populations now incorporate emojis and emoticons into their texts and emails. The paper, published in the journal *Trends in Cognitive Sciences*, implores researchers to look further into the use of emojis as a tool to uncovering human nature and interactions online.

A DAY IN THE LIFE OF A...

RAILWAY ERGONOMIST

Richard Bye, Principal Ergonomics Specialist, Network Rail

"A Principled Ergo-What-A-Mist? What's that then?", was the response from the last person who asked me what my job was. And admittedly it's not just my job's title that can be a little confusing, as the diversity of the role makes it quite difficult to explain exactly what I do.

Reporting directly to Network Rail's Head of Ergonomics, Mike Carey, I work as part of a small yet dynamic team, based out of our head office in Milton Keynes. The team's aim is to optimise the safety and performance of people's interaction with the railway system, a goal we approach through research, standard setting, and assurance, as well as the delivery of evidence-based guidance to other teams across Network Rail. Our work covers physical, cognitive and organisational ergonomics, and requires big-picture thinking about the future of the railway, as well as a focus on the people, processes and technology at the sharp end of operations and maintenance activities.

At any one time, I could be involved in up to ten projects, looking at, and working on, the design and implementation of new technology, the analysis of business processes, the assurance of engineering work and the management of ergonomics integration.

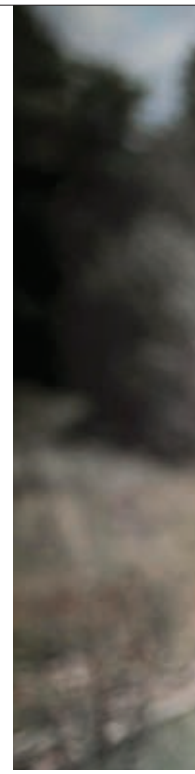
Network Rail's remit is vast, and as such so is the scope for ergonomics work. During my 11 years here, I've been involved in a myriad of different initiatives, ranging from the analysis of electrical isolation procedures to the layout of engineering train cabs and control rooms, and the user experience design of the first iPhone apps for frontline maintenance staff.

My work is currently focused on several cognitive ergonomics projects including the delivery of automation to reduce signaller workload, decision support tools to help controllers reduce the time it takes to recover from operational incidents, and the development of new hardware and software to control level crossings. Besides project work, I also have line management responsibilities for several members of the team, co-ordinate contractors and suppliers, and regularly meet with the Head of Ergonomics to discuss and evaluate current and future strategy and priorities.

When I first started to think about this article, I thought: "Typical day? I have no typical day!", but then I realised that whilst no two days are the same, most do share commonalities in terms of the tasks I carry out and the methods and ways of thinking I need to employ. Although my job can be incredibly varied, one thing that rarely changes is the way I start and end my working day, which, appropriately, is on a train accompanied by a strong coffee and what seems like a never-ending triaging of my inbox and to-do list.

Despite my mode of transport usually being the same, my days' destinations are ever-changing. This is because it's crucial to understand operational context, so besides spending a considerable amount of time with project teams at offices around the country, I often find myself out and about, working anywhere from a control room in Cardiff to a signal box in Sheffield, or even from the trackside ballast in Bristol.

Last week saw me holed up in a hotel in Swindon for



Using apps to assist maintenance tasks and pictured below: Stakeholder workshops

The team's aim is to optimise the safety and performance of people's interaction with the railway system

IMAGES: NETWORK RAIL

several days. I was there to run a workshop based around the implementation of a new rail traffic management system on the Great Western mainline, which goes from London Paddington to Bristol Temple Meads.

Rather fittingly given the title of this article, the workshop was a 'Day In The Life Of' (DITLO) session, set up to replicate and understand the everyday experiences of the people who'll be using the proposed new traffic management system. The workshop was designed to reflect the working day of the signallers and controllers who'll be using the system. This enhanced traffic management technology is being introduced to control the flow of trains as part of a move from the existing Victorian-built infrastructure towards the vision of a digital railway.

For this Western route traffic management DITLO event, we brought together a group of 30 people, representing all stakeholders - from both inside and outside of Network Rail - including suppliers, project delivery teams and route sponsors. The purpose was to thrash out detailed operational scenarios (think broken-down trains, signalling failures, leaves on the line) to understand how new technology could impact, both negatively and positively, on the information needs, decision-making processes, skills and expertise of the people running the railway.

Prior to the workshop the ergonomics team completed a detailed series of ethnographic research activities to understand the existing work system by looking at organisation, tasks, job design, work environment and equipment. We also developed specifications for the proposed software and hardware functionality, design concept and system goals.

Although seemingly rather unsophisticated, a DITLO exercise is particularly useful at this stage of the project. This is due to the evolving maturity of the technology, as well as the uncertainty and ambiguity relating to the impacts on existing business processes, and the needs of the humans at the centre of this socio-technical system.

Structured role-play discussions formed an integral part of the workshop activities. These were captured in real-time by sketching out process diagrams, and through enhancements to the existing task analysis. We also produced affinity maps by sorting, grouping, and prioritising the considerations generated through the participants' discussions. From this, formal updates to the project's RAID log (risks, assumptions, issues and dependencies) were recorded in detail for later review as part of the Network Rail ergonomics assurance process.

Besides having tangible outputs, and driving key insights, decisions and constraints, the DITLO workshop was extremely valuable in fostering a culture of collaboration. It did this by building an appreciation of 'what's required' and 'what's important', and by demonstrating why even apparently simple objectives can be difficult to achieve.

Facilitating a workshop of this complexity, with the need for specialist railway domain knowledge, participatory design techniques and experience of solving complex technology problems, called upon many of my skills as an ergonomist. As I guided the discussions between the parties, it struck me that this workshop was a microcosm of my day job - working with trusted ergonomics colleagues to weave together the changes in human factors, business processes and information technology, that are required to deliver measurable improvements for the railway. ●

Richard has over 14 years of hands-on human factors experience and holds a BSc in Psychology, an MPhil in Memory and Cognition, and an MSc in Human Factors and Ergonomics.

Revolutionising cancer detection and treatment

Patient Receiving Chemotherapy Treatment for Breast Cancer

The Parliamentary and Scientific Committee, founded in 1939, is a major focus for scientific and technological issues providing a liaison between Parliamentarians and scientific bodies, science-based industry and the academic world. CIEHF is a member and the President is invited to their meetings at the House of Commons where there is a themed series of presentations and a Q&A session. In June, it was 'What can we gain from Space Research?', in October it was 'How research and innovation issues are being considered in Brexit negotiations' and in March it was 'Revolutionising Cancer Detection and Treatment'. So clearly, they schedule a very broad range of speakers and interests.

Claire Dickinson attended the March focus session as CIEHF President to better understand the technological advances being developed for the 360,000 new cases of cancer diagnosed each year. Fortunately, the detection and treatment for cancer is the most rapid area of technological advance. Of note, was a presentation by Dr Bethany Williams of the University of Leeds about digitalising pathology. Ordinarily, tissue specimens are mounted on slides, stained and examined under a microscope but with digital pathology there is an extra step of scanning the slide to form a digital image for rapid sharing with other experts. Dr Williams saw the importance of including ergonomists to support improvement in work flow, and connectivity of laboratories and augmented intelligence to support the diagnostic process.

A note of each meeting is available online and sometimes there is live streaming of the meeting. For more information, visit www.scienceinparliament.org.uk.

Congratulations to Freyssinet

Well done to civil engineering specialists Freyssinet who've won the Health & Safety Executive's annual musculoskeletal disorder 'Risk reduction through design' award for its work with Glasgow Subway. Sponsored by the CIEHF, the award was created to highlight the important contribution that design changes can make to reduce musculoskeletal disorder risks.

Pastures new

After an impressive 18 years, CIEHF Fellow Dr Bob Bridger has left the Institute of Naval Medicine and is venturing into the world of consulting as an advisor in human factors and ergonomics. To view Bob's profile and activity visit his website at **www.rsbridger.com** or email **info@rsbridger.com**.

Celebrating the discipline's domains

The Human Factors & Ergonomics Society of Australia is holding its 53rd annual conference in Perth from 26 to 28 November 2018. This year's conference theme is 'The Many Faces of Human Factors & Ergonomics' which aims to embrace and celebrate the discipline's multiple domains of specialisation.

This event brings together the key influencers in the design and evaluation of Australian workplaces, communities and technologies. It is the premier human factors and ergonomics conference in Australia, underpinned by a rigorous scientific panel, it includes a wide range of research presentations, case studies and practice-based workshops and sessions.

The deadline for abstracts is 30 April and discounts are available for CIEHF members. For more details, visit **www.ergonomics.org.au**.

Standard for OH management

British Standard BS 45002-1 'Occupational health and safety management - Guidance on the management of occupational health' is currently in draft and CIEHF members are invited to comment. This is an opportunity to inform those working in small and medium enterprises who may not have much knowledge on what they need to do in this area, why they need to do it or how, and where to get help. Many do not have access to occupational health providers or services. Visit the BSI Standards Development Portal at **https://standardsdevelopment.bsigroup.com/committees/50274349**. The deadline for comment is 14 May 2018.

IMAGES: ALAMY

CHIEF EXECUTIVE'S PERSPECTIVE

Recognising the journey taken

Marking an anniversary is acknowledged by many as a fitting opportunity to recognise not only the journey taken, but also the point reached. Both the journey and the point in time will be telling as to the significance and value of the project.

We have our own anniversary approaching next year, our 70th year, about which members will have an opportunity mid-year to have a say as to what the Institute might do to mark the point in time. Look out for news as to how this will happen, and how it feeds in to Council and our planning process for our 70th year.

One of the most under-publicised, it seems to me at least, anniversaries on the current horizon is that of the Royal Air Force, which is 100 years in existence this year. Aircraft like the Sopwith Snipe were defending our way of life back in 1918. Today, the role of the RAF, the role it should play in an evolving Europe and the funding that makes it what it is are very much under the microscope. What is not in question is the courage and bravery of those who have played a part both on the ground and in the air in our defence over those 100 intervening years.

Interest in military aviation amongst the public remains undimmed, as any scan of aviation magazines will tell you. There are hundreds of air shows across Europe this year, including many in Britain to commemorate the anniversary. Air shows are also high in the public mind in the UK following Shoreham, a tragic outcome in itself and one that illustrates the value of accident investigation, a theme very close to the core expertise of this Institute, and the subject of a learning and sharing event the Institute will be holding later this year.

The positive gloss generally associated by the public with military aviation, and the extent to which our discipline can contribute to it, is attractive. Many of you may have seen the restored Vickers Wellington N2980 'R-for-Robert' at Brooklands museum, recovered from Loch Ness over 30 years ago. Space of necessity was at a premium and entry was through a tiny hatch under the nose, the crew wriggling into it in full flying kit designed for warmth in a bare, light as can be made, fuselage. In darkness, the crew hunched over, cold and confined. Projections and internal spars meant that escape in an emergency would be, and tragically was, very challenging. Preparing, arming, fuelling, maintaining and flying such a machine in extraordinary circumstances would be, and was, very challenging for ordinary people who were finding themselves in extraordinary circumstances.

Interest in military aviation amongst the public remains undimmed

So, aviation, a sector very recognisable to the public within the transport orbit, brings together many elements of why our discipline can bring so many benefits to working lives. One of the things we need to do as a body is to inspire ergonomists of the future to become qualified and to contribute to the evolution and growth of our discipline. Many of our members will, today, contribute to the effectiveness and safe operations of bodies like and including the RAF, yet we hear relatively little about the routine, but inspiring work going on. My challenge to those members is to increasingly offer up examples of your work to this magazine, for our webinar programme and for national events like our Human Factors in Aviation Safety event at Gatwick in November that can inspire, excite and amaze. That is your mission. Some aspects of that work can be shared to illustrate the contribution human factors routinely makes to a great project. Ahead of our 70th year - but every year too - we need to make the absolute most of the sometimes extraordinary, sometimes 'obvious', routinely valuable work that human factors contributes to a better life.

Timing is everything in the way we illustrate to the world how our discipline makes a difference, and how life, play and work is plainly the poorer without it. The Institute now has a public relations capability better funded and better equipped to make the most of your success as qualified ergonomists, and able to sow the seeds of a satisfying career for someone. Join us in exploiting that capability.

Steve Barraclough
Chief Executive of the CIEHF
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OPINION

Balancing the focus of design and people

We all have the desire to work within systems that make it easier to get things right and harder to get things wrong. But in the healthcare context, which relies so heavily on human behaviour and decision-making, **Ben Tipney** asks whether it's even possible to design systems that are error-proof and to remove the need for human judgment

The NHS deals with over 1 million patients every 36 hours, which equates to 243 million patients every year at a cost to the taxpayer of £120billion. The NHS is currently operating in the most challenging climate since its inception in 1948. Patients are living longer, suffering from more chronic illness and their expectations are rising. Technology and treatments are constantly changing and becoming more expensive, and staff shortages abound across the entire service. The ability to deliver safe, high quality healthcare under these conditions is extremely challenging.

The conditions create a pressing need to find fit-for-purpose strategies to deliver the best possible outcomes for patients. The last two decades have seen a huge amount of resources and effort being poured into patient safety with one key shift being towards human factors. The most significant event that catapulted human factors into the broader consciousness was the death of Elaine Bromiley in 2005. Elaine was a

healthy young woman who died following anaesthetic complications. Following her death Martin, her husband, set up the Clinical Human Factors Group. Martin and the CHFG have been at the vanguard of increasing awareness of human factors in healthcare, and many have been inspired by Martin's message that we must focus on learning, not blame.

Thirteen years on and at a point where most healthcare professionals have had some exposure to human factors, questions are now understandably being asked regarding definitions of human factors and where the healthcare industry has focused investment and effort within its services. There have been concerns raised that the healthcare industry has 'misunderstood' what human factors is, specifically that when human factors is referenced within healthcare, it's often referencing training that focuses on behaviours and non-technical skills, culture and cognitive ergonomics, as opposed to the science of system design.

A focus purely on behavioural solutions at the expense of systems thinking is clearly not helpful and it's vital to get the message out there about the pitfalls of behavioural solutions that compensate for poorly designed systems. Equally, is it possible to design systems that are error-proof and remove the need for human judgment? Perhaps in some industries we can get close, for example nuclear power and commercial aviation, where due to the (relative) lack of variation and amount of automation, levels of engineered protection and redundancy can be built into the system to protect operators. Is this realistic in healthcare? Initially we must acknowledge the vast array of different healthcare environments and challenges. Charles Vincent and Rene Amalberti, in their book *Safer Healthcare – Strategies for the Real World*, suggest three models for safety:

1. Ultra-safe: The more structured and controlled environments, such as medical labs and blood transfusion, relying predominantly on system design, regulation and supervision to avoid risk.
2. Ultra-adaptive: The more dynamic and unpredictable environments, such as trauma care, have to rely to a far greater extent on people's ability to adapt and make judgments.
3. High reliability: Environments where risk is not sought out but is inherent within it, such as elective surgery, and combines elements of the other models.

Levels of inherent complexity and unpredictability mean that it's simply not possible to design out error in the majority of healthcare domains. This fits with Eric Hollnagel's work on Resilience Engineering and Safety II. Resilience Engineering Theory tells us that ergonomic functioning and reliability of technical systems can only take us as far as safe operations in stable and predictable environments (Safety-I). Safe outcomes in unstable and unpredictable environments depend on variable human behaviours such as resilience, adaptability and flexibility (Safety-II).

Atul Gwande's work on surgical checklists offers a great insight into the importance of a balance between system design and interventions that create the attitudes, behaviours and culture that allow the system to work in the way intended. His book, *The Checklist Manifesto*, details his initial failed attempts and acknowledges the importance of getting the design of the checklist right to make it fit-for-purpose. His global study across eight hospitals and involving thousands of procedures showed an average of 46% reduction in harm to patients following introduction of the checklist. NHS England introduced the same validated checklist in 2008, but after two years of use their figure was just 0.2%. So why the difference? In short, a lack of buy-in and, in some cases active resistance, reduced the checklist to a tick-box exercise. This was the result of little or no investment in education around the purpose and appropriate application of the checklist. In hospitals where that education has been well delivered, in general the checklist serves as an effective barrier to potential threats.

Resources and effort have been poured into patient safety with one key shift being towards human factors

A balanced view is offered by the Philosophical Breakfast Club, an independent, non-profit organisation with the aim of promoting collaboration, innovation and performance improvement in risk professions: *"Ergonomics changes the things around people. Training changes people. System design is fundamental but training always has a role. Good system design ensures safe levels of functionality. Good training design builds resilience into the system. Optimum outcomes depend on the successful integration of training and design."*

If we accept the need to develop the appropriate attitudes, behaviours and organisational culture, then the next challenge is how. Questions have been raised about training as an intervention, with many articles citing the Hierarchy of Controls (HoC) model, where training is seen as a weak intervention. This model, however, does not take into account training efficacy, specifically:

- Robustness of the pedagogical approach. Aviation for example has recently moved away from the oft-quoted and out-dated Crew Resource Management to Evidence Based Training, a development in methodology rather than content.
- Fit between the identified hazards and the planned interventions. Risk controls that rely heavily on human behaviours may feature lower in the HoC hierarchy but may be highly impactful if designed to be congruent with the identified risks and implemented with a robust and appropriate approach.
- Social and organisational factors that contribute to the →

IMAGES: ISTOCK

Inherent complexity and unpredictability mean that it's simply not possible to design out error in the majority of healthcare domains

success or failure of safety interventions in healthcare, such as senior management support or strategies to embed and sustain learning over time.

Liberati and colleagues challenge the appropriateness of an HoC approach for healthcare, stating that: *"Valuable opportunities for safety improvement may be lost if inappropriate hierarchical models are used to guide the selection of patient safety improvement interventions"*.

There is little discussion happening around educational methodology in relation to human factors in healthcare, with the current debate centring on content and definitions. For example, Vosper and colleagues offer some interesting tips for medical educators on including human factors in curricula. In this paper, developing a just culture is cited as a key element in safety but it's acknowledged that developing such a culture is complex. Indeed, Sidney Dekker has published a second edition of his book, *Just Culture*, with the updated sections focused on the difficulties of implementing such a culture in practice. We know that culture has a huge impact on organisational outcomes and cultural development requires a very different skill set to system design.

If we revisit the tragic death of Elaine Bromiley, the key contributory factors identified were:

- Lack of clear leadership.
- Ambiguous communication and lack of communication, leading to a lack of role clarity and team-working.
- Lack of assertiveness from nursing staff, potentially linked to inter-professional hierarchies (and potentially to broader cultural hierarchy issues).
- Task fixation, which lead to a loss of situation awareness and poor task prioritisation.

This is the event that's largely responsible for the spotlight the healthcare industry has shone on human factors, and the causational factors were cognitive, cultural and behavioural. The industry has recognised these elements of performance as vitally important and see them as within the domain of human factors. Ultimately, optimising performance in high risk environments depends on multiple factors:

- Developing and sustaining a high level of specialist skills.
- The right intent (to do your best, put safety first and do no harm).
- Well-designed systems based on a human factors approach.
- Developing and sustaining an effective safety culture.
- Developing and sustaining a high level of non-technical skills.
- Integrating effective education around the human factors underlying the safety systems in place.
- Understanding human performance and its limitations in healthcare.

Individually, these are all vital but none of them are sufficient in isolation.

If we accept that we cannot eradicate error entirely, creating the safest possible environments and processes requires excellence in all of the above areas. It's absolutely right that we keep seeking to broaden the understanding of human factors within the healthcare community, but to promote one component of performance at the cost of another poses a dangerous risk to overall improvements in safety.

I envisage a future of cross-discipline collaboration where the combining of knowledge and skills will lead to the co-creation and implementation of solutions that will ultimately lead to the delivery of better, safer healthcare. Maintaining and improving performance in today's healthcare system is a huge challenge: we will achieve more together.

Ben Tipney is a former international athlete and coach and a specialist in team and organisational performance. He has an Honours Degree in Leadership and 13 years' experience working with teams and organisations across a variety of industries, the last five years of which have been focused on healthcare. He recently founded MedLed, an independent organisation with the aim of approaching patient safety with a more comprehensive view of performance and taking a more robust educational approach to human factors development.

Further reading

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Human Factors in
Future Transport

18 - 19 June 2018 | Birmingham

Raising awareness of the critical role of human factors in the future transformation of transport systems

This event will highlight the issues of people coherently using multiple services to reach destinations and identify the issues around the integration of different multi-modal transport systems using the same space. We will raise awareness that many discussions taking place about transport systems today involve human factors issues and that we have the expertise to contribute and to provide solutions.

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Transformation of mobility: What could the future of transport look like and how will it affect commuting patterns and where people live?

Autonomy: How can human factors enhance the development of autonomous transport solutions?

Accessibility: How can we ensure future transport solutions don't leave us stranded (in the widest sense of people, communities, industry sectors, regions)?

Behaviour, acceptance and ethics: How can we ensure future transport is sustainable in terms of power generation, air quality, climate change and waste management?

Design: How do we ensure integrated transport systems are based around human-centred design?

Big data: How will we integrate distributed data from multi-model transport systems and provide an holistic view for strategic planning and real-time monitoring?

Talks from: Transport for London, Transport Systems Catapult, University of Nottingham, QinetiQ, Coventry University, Rail Safety and Standards Board, Brunel University, University of Central Florida, Monash University and Arup

How do I find out more?

The event will take place at Maple House, a modern conference venue in the heart of Birmingham, close to New Street station. Our all-inclusive package is just £380 and includes two days' attendance and an informal networking dinner. Or, if you're short on time, attend for one day for £190. It's even better value for CIEHF members who get 25% off these standard rates. For all details, visit the event website and book today. Prices exclude VAT.

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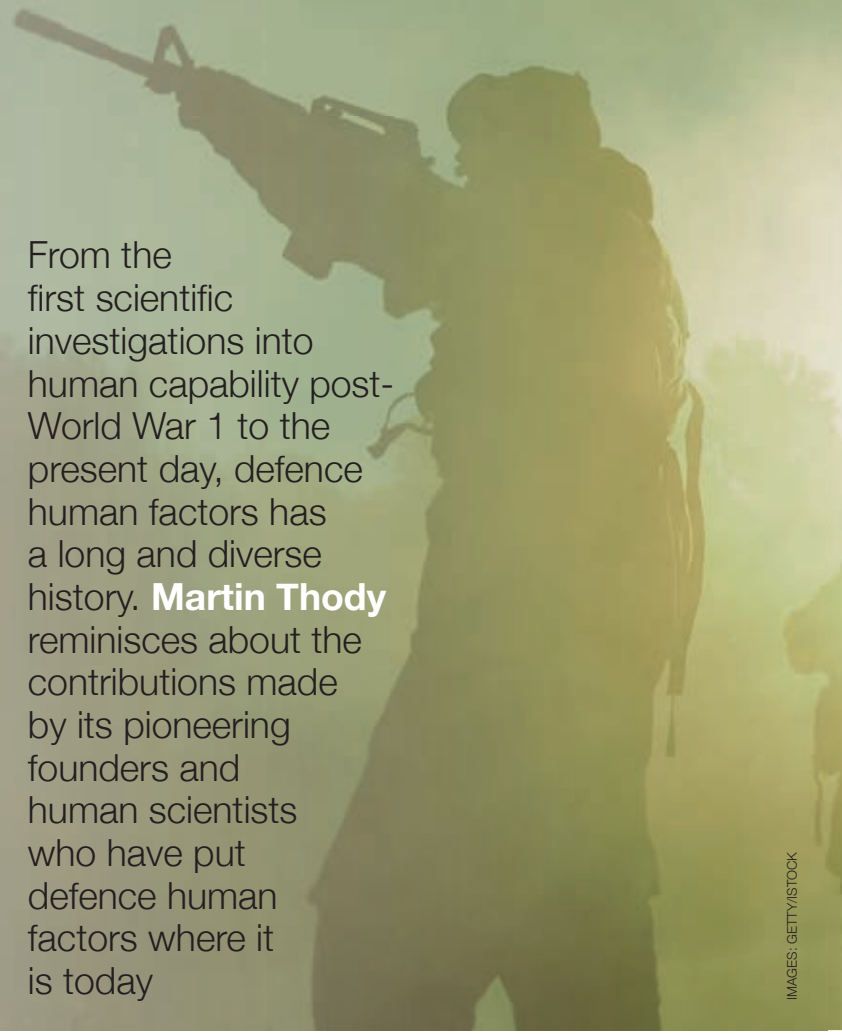
Developments in defence

From the first scientific investigations into human capability post-World War 1 to the present day, defence human factors has a long and diverse history. **Martin Thody** reminisces about the contributions made by its pioneering founders and human scientists who have put defence human factors where it is today



IMAGES: GETTY/ISTOCK

Whilst equipping our armed forces to keep the country safe, the UK defence industry plays an integral role in our national life, employing over 142,000 people and contributing over £23billion to the UK economy in 2016. Integral to that is the application of ergonomics and human factors, which has a long and diverse history. Although it's difficult to pin down exactly when it started or to identify what that first contribution was, it's safe to say that our defence systems and service personnel saw the influence of human sciences long before the term 'ergonomics' existed, or our discipline was formally recognised. Its history is certainly longer than my 32 years of being part of it.

By the time I joined the Army Personnel Research Establishment (APRE) in 1985, ergonomics in defence had come a long way and was extremely well-established; some might even argue that it was a golden era. Times change though, and I've seen a great deal of change in defence human factors since 1985. But first, let's provide a little context with a summary of developments during the first 40 years following the end of World War 2.

The early years

In 1945, the youngest of the three services, the Royal Air Force, succeeded its Physiology Laboratory with the opening of the Institute of Aviation Medicine (IAM), located in a corner of the Royal Aircraft Establishment (RAE) airfield at Farnborough. The Army followed some 20 years later with the formation of APRE in 1965, located next to the IAM. Finally, the Institute of Naval Medicine (INM) opened in Gosport in 1969 and the Admiralty Research Establishment based in Kingston was formed in 1984 to serve the Royal Navy.

In amongst the formation of these armed-service-focused organisations, the term 'ergonomics' was coined at a meeting at The Admiralty, reinforcing the link between the discipline and defence. This was followed shortly after with the formation of the Ergonomics Research Society, the first such professional body in the world, and what has now become our Chartered Institute.

Working alongside soldiers in their environment: what better way to understand why we do what we do?

In addition to the organisations mentioned already, which had a combined staff in excess of 300 scientists including ergonomists, physiologists, psychologists and domain specialist medical doctors, there were also small teams and individuals providing ergonomics and human factors directly to the likes of the RAE at Farnborough and Bedford, the Royal Signals & Radar Establishment in Malvern, the Royal Armament Research & Development Establishment sites at Chertsey and Sevenoaks, RAF Boscombe Down, the Army Air Corps in Middle Wallop and the Royal Armoured Corps in Bovington.

So far, the organisations mentioned were government-funded and staffed by civil servants and serving personnel but there were also human scientists employed by companies supplying the ships, vehicles, aircraft and other defence technology and equipment. Although, at that time, there were far fewer ergonomists working for the defence industry companies than there were for the government, and many of those were individuals, Thorne EMI Electronics' Human Factors Team and British Aerospace's Sowerby Research Centre were notable exceptions.

Research and setting standards

Coming back to the mid-1980s, where it all began for me, the Iron Curtain separated East and West. It was still the Cold War and the UK's defence budget was channelled into making our side of that curtain as robust as possible. Much of this budget was spent on research and much of the money flowed into IAM, APRE and INM. Though undoubtedly equally significant, I have little knowledge of the specific research or applied project programmes that were being undertaken outside APRE. However, the breadth of human sciences research that was being done at APRE was vast and served to create a wealth of knowledge that would ultimately end up as requirements for equipment, or be used in the creation of Defence Standards, guidelines and human factors good practice, much of which remains valid and in use today.

There were endless experiments, studies and trials taking place in purpose-built laboratories in the extensive library (there was no internet in those days) and in the field with in-service and prototype equipment. There are far too many studies to mention here but some notable examples include: those that investigated the causes of and protection against noise-induced hearing loss; longitudinal studies looking at personnel selection, training and retention; extensive anthropometry surveys; physiological studies investigating human responses to and protection from cold, heat, fatigue, manual handling and other stressors; and applied psychology studies investigating weapon aiming, data presentation and image analysis, command and control, and electronic mapping systems long before the ubiquity of Google Maps and SatNav.

Field studies were also common, where we would spend four or five weeks at a time running rigorous experiments with the end user operating in realistic environmental conditions in the UK and overseas. This is where I cut my teeth, so to speak, spending five months during my first year in the field working alongside the soldiers in their environment - what better way to understand why we do what we do? Amongst other things, we investigated tank commanders' vision systems, manning requirements and tank crew endurance. The UK's Challenger 2 main battle tank →

incorporates many of the findings from these studies.

In addition to APRE, IAM and INM doing the bulk of the government's defence human factors research and contributing to their substantial human sciences knowledge base, they had extremely strong links with academia. This was manifest in having university research fellow contractors and by supporting ergonomics and other human science students through the provision of gap year placements and, for example, APRE hosting the London MSc students for a full week every year. It's not surprising, when looking down the lists of today's CIEHF Registered Members and Fellows, that so many spent their gap year in a defence organisation.

The shift towards integration

The end of the Cold War spelled the end of the vast defence research budgets and saw the transition from individual research establishments to largely integrated organisations under the Defence Evaluation & Research Agency (DERA), followed a few years later with a split between the government retained Defence Science & Technology Laboratory (DSTL) and the commercial company QinetiQ. The various human sciences establishments were included in this re-organisation with the formation of the Centre for Human Sciences (CHS) which brought the majority of the government's defence human scientists into a single organisation which was then the largest of its kind in Europe, if not the world.

At the same time, the importance and value of integrating human factors into defence procurement and acquisition projects was also gaining traction. The Ministry of Defence (MoD) recognised that a failure to consider the people component of capability could result in increased accidents and incidents, greater training costs, reduced performance and mission effectiveness, breaches in duty of care, a scarcity of appropriately skilled personnel and substantial increases in design costs. The emphasis was on developing processes and standards to enable the customer to be better informed and to facilitate industry, including human factors, much earlier and proactively in the design cycle.

Soldiers of the Royal Anglian Regiment on Parade at St Neots, Cambridgeshire

We've helped design some of the world's most complex socio-technical systems

First called *Manprint*, this initiative followed the American model of the same name and, through a mixture of dogged determination and strong leadership from within the MoD and across the defence industry, the processes and standards for Human Factors Integration (HFI) were consolidated in 2010. The policy, known as JSP 912, defines HFI as the MoD's systematic process for identifying, tracking and resolving human-related considerations ensuring a balanced development of both technologies and human aspects of capability. And, for the first time, it mandated the integration of human factors in defence projects and stated the need for Suitably Qualified and Experienced Personnel to deliver it.

To support the development of the HFI processes and the underpinning knowledge base, in line with the changing defence strategy and economic shift, defence human sciences research contracts were issued in a competitive manner. This opened what had once been a firmly shut door to the commercial market place including the various defence manufacturing companies, research consortia and to numerous human factors consultancies.

These new commercial, project and process demands, coupled with the overall reduction in defence spending, saw a significant growth in the number and size of human factors teams employed in the private sector to deliver defence human factors. This growth has been seen in the primary defence contractors, for example BAE Systems, Rolls-Royce, General Dynamics and MBDA, and in consultancy firms and individual contractors. The market place is only so big and, inevitably, something had to give; QinetiQ's CHS was disbanded, ending another chapter in the story. However, small specialist groups still survive within QinetiQ, at the RAF's Centre for Aviation Medicine, the INM and within DSTL.

A solid future

It perhaps comes across that I feel that defence human factors is not quite as good as it was. It certainly is very different, that's for sure, but the foundations put down by those early pioneering founders and the inspirational human scientists that followed have put defence human factors where it is today, and where it needs to be today, that is, at the sharp end of industry embedded in projects feeding directly into the design of some of the most complex socio-technical systems in the world for use by our nation's finest men and women. If we can make a difference here, to continue to improvise, adapt and overcome so the user doesn't have to – and I know that we can – then I'm privileged to be part of it.

Martin Thody is a Chartered Fellow of the CIEHF with over 30 years' experience of applied human factors, primarily in the defence sector, working on projects across all three services including armoured vehicles, fast jets, command and control systems, HQ and control rooms, and surface ships and underwater vessels. He is currently working as a contractor with the BAE Systems Human Factors Team in Barrow-in-Furness.

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It's life in the fast lane at Royal Mail as new high-speed conveyors enhance the parcel sorting system. **Corinne Parsons** and **Robin Ellis** shed light on the latest human factors approaches being implemented to reduce motion sickness in workers

Sorting out the sorting office

Reclaiming its place in the FTSE 100 this March, Royal Mail is facing huge business challenges head on. Balancing its obligation to deliver the UK's mail with an increased need to expand its parcel business to keep pace with the e-commerce boom, efficiencies are being driven across the 500 year-old business. And it's in the sorting office, a fast-paced operational environment housing up to 1000 people at a single site, that the latest human factors approaches are supporting workers in the era of manufacturing automation.

Early testing during a feasibility study of a new Royal Mail parcel sorting machine found that a high proportion of people suffered from motion sickness due to working beside high-speed conveyors. Ergonomists were tasked with designing workstations and work tasks which allowed processing of parcels at sufficient rates, whilst minimising musculoskeletal risks and which did not cause

IMAGE: GETTY

significant motion sickness problems for workers.

A key goal for the design was that a maximum of 5% of workers would be unable to undertake the sorting tasks due to motion sickness problems. In addition, the changes must fit within size constraints of existing buildings. An iterative ergonomics approach was adopted by Royal Mail with distinct phases.

Phase 1: Feasibility and task design

Initial testing was conducted with specialist conveyors and a scanner to explore the potential functionality and task design where workers were required to separate out the parcels which were already on the conveyor. Up to 50% of participants complained of dizziness, visual symptoms and nausea when working at the conveyor. A literature review was carried out which revealed:

- Motion sickness caused by a mismatch in the information coming to the brain from the eyes, inner ear and musculoskeletal systems is a recognised problem in relation to conveyor belts. HSE guidance states: "Operators working perpendicular to the belt may feel 'carsick' with conveyor speeds greater than 10 m/min".
- There is wide variation in individual susceptibility, and of those affected, some people adapt quickly whilst others fail to adapt at all.
- Behaviours can be adopted which reduce the impact of motion sickness.

A high proportion of people suffered from motion sickness due to working beside high-speed conveyors

Further rounds of testing were conducted with four different conveyor surfaces and three different conveyor speeds to explore options that might reduce symptoms. Results showed that although reducing the speed of the belt and changing its texture did reduce symptoms, it could not be reduced enough to be fully effective and still retain adequate throughput, and so a task redesign was explored.

People were re-orientated to work sideways on when placing the parcels onto the conveyor. This increased the physical element of the task and the conveyor speed had to be increased to allow space for the parcels. Development of the task and workstation design resulted in sit-stand workstations where parcels were slid onto the conveyor to minimise musculoskeletal risk but early testing showed that symptoms were still likely to occur.

Phase 2: Prevalence testing

A larger study, developed with assistance from the Human Factors Research Group at the University of Nottingham, aimed to determine the likely prevalence of symptoms for both separating parcels already on the conveyor and for sliding parcels onto the conveyor. Testing involved 20 participants working for one-hour sessions with a varied order of methods and recording, via a Quick Exposure Checklist, subjective opinions and observations that looked for behaviours which may indicate symptoms.

It was found that dizziness and eye strain were the most common symptoms, and more severe symptoms were reported separating parcels already on the conveyor than sliding parcels onto it. It was also discovered that patterns of symptoms varied between individuals and that 15 to 20% of people may not be able to work on these belts at all due to the severity of their symptoms.

Phase 3: Development of workstations

The workstation, conveyor and work tasks were developed to minimise symptoms and maximise throughput. Testing involved prototype workstations on which 24 workers tried simulated tasks with two conveyor designs. The final solution resulted in workstations and work tasks which met the key operational requirements of machine throughput rates and space constraints whilst also resulting in a low incidence of motion sickness symptoms.

The design allowed people to work from seated or standing positions, minimising aches and pains associated with prolonged standing or sitting postures. Manual handling and the associated risk of musculoskeletal problems were minimised by sliding parcels onto the conveyor rather than lifting them. Problems were reduced by working sideways on to the conveyor, the belt having minimal colour contrast, and by shielding workers from flashing lights, acceleration/deceleration and other motion in their peripheral vision. Another key control measure was to give workers the ability to pause and look into the distance.

The development of a workstation and work tasks which successfully manages the potential motion sickness symptoms associated with high speed conveyors could have a similar positive impact in other industries. ●

Dr Corinne Parsons is an Occupational Health & Ergonomics Manager with Royal Mail.
Robin Ellis is a Principal Consultant at RED Design Ergonomics.

Ergonomics perspective from Bolivia

Holding 70% of the world's lithium reserves, Bolivia's mining industry looks set to take a new turn as the demand for electric vehicles booms together with the lithium batteries needed to power them. **Carla Alvarez** says that while occupational safety is recognised, historically, ergonomics has been the poorer cousin

The highest and most isolated country in South America, landlocked Bolivia is home to 11 million people, two thirds of whom are indigenous, and the government officially recognises 36 ethnics groups. The country's principal economic activities are rooted in hydrocarbons, mining, manufacturing, commerce, construction, agriculture, livestock, transport, communications and tourism.

Today, hydrocarbons and mining are the main sources of employment for Bolivians and whilst there is a focus on occupational safety in these industries, ergonomics struggles to get a foothold through lack of knowledge. Despite continuous mining for over 500 years, it's estimated that only 10% of Bolivia's mineral resources have been extracted. Principal metals and industrial minerals include gold, silver, zinc, copper, lithium and semi-precious stones.

However, the electric car battery market could soon see both mining and manufacturing taking a new turn in Bolivia. Holding 9 million tonnes of potentially mineable lithium, much of it below the Salar de Uyuni salt flats, the Bolivian government aims not only to mine the raw material but also to exploit partnerships which will see Bolivia manufacturing lithium batteries or possibly even cars.

Subjected to difficulties involving posture, lighting, acoustics and temperature, the miners work in extremely hazardous environments. Recently, news of Bolivian miner Freddy Toco's rescue hit the headlines. He was trapped for more than 26 hours without food or water in the San Jose mine under the city of Oruro. Whilst internationally, there are a plethora of ergonomic indicators surrounding worker conditions and safety for miners, there is little data specifically about Bolivian workers, making it hard for local companies to use ergonomics to improve conditions.

Accounting for around 15% of GDP in Bolivia, the manufacturing industry covers a wide spectrum of textiles, clothing, non-durable consumer goods, processed soya, refined metals and refined petroleum. Processing of food, beverages and tobacco is the biggest sector and one which currently presents the highest occupational safety risks. Only three out of every ten slaughterhouses are able to function optimally, so occupational risks for abattoir workers are high. There is a widespread lack of contamination control and safe systems of work which increases the risk of contamination by blood, viscera and all

Bolivian workers at a pilot lithium extraction factory in the Salar de Uyuni, the largest salt desert in the world.

other part of the animals taken for slaughter and process. Cross-contamination between different areas of plants is also a major risk. Workers must live with the smell and constant humidity generated by the washing of floors and the indiscriminate use of water. Shifts are long and workers are expected to stand for between four and eight hours at a time and many areas are badly lit, putting workers at risk of eye strain.

Working conditions for sugar cane harvesting, or *La Zafra*, are also extremely tough. The industry relies on temporary workers many of which harvest the cane with their bare hands. Exposure to solar radiation and heat are two of the highest occupational hazards according to a study by the Ibero-American Social Security Organisation. Cuts from blades are common in cane workers, which are further compounded by exposure to the sun, humidity and insects. Other physically demanding tasks include sowing the cane seeds and irrigation work. Use of productivity-linked payment models is rife which drives workers to work more intensively and to avoid taking breaks in order to maximise pay.

In the sugar production factories, on top of the extreme heat exposure, the most common problems are noise and danger of injury due to the equipment and tools they use and respiratory problems due to exposure to dust.

State intervention in agriculture has fluctuated over time and whilst Bolivia is taking steps towards agribusiness (large corporate-owned estates), currently there are around 800,000 smallholdings held by indigenous families and farmers (*campesinos*). Many of them live on less than $2USD a day, using ancient methods and home-made tools and the work is hard. Both adults and children participate, working in the heat, often wearing inappropriate clothing and shoes.

Whilst occupational risks in the major industries have been identified by employers and government, proposed solutions to improving working conditions are often taken from other industries and are not fit for purpose. This is a direct result of a lack of local ergonomics studies. An example of this is child labour. Currently, over 850,000 children work in Bolivia, some as young as four or five. And whilst a law was passed in 2016 setting the minimum age for work at 14 years, children aged from 10 years can now also work, so long as it doesn't harm their education, is not unhealthy, dangerous, an assault on their dignity and integral development, nor is expressly prohibited by law. The law responds to a social need but ignores the physical and mental impacts on the child. This is where scientific evidence is needed of the harmful effects of work on young children.

Bolivia is in many ways a developing country and many areas of study are progressing, albeit slowly. Whilst it's recognised that ergonomics could contribute greatly to improvements in working conditions and life in general, the advances in this area are slow. Where ergonomics is applied, existing international standards are used as there is little in the way of national data including anthropometry. However, steps are being taken to gather national ergonomics studies from institutions and foundations that are working in ergonomics. Developing a reliable and usable database of ergonomics studies and information and promoting it to increase application in the areas that need it most would require a considerable investment of effort. To do this, specialists must be trained and agreements made with public and private institutions to set goals.

Differences in geography, ethnicity, food and weather conditions affect the physical characteristics of Bolivians

Within Bolivia there are major differences in geography, ethnicity, food and weather conditions that affect the physical characteristics of Bolivians resulting, in some cases, in anatomical variation. The anthropologist Jean Albert Vellard, the first head of the Bolivian Institute of High Altitude Biology, investigated this phenomenon and produced extended biological studies recognising the anthropometric features typical of Andean people. Vellard's study demonstrated clear distinctions between the anatomical characteristics of two of them, the Altiplanidos and Andidos.

The descendants of the Altiplanidos generally live in the northern part of the Bolivian Plateau or altiplan (La Paz city). Compared to other Bolivians the average height of the population in this region is 161.5cm. Their trunk is of average size but their chests tend to be large which causes alterations in their anatomy. Their upper limbs are of medium length or long, the skull is long, the forehead is relatively wide and the nose is pronounced with an aquiline profile. The descendants of the Andidos prevail in the southern part of the Plateau (Cochabamba, part of Sucre and Tarija). These people are shorter than Altiplanidos, with an adult height typically 156 to 158cm. The trunk is longer compared with other Bolivians, the skull is shorter, the face is wide and the nose is broad.

These differences often present problems with standard clothing sizes which currently use measures from Brazil, Argentina and the United States to make clothing, shoes and other products, which do not fit well. For example, patterns for leatherwork gloves are of Argentine origin and so these are, more often than not, too large for Bolivian workers. There are numerous situations like this and over time Bolivians have accepted such ill-fitting clothing and equipment as normal.

There are, however, some good specific studies by students and private institutes, such as oil company BG Bolivia's 2007 ergonomics programme Quality of Work Life. The result was greater worker cohesion and a deeper identification with their company, a reduction in identified risk factors, and behaviour change was established. This experience inspired similar programmes in another 12 companies and the Bolivian Hydrocarbons Chamber is now considering promoting workshops about ergonomics and wellbeing at work.

Bolivia provides an interesting region of study because of the range of industries and the different ethnic origins of its people.

Carla Valeria Alvarez Cazón has a Masters in higher education and is a Research Coordinator at the Bolivian Catholic University in Tarija. She is also an Industrial Designer at the University of Chile.

IMAGES: ALAMY

JOURNAL EXTRACTS

Published research from our membership package journals

Car safety and decision-making habits

1 As news that a fifth of UK parents are risking their children's lives and leaving themselves open to a £500 fine by failing to use the correct child car seats hits headlines this Spring, a study has examined whether parents' decision-making patterns relate to car booster seat use.

A recent survey by Confused.com reveals that 18% of drivers with children under the age of 12 admit to never or rarely using a car seat for their children, despite the law stating that they must. And 42% who had been involved in an accident while their child was in the car admitted that their child was either not in a child seat or was not wearing a seatbelt.

In a recent human factors study, researchers asked Israeli parents of four to seven year-olds to answer a questionnaire about car safety and decision-making habits. They found that 90% of parents reported having a booster seat and 70.5% reported consistent booster seat use in general and on short drives during the last month.

Researchers discovered that the use of a child's booster seat was positively related to vigilant decision-making patterns, passenger compliance with rear seat belts and families with fewer children whereas non-compliance was related to a 'buck-passing' pattern.

In their conclusions, the team advocate that when presenting health and safety education it's important to consider parents' habitual decision-making patterns when designing interventions for car booster seat compliance.

They are keen to see further research conducted to ascertain whether these findings are consistent with different populations and different settings and to examine whether general decision-making patterns relate to a range of other parental safety behaviours at home and on the street.

S Shimony-Kanat, R Gofin, A C Kienski, W Wruble & L Mann (2017). Do parental decision-making patterns predict compliance with use of child booster seats? International Journal of Injury Control and Safety Promotion, 25:1, 53-57, DOI: 10.1080/17457300.2017.1323930

Are you a weekend warrior?

2 For those of us striving to achieve a work/life balance and to find time for leisure and exercise, a recent study has shone a light on the little known 'weekend warrior' pattern of physical activity, where people perform all their exercise in just one or two sessions each week.

As wellbeing continues to climb the corporate agenda, a recent study by the Reward & Employee Benefits Association found that 85% of employee wellbeing strategies address physical activity, with 75% of business owners surveyed now offering discounted or free gym membership to their employees.

So, if you simply cannot fit a workout into the recommended three to five sessions a week, is it healthy and productive to cram this into a couple of sessions?

Working with data on sociodemographic and lifestyle characteristics from over 20,500 men and women as part of the Nantong Metabolic Syndrome Study, researchers found that compared with inactive participants, weekend warriors were at lower risk of metabolic syndrome, a cluster of conditions that increase the risk of diabetes and hypertension. In addition, the team discovered that both weekend warrior and regular physical activity patterns showed a 10–60% decrease in abnormal triglycerides, glucose and blood pressure in both sexes, abnormal waist circumference in men only, and abnormal high-density lipoprotein in women only.

The team drew the conclusion that by either performing more than 150 minutes a week of moderate physically activity, or just 75 minutes a week of vigorous-intensity physical activity, metabolic syndrome and its component diseases can

be prevented. This is great news for all of us burning the candle at both ends and demonstrates different approaches that can be taken to fit into our daily lives.

J Xiao et al (2018). Relationship of 'weekend warrior' and regular physical activity patterns with metabolic syndrome and its associated diseases among Chinese rural adults, Journal of Sports Sciences, Jan 18:1-9, DOI: 10.1080/02640414.2018.1428883

Strictly stilettos

3 With *Strictly Come Dancing* firmly lodged as essential TV viewing for many, sequins and stilettos are literally in the spotlight. Despite the pain and discomfort that often comes with wearing high heels it rarely stops women from wearing them and in fact, 78% of women wear them almost daily, despite them causing pain, on average, after just one hour and six minutes.

Several commercial stiletto designs have been marketed to alleviate discomfort through memory foam, arch wings and other improvements. Some studies have been carried out but have been limited in that comfort was evaluated after five minutes on a treadmill and in those not used to wearing high heels. No study has evaluated comfort during everyday use, where prolonged time in high heels may increase discomfort. But now researchers have sought to discover more scientifically whether an off-the-rack orthotic stiletto alters pressure and comfort scores in the forefoot, arch and heel.

Twenty-two women accepted the challenge and across three sessions of three days each researchers compared orthotic stilettos with toe pads, arch support and heel caps, standard stilettos without inlays, and trainers. Measuring the peak pressure and pressure-time integral, the orthotic stiletto exhibited lower toe and heel pressures than the standard stiletto. Following investigation, the comfort in the forefoot and heel was higher in the orthotic stiletto than in the standard shoe.

The research shows that off-the-rack orthotic stilettos can notably reduce plantar pressures and improve forefoot and heel comfort during everyday use. The study concludes that having a long second toe is also a risk factor for increased forefoot pressure.

J Ø Penny, M B Speedtsberg, T Kallemose & J Bencke (2018). Can an off-the-rack orthotic stiletto alter pressure and comfort scores in the forefoot, arch and heel? Ergonomics, published online: 16 Mar 2018, DOI: 10.1080/00140139.2018.1443518

IMAGES: ISTOCK/SHUTTERSTOCK

Pre-empting behaviour

4 Mental Health Awareness Week takes place in May and focusing on one of the many devasting outcomes to poor mental health, the Office of Rail and Road reports that 273 people died in suicides on Britain's railways in 2016/17. The question Brendan Ryan, of the University of Nottingham asks, is could better knowledge of behaviours of people on railway property help with identifying those at risk of suicide?

In March 2018, Network Rail joined with the Samaritans, the British Transport Police and the wider rail industry to host a parliamentary reception on suicide prevention. This follows the launch of the 'Small Talk Saves Lives' campaign created to help give the public the confidence to trust their instincts and act if they see someone who may be at risk. Promoting the message that suicidal thoughts can be temporary and interrupted by a simple question, the campaign stresses that there is no single sign or combination of behaviours that mean a person is suicidal but if passengers spot something that "doesn't feel right" they should start a conversation or alert rail staff or the police.

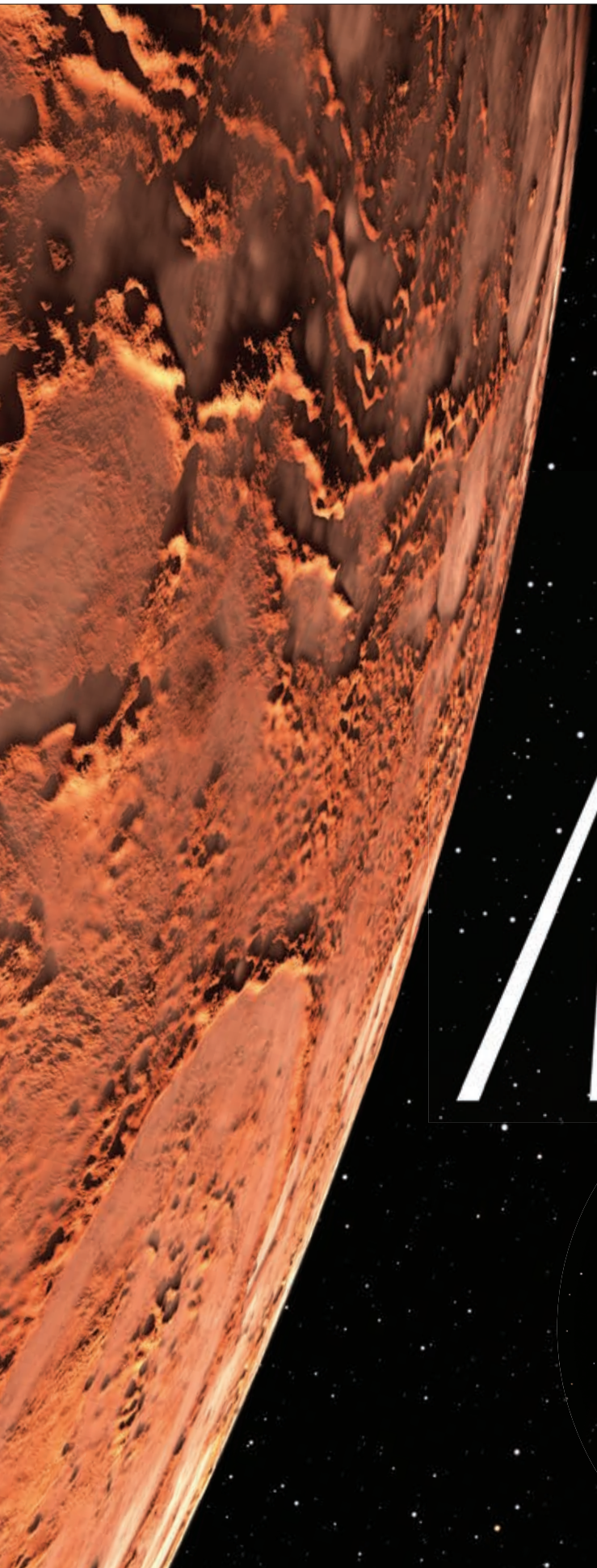
Combining both an extensive literature review on what is known about studying behaviour in this type of public location, and secondary analysis of descriptions of behaviour from structured exercises with experts and other pre-existing sources, a framework was produced that included five main classes: display of emotion, appearance, posture/movements, activities and interactions.

Many railway suicides could be prevented with better understanding

Warning signs could include someone standing alone and isolated, looking distant or withdrawn, staying on a platform for a long time without boarding a train, or displaying something out of the ordinary in their behaviour or appearance. The research has produced commentary on factors that influence identification of suspicious behaviours, how to distinguish these from normal behaviours and the circumstances that inhibit timely reactions to the behaviour amidst the complexity of the operational railway.

Many railway suicides could be prevented with better understanding of behaviours before events. By analysing pre-existing data sources to produce this framework, this research can prompt the collection of better evidence on pre-suicidal behaviours. The study concludes that there is room for future applications in developing surveillance technologies, training staff and public awareness to help reduce this tragic statistic.

B Ryan (2018), Developing a framework of behaviours before suicides at railway locations. Ergonomics, Vol 61, Iss 5, DOI: 10.1080/00140139.2017.1401124



Fancy taking on Professor Brian Cox and counting craters on Mars? Two thousand people from over 40 countries have said 'yes' in one of the world's most exciting citizen science projects. **James Sprinks** shares learning from applying human factors approaches to the design of online citizen science platforms.

The mapping of Mars

Recently we learned of cosmologist Professor Stephen Hawking's passing; a man who awed both scientists and the public and one of few that inspired public participation in science. Coupled with public outreach by Sir David Attenborough in his latest *Blue Planet II* series, the UK is witnessing an explosion of citizen science projects.

Online citizen science platforms are a relatively new form of activity, enabling non-scientists to take part in scientific research across a range of disciplines, anywhere

and at any time. To date, online citizen science research has tended to be driven by concerns around the core science rather than being considered as something that can be designed to suit its user population. This is perhaps remiss given the importance of the 'citizen' to the endeavour, as the effectiveness of citizen science is related to its ability to attract and retain engaged users, to ensure the quantity and quality of the data collected.

Through this work, a first attempt is made at applying human factors approaches to the design of online citizen science platforms. Such platforms involve processes, mechanisms and methodologies that have historically been used in other systems, and as such there is a wealth of research regarding their design and implementation. They often require the user to analyse visual stimuli on-screen, through completing tasks in a repetitive manner, a scenario analogous to that concerning the mechanisms of industrial work. As such, the relevant insights of perceptual psychology and work design have been applied to the citizen science case, specifically the methodologies of psychophysical methods and Job Characterisation Theory.

Factors including autonomy, variety, task type and the user judgement required have been identified as operational at the design stage of a citizen science project, whilst several decades of human factors research have confirmed their potential influence on performance and engagement. To investigate if this is true in the online citizen science domain, a science case was developed in association with the University of Bristol concerning crater counting on the surface of Mars. This approach also provided an expert set of data to use as a ground truth to compare with the volunteer data.

In conjunction with the internationally recognised citizen science platform the Zooniverse, a website was developed allowing the online public to mark craters on the surface of Mars. The website incorporated three different interface designs that presented different workflows to volunteers, comprising of different task types and judgements, and differing degrees of variety and freedom. In addition to the task interface, the site incorporated information about the science being addressed and a community forum for communication with both other volunteers and the scientific experts.

The Planet Four: Craters site went live in March 2015, with data collected through until the end of June 2015. Over this time, approximately 2000 volunteers from over 40 different countries contributed a total of 27,000 separate crater markings over the three different task interfaces. As well as directly communicating about the website through the forum, volunteers also had the opportunity to fill in an online questionnaire to share their opinions on the tasks, interface and imagery presented to better understand how task and interface design affects volunteer website behaviour.

Analysis of the data collected showed that an interface that presents a simpler task resulted in more data being collected, whilst an interface that restricts the volunteer to do tasks in a step by step fashion, becoming more complex over time, provided more accurate results when compared to the expert. Considering website behaviour, visitors were more likely to return to the site when presented with an interface that allows more freedom to choose what task to do, and more variety of task. Through volunteer feedback it was shown that this preference depended on their knowledge of the platform, with new volunteers preferring more guidance and less freedom when compared to returners.

Insights from perceptual psychology and work design have been applied to citizen science

This research has shown that human factors considerations learnt from similar systems can be applied to the online citizen science case. Additionally, the factors identified can be easily adapted at the design stage of the project to develop different approaches even if the overall scientific task remains the same. It has been shown that such considerations can have a significant influence on both the data produced and the engagement of the volunteers suggesting that future citizen science developers could tailor the design of task and interface to achieve the appropriate outcome for their particular science goal.

Although this work has online citizen science as its focus, other platforms exist, requiring the volunteer to act as data collector, using mobile technologies. The lessons learnt regarding the application of human factors considerations to task and interface design could have implications in this domain. Beyond citizen science, the research has the potential to be applied to other crowd-based, online systems. It could well assist with identifying design opportunities for performance gain, for instance 'Mechanical Turk' type platforms could use the research to adapt the tasks they present to their online workforce, improving both data output and user motivation.

Online citizen science developers will have to consider which human factors lessons are applicable to suit their needs, by considering the type of data required, the amount that needs analysing and the prospective size and motivation of their volunteer community.

Dr James Sprinks is a Research Fellow in the School of Science and Technology at Nottingham Trent University.

Further reading

Planet Four: Craters website: www.craters.planetfour.org

Mars in Motion website: www.zooniverse.org/projects/imarsnottingham/mars-in-motio

Citizen Science Association website: www.citizenscience.org

IMAGES: ISTOCK/SHUTTERSTOCK

Building London's super sewer

As Tideway gets set to build upon the UK's legacy of construction megaprojects by upgrading London's sewerage system to cope with the demands of the city well into the 22nd century, **Karin Boers** examines the multiple, complex sociotechnical system challenges faced, sharing her research towards transformational occupational safety and health

After years of study, construction work has started on a new 25 kilometre interception, storage and transfer tunnel running up to 66 metres below the Thames, known as the Thames Tideway Tunnel. Dubbed as 'London's super sewer', running from Acton in the west to Abbey Mills Pumping Station in the east, it's the largest infrastructure project ever undertaken by the UK water industry. The project will put paid to overflows of tens of millions of tonnes of untreated sewage flowing into the tidal River Thames each year.

Joining an impressive line-up of construction megaprojects including Heathrow Terminal 5, London 2012 Olympic Park and Crossrail, delivery of the £4.2billion Tideway involves multiple partner organisations, who must work together efficiently, effectively and safely, to address significant technological challenges.

Currently in the early stages of my PhD research, I'm examining how decisions are taken and the communication that accompanies this in major construction projects. Funded by Loughborough University, my research is working towards a best-practice approach to managing the occupational safety and health (OSH) of the workers on the project.

The research forms a case study demonstrating the intricacies of these complex sociotechnical systems, with its layers of alliances, management, contractors and subcontractors working together over an extended period. As researchers, we have unprecedented access to the project and, through an ergonomics lens, I'm exploring the client's ambition to achieve transformational occupational safety and health on the project. My research is examining the realisation of this ambition and associated strategies, mapping how the three Main Works Contractors (MWCs) translate them into practice.

At this early stage of my research, some of the methods I'm considering using are cognitive work analysis, social network analysis and ethnography. I'll be questioning how Tideway's transformational OSH strategies are implemented in the three MWCs, particularly focusing on their differences and similarities and why. I'll also consider how OSH-related decisions are taken, the factors that influence decision-making and communication, and how an understanding of the differences and similarities and their influencing factors aid the wider construction industry to improve OSH in the future.

Tideway really is a 'mega' project. In terms of scale, the tunnel will be 25km long and large enough to accommodate two double decker London buses side by side. The tunnel will run mostly underneath the river Thames and will require 24 separate construction sites. The research opportunities presented are huge and it has

Cross section of the Thames Tideway Tunnel

IMAGE: THAMES TIDEWAY TUNNEL

been paramount that I focus my early research. As a Chartered safety and health practitioner I have a natural affinity to concentrate on strategies that have serious OSH implications for the workforce.

I've identified three strategies employed by Tideway which warrant further investigation, two of which were mandated by the client:

1 Ten-hour shift limits for tunnellers

This strategy was mandated by Tideway, via the legal contracts, to the three MWCs. The industry norm is 12-hour shifts in a variety of weekly patterns but due to the recognition in the construction industry of the risks of fatigue in shift workers, the client's aim is to reduce the incidence of fatigue for tunnellers since an underground environment can be hazardous. However, with changing shift patterns, there are multifaceted social and personal implications for the workforce that also come into play and need to be considered.

2 Acoustic sheds to decrease the impact of 24/7 tunnelling activities

Acoustic sheds are large, temporary structures that cover the tunnel access shaft and the surrounding area. Tunnelling and the supporting above-ground activities produce noise which has an impact on the neighbouring residential communities. The client mandated that acoustic sheds be used on the central London sites to comply with urban noise regulations and reduce the noise impact as much as possible. While there are benefits for workers, especially in keeping warm and dry in winter, there are also potentially detrimental safety and health implications resulting from worker exposure to heat, noise and diesel fumes trapped by the shed.

3 Diesel or electric tunnelling locomotives

Locomotives are used in the construction of tunnels to remove spoil and transport materials along the tunnel. There are different types of locomotives available such as diesel, electric and hybrid models. Although historically the industry norm has been the use of diesel locomotives, recognition that diesel fumes cause respiratory problems and can be carcinogenic has pushed the development and use of electric locomotives for work in tunnels. Electric locomotives would seem a better option but then there are issues with an increase in lifting operations for the batteries, the storage of batteries which presents a risk of fire, and the space constraints of central London construction sites. In this case the client has not set out a mandate for what type of locomotives must be used on the project and different choices have been made by the three MWCs.

Layers of alliances, management, contractors and subcontractors represent hugely complex sociotechnical systems

My research is focused on senior management decision-making and communication surrounding the three strategies described. I'm aiming to understand how these decisions were made, the communication involved in both making the decisions and implementing them, and then the outcome in terms of the realised strategies. Learning from this should help to ensure positive implementation of future decisions and communication. At this stage of my research, I've mainly used interviews to elucidate the different interpretations and implementations.

So far, the emerging high-level influencing factors for decision-making and communication have been custom and practice, environmental considerations, financial implications, perceived effects on worker health and safety, social impact and misconceptions. The next stage of my research will trace the decision-making and communication further by using established methods as an aid to a deeper understanding of this complex sociotechnical system. The aim will be to complete a prospective study following some example archetypal decisions having OSH implications for the workforce, from inception to realisation in this multi-layered senior management environment. Such an approach should allow important lessons to be learnt, taking advantage of our living lab: the Tideway project.

Karin Boers is a PhD student studying at Loughborough University's Design School. Her PhD supervisors at Loughborough University are Professors Roger Haslam, Alistair Gibb and Andrew Dainty.

Further reading

The Tideway project: www.tideway.london

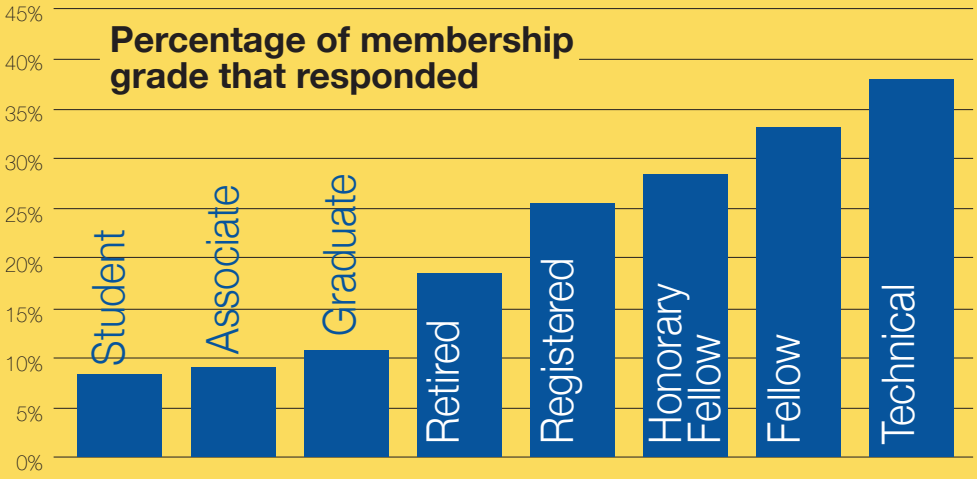
The Loughborough Tideway Tracer research project: http://tideway.lboro.ac.uk

Where respondents work

Membership survey results

The CIEHF offered its members the chance to take part in a membership survey in March 2018, the first for several years. Here are some of the early findings about the respondents.

313 Members responded (16.4% of our total membership)



13%
Have 'ergonomist' or 'ergonomics' in their job title

29%
Have 'human factors' in their job title

54%
Would definitely recommend CIEHF membership to a colleague or friend (and 43% might)

37%
of membership fees are paid by an employer

76%
Feel a sense of community

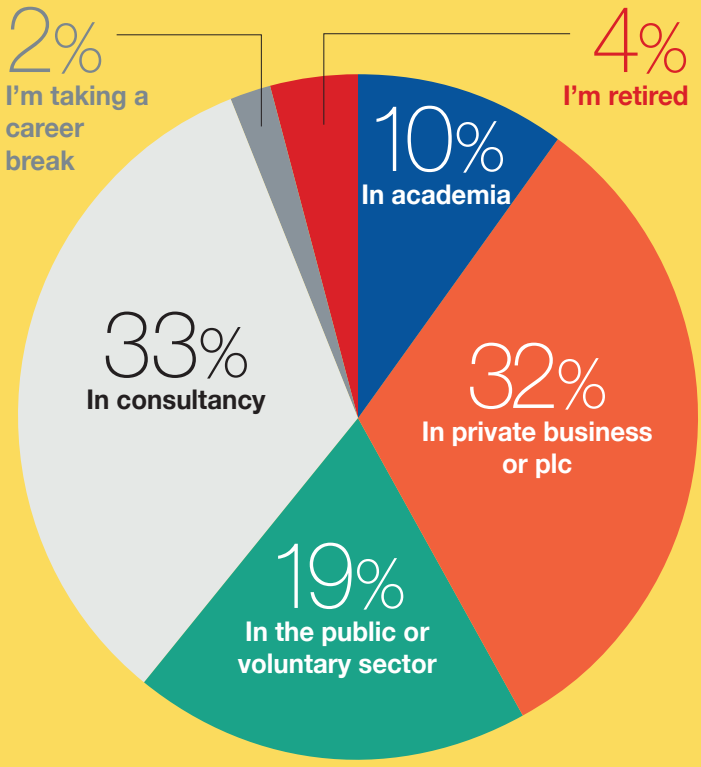
Time: the biggest barrier to contributing to CIEHF activities (54%) or to *The Ergonomist* (51%)

86%
Would value access to standards

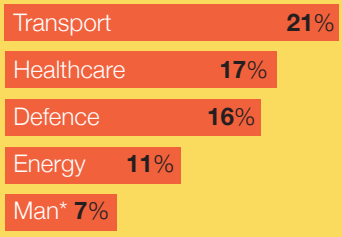
53%
Are interested in Chartership

41%
Want to be active in CIEHF and help shape policy

The full survey results will be shared with CIEHF's Council and committees in order to contribute to ideas, plans and activities for the future. Look out for further news on this



Top 5 sectors respondents work in



* Manufacturing

Top 5 membership benefits in terms of perceived value

1. Exposure to or exchange of new ideas
2. The Ergonomist magazine
3. Networking opportunities
4. Learning transferable skills through involvement in CIEHF activities
5. Regional Group events/Webinars

9%
Want nothing from membership, simply to support the CIEHF

65%
Feel the value of their membership exceeds the subscription fees

53%
Have accessed our official journal *Ergonomics* in the last year

and more information on the survey results. Thank you to all members who took the time to respond.

Getting the message out

In order to raise awareness of the CIEHF and to publicise our Ergonomics & Human Factors 2018 conference, and in particular the 'Life in the Smart Age' session, we took our first step into electronic billboard advertising with this giant screen beside the A38 in central Birmingham. The advert rotated with a number of others for a period of two weeks in March, ensuring that it was displayed to thousands of drivers, riders, passengers and pedestrians each day.

REGIONAL NEWS

SOUTHERN

Ejection seat technology

The CIEHF Southern Regional Group will be holding an afternoon event on Wednesday 6th June 2018 with a visit to Martin-Baker Aircraft Company, a world leader in the design and manufacture of ejection and crashworthy seats for nearly 70 years.

This is a unique opportunity to visit the company's Middlesex headquarters, where an overview of the company and details about its history will be given, together with a presentation and demonstration on ejection seat human factors. The visit will also include a factory tour.

Visit **http://events.ergonomics.org.uk/event/ejection-seat-technology/** for more details and to book.

IMAGE: ALAMY

Volunteer a visit

One of the CIEHF's roles is as a facilitator and we have resources to facilitate Regional Group events. We can help arrange and fund visits to organisations and premises where you'll see human factors challenges and applications from a unique vantage point.

If you think a visit to an organisation in your area would be a great experience for members, allowing them and you, a glimpse into a fascinating or unusual workplace or public building, please get in touch. Your Regional Group Lead welcomes suggestions and we can help them organise the event.

CIEHF events at a glance

Eligible for CPD Lifelong Learning

For more details of all CIEHF events, see our website at **events.ergonomics.org.uk**

EVENT	WHEN & WHERE	DETAILS
Ejection Seat Technology	6 June 2018, Uxbridge	A unique opportunity to visit the Martin-Baker Aircraft Company for a presentation and a tour of the factory.
Human Factors in Future Transport	18-19 June 2018, Birmingham	A new event investigating new technologies including the human factors issues surrounding the design and control of autonomous transport.
International Ergonomics Association 20th Congress	26-30 August 2018, Florence	'Creativity in Practice', transforming the results of research on innovation into concrete actions to improve the quality of life and work.
Agile Working Workshop	10 September 2018, London	An interactive day recognising the revolution in the way we work, concentrating on agile working issues and risk assessment for mobile workers.
Learning from Incidents	15-16 October 2018 (date tbc), location tbc	A cross-sector look at understanding and learning from incidents including those from rail, air, maritime and healthcare.
Human Factors in Aviation Safety	12-13 November 2018, Gatwick	Presentations, discussion and debate on human performance issues in military and commercial sectors.

Please note that some events details may be subject to change after publication. Please check the events website for up-to-date information.

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THE ERGONOMIST

Bringing human factors to life

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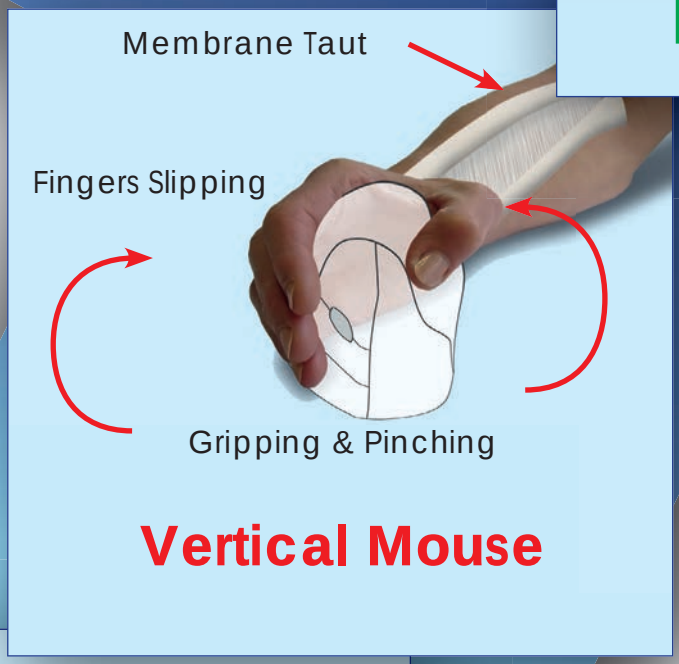

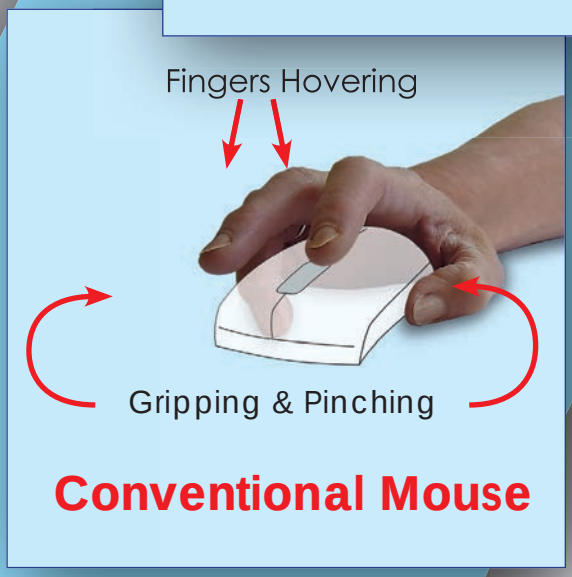

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FROM THE PRESIDENT

Combining networking, discovery and training

Neil Mansfield
CIEHF President

@profnjmansfield

Our annual Ergonomics & Human Factors Conference has been a long-standing highlight of the year for many in the Chartered Institute. I recall attending my first one back in 1997 at a venue near Grantham, where I was struck by a strong sense of community and a healthy representation from industry, characteristics that have been retained.

The 2018 conference, held in Birmingham, again combined opportunities for networking, discovery and training, with opportunities to hear detailed presentations of the latest research and big-picture views from our keynotes and Institute lectures. Three of these focused on transport systems (maritime, rail and aviation); the other two focused on interactive teamworking and effective ongoing safety improvement. Whilst the speakers' styles and backgrounds covered a broad spectrum, it was clear that all approached problems with the goal of understanding the system as a whole in order to improve it.

We also had the pleasure of welcoming the current President of the International Ergonomics Association, Yushi Fujita, who gave an overview of IEA activity and impact. We are looking to strengthen links with the IEA and I know that many members will be attending the IEA Congress in Florence in August.

Those able to attend the Institute AGM in Birmingham will have heard how we're continuing to grow and membership is approaching 2000 summed across all grades. When I attended my first Ergonomics Society (as was) conference, membership stood at about 1250 meaning that we've grown by 60% in that time, and this growth has been accelerating in recent years. We strive to provide opportunities for all members to benefit from professional development through the annual conference but also via the webinars, regional groups, and other, ongoing CIEHF events. I hope to see many of you at these over the next year.

We've grown by 60%... and this growth has been accelerating in recent years

FROM THE EDITOR

From accessibility to zoology

Imagine having to look after 21,000 animals, the 1.9 million visitors they attract each year, plus up to 800 workers, all on the same site. Our cover article explores the challenges involved for Chester Zoo's occupational health advisor, Rebecca Dutton, who takes care of staff from keepers and feeders to finance and marketing personnel.

But we start with a thought-provoking piece about transitioning from automated to manual control. It can be instant and effective in simple scenarios when the changeover is expected and instigated by the operator such as deliberately changing from cruise control to manual driving, but what happens when it's unexpected and suddenly there are multiple complex operations to perform to bring the system back under full manual control? Taken from an award-winning paper, Martin Thody's article explores the issues in the context of submarines where complicated hydrostatics come into play.

Technology features throughout the issue with an article about accessibility of connected transport systems, an explanation about ensuring trouble-free restarts of oil refineries, and a discussion focused on understanding the needs of workers in a future increasingly dominated by technology-driven systems.

Ensuring safe use of powered access platforms, integrating ergonomics and sports science, and that all-important work-life balance rounds off the issue.

Tina Worthy
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Expecting the unexpected

Automation is often introduced to take dull, monotonous, difficult or repetitive tasks away from a human operator, but this can result in people being required to step in only when something unexpected happens or the automation fails. What if the point of transition from automation to human is safety-critical? **Martin Thody** and colleagues explored the issue in an award-winning paper which considers the potential influence of automation in accident sequence development in future submarines

Both Tesla and Uber have made headlines in recent months due to fatal crashes involving their self-driving cars. Thankfully, these instances are rare but, as in these cases, when highly reliable automation goes wrong, the results can be catastrophic. This can be because the human operator trusts the automation too much and takes too long to regain true situation awareness. This so-called automation-induced complacency comes about because failure of reliable automation is, by definition, rare and unpredictable, and the operator's attention is usually focused elsewhere, assuming the automated system will not fail.

Automation could be a way of reducing error by excluding the human operator from the control process but automated systems are never completely autonomous and they don't all have the same functions. People are always needed to oversee operations and

system design needs to accommodate co-ordination between the automation and the human operator.

Automation is also often introduced to reduce operator workload and improve performance and is usually successful in doing so. But as workload falls the quality of an operator's situation awareness decreases because they need to put less effort into processing information. There may be a point at which the level of automation actually introduces a latent risk of the operator being less able to regain control should the automation fail because their mental model of the situation has become incomplete.

Automation may be introduced to carry out tasks beyond the capabilities of human operators such as calculating multiple complicated solutions or executing actions in parallel. System design needs to take the possibility of failure at this point into account to ensure a smooth transition to human control.

In reliable automated systems there are reduced opportunities to practice skills, for example, pilots must manually land their planes a minimum number of times a month just to be able to maintain skills, even though the autopilot can do the job perfectly well for them. So long as it functions correctly, of course.

Similarly, in the maritime sector, modern submarines usually operate under autopilot control which means that operators have very limited opportunities to gain experience, and don't have many chances to become familiar with emergency and recovery procedures.

Manoeuvring a submarine successfully depends on a delicate and complicated balance between boat mass, speed and hydrodynamic lift which are usually controlled automatically. If automation is disrupted and human operators need to take back control, feedback to operators from actions taken to trim the boat or to change direction for example, can be delayed due to the submarine's momentum and inertia, resulting in doubt about the success of those actions until the outcome becomes apparent.

System design needs to ensure a smooth transition from automation to human control

One particular difficulty is that hydrostatic control is complicated by changes in the pressure on the boat as its depth in the water increases. This results in changes in the boat's density which affects its buoyancy, so control and management of the hydrostatic process needs to adapt accordingly.

Automated systems require human inputs to guide their behaviour and this in itself can introduce error into performance. As automated systems are not truly autonomous, people are still needed to supervise the automation despite, in some cases, not actually understanding the way in which the automation is achieving its goals due to the complexity of the operation.

So, whilst automation increases capability by allowing a broader range of operations to take place, it can also increase the risk of something going wrong, which is in part shared with the human operator, especially at times of unexpected events. To some extent there is always a balance between capability and risk because demands for greater capability often incur greater risk and the issue is then managing the risk effectively.

Where automation creates new opportunities for human error, the problems associated with human-automation interaction need to be successfully resolved. For environments which don't share the momentum and breadth of human factors input that aviation engineering has, it's important to learn the lessons before implementing them in systems. That many of the problems are rooted in design supports the view that this is where the greatest change will result in the greatest improvement. Now it seems impossible and unacceptable to say we didn't see these problems coming out of implementing automation.

RINA award presentation. From left to right: Professor Richard Birmingham (RINA President), Dr Malcolm Cook, David Garrett and Martin Thody

This work, described in the paper "I didn't see that coming: the perils of underwater automation", won the David Goodrich Award for the best paper presented at the annual Royal Institution of Naval Architects (RINA) Warships conference. The authors, CIEHF's Chartered Fellow Martin Thody and BAE Systems colleagues Dr Malcolm Cook and David Garrett, were presented with the award at RINA's AGM in April.

RINA is holding a Human Factors Conference on 26-27 September 2018 in London, where several topics will be explored including how the work of naval architects and marine engineers directly influences the operability and safety of the vessel and the seafarer. Decisions made at the design stage can influence human behaviour and health and an improved understanding of ergonomics by engineers can 'design out' hazards and prevent incidents, both to the individual and the vessel. With ever more complex systems and technology, greater improvements in safety can be achieved through a better understanding of human/system dynamics. A greater awareness of the role played by management structures, culture, procedures and regulation in safe and effective operation is also important to the effective running of the vessel and wellbeing of the crew.

For more details about this event, visit www.rina.org.uk/Human_Factors2018.html.

Martin Thody has over 30 years' experience of applied human factors in the realms of complex systems, specialising in human factors engineering and safety in design. Dr Malcolm Cook and David Garrett are both principal engineers in the Human Factors Department of BAE Systems, Maritime Submarines, UK.

Further reading

Warship 2017: Naval Submarines & UUVs. 14-15 June 2017, Bath, UK

IMAGES: ISTOCK

An ergonomics perspective from Portugal

Changes in the structure of the economy in Portugal over the past three decades now sees the service sector flourishing. As the country makes significant strides towards excellence, **Pedro Ferreira** explains how the demand for ergonomics best practice is on the rise

Nestled along the Iberian Peninsula, bordering with Spain, Portugal has a rich and unique culture, lively cities and one of the warmest climates in Europe. As one of the top five most-visited European countries, and winner of the World Travel Awards' prestigious Europe's Leading Tourism Destination award last year, Portugal's tourism industry is flourishing. It's now one of the biggest contributors to the national economy and the largest employer, with almost one million jobs as a result. Other main sectors of the economy today include construction, textiles and car production.

Back in the late 80s and early 90s, whilst the economy began its transformation, there was a strong demand for occupational health best practice within various traditional industry sectors. The process industry was rapidly growing in Portugal and ergonomics-related issues, such as musculoskeletal disorders, became one of the main demands for ergonomics interventions. However, both in terms of the economy and employment, the service sector has risen dramatically since the 80s, whilst industry, construction, agriculture and fisheries have taken a back seat. Sectors with higher levels of technology, such as transport, healthcare equipment and machinery, are now causing a growth in demand for ergonomists and human factors professionals.

Service sector growth

Demand for external ergonomics and occupational health expertise is currently high in Portugal. In the 2015 National Survey on Working Conditions in Continental Portugal, researchers found that health and safety at work

Street paver at work in Lisbon, Portugal

services were not well organised in almost one fifth of the companies. The contracting of external services was found to be the most common form of managing occupational safety and health management with almost 70% of companies taking this route.

With economic and social development comes an increased demand for mobility and, as a result, the transport sector has grown exponentially. A high volume of the current workforce are professional self-employed drivers who work long hours and are exposed to strong vibrations, extreme temperatures and frequent lifting, carrying and manoeuvring of loads without help from other workers or devices, all of which can contribute to musculoskeletal disorders. Employers and professional bodies now recognise ergonomics as fundamental for both vehicle safety and traffic control needs across the country.

Portugal has achieved a significant decrease in the number of road fatalities per million inhabitants since 2010 and this April, plans were also unveiled for a network of intelligent roads by 2050 to help further cut fatalities and reduce fuel emissions, all of which will require ergonomics input.

Ergonomics practitioners are in steady demand across Portugal's service sectors, from healthcare and banking, to public facilities. And more recently, the design of IT and web-based systems shows considerable growth, mainly around usability.

Growth in higher education

Ergonomist roles have been progressively opened up with the help of the creation of the Portuguese Ergonomics Association (APERGO) in 1992 together with its affiliation with the International Ergonomics Association (IEA). Since then, APERGO has evolved to become recognised as the representative body of ergonomics practice in Portugal, both at national and international level.

Ergonomics education and training at the Faculty of Human Kinetics at the University of Lisbon began in 1985 and was structured around a five-year undergraduate programme. The programme was initially based on the French conceptual approach to ergonomics, which put strong emphasis on the knowledge of human functioning, capabilities and limitations, and its application to the analysis of human activity at work. The programme rapidly evolved into a broader conceptual framework by integrating more robust knowledge and practice relating to ergonomics design tools and approaches.

The undergraduate programme included a six month industry placement during the final year, under the supervision of a faculty member. The real-world practice that students acquired through this industry placement rapidly became a cornerstone, particularly during early years when it was often challenging to provide them with other relevant tangible examples of ergonomics practice. This also became a fundamental path for the strengthening of relations between academia and industry and provided ample demonstration to industry stakeholders in Portugal of the potential added value of ergonomics intervention, both from the health and safety and the process perspectives.

In 1991, the adoption of the EU Directive on occupational health and safety made ergonomics more robust in Portugal. Ergonomics was formally recognised as a requirement for continuous improvement, and the training provided by the undergraduate ergonomics programme at the Faculty of Human Kinetics became one of the first courses to grant certification as a health and safety specialist.

Thirty years of economic transformation sees the service sector drive ergonomics demand

In 2007, following the Bologna Agreement, the undergraduate ergonomics programme was reduced to three years and the full-time placement sadly eliminated. This was transferred to the Masters in ergonomics that started in 2009, but nevertheless, a three-month supervised placement was still maintained within the undergraduate programme. This undergraduate ergonomics programme is one of very few globally as most courses are now at postgraduate level.

The success of the course has helped contribute to the development of the profession of ergonomist in Portugal. Most ergonomists are employed within private organisations either in ergonomics or under the health and safety banner.

Industry members and other stakeholders such as regulators have continuously recognised that the undergraduate training in ergonomics provided by the Faculty has helped transform the domains of safety and human factors across many sectors.

Continuing demand

Very recently, a European research call under 'Horizon 2020' for human factors in transport safety stated that "Human factors are the largest cause of accidents across all transport modes" and that "increased technical development and automation (...) can improve safety by decreasing the human element".

This underlines a prevalent yet misguided perspective of the human contribution to safety and is not limited to the domain of transport. In this context, strongly-rooted ergonomics training and education should be encouraged and fostered. Demands for increasingly specialised and highly skilled professionals is rife across all industry sectors and it looks set to continue.

Pedro Ferreira is a Researcher (Joint Professor) at CENTEC, the Centre for Marine Technology and Ocean Engineering, Instituto Superior Técnico, University of Lisbon. He was assisted in writing this article by Teresa Cotrim from the Faculty of Human Kinetics at the University of Lisbon and current President of APERGO.

Further reading

The European Commission - Horizon 2020 Research and Innovation action MG-2-1-2018: Human Factors in Transport Safety. Retrieved from: http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/mg-2-1-2018.html on 06.05.2018

IMAGE: ISTOCK

Hidden dangers of keyless cars

More than half of the 17 million vehicles sold annually in the US now have keyless ignitions, yet dozens of people have been poisoned by carbon monoxide after failing to turn off the ignition on keyless cars, according to the *New York Times*.

The report found that 28 people died and 45 others had suffered injuries since 2006 due to drivers leaving their vehicles running in enclosed garages which allowed carbon monoxide gas to get into their homes.

While the Society of Automotive Engineers (SAE) said it had published safety recommendations in 2011, director of SAE Jack Pokrzywa, has commented that standards are voluntary and it's up to manufacturers to adopt them.

Used in cars around the world, keyless ignitions consist of a device that's carried by the driver, allowing them to start the car with the press of a button linked to the fob. While the car will not start if the key fob is not detected, once the car has been started it will continue to run even if the device is removed from the vehicle.

Hermit life

Research released from interior landscaping firm Ambius reveals that 40% of Britons spend just 15 minutes outdoors each day. That's even less than prisoners, who require 'at least one hour of suitable exercise in the open air daily', according to UN guidelines.

The study of 1000 UK office workers found that on average, those surveyed spent more time at their desk (6.8 hours) than they do in bed (6.4 hours), or even relaxing at home (3.5 hours).

Kenneth Freeman, Head of Innovation at Ambius said: "It's worrying how little time people are spending outside during the working day. Whether this is on purpose or not, we should all make a conscious effort to ensure we are finding the time in our day to reconnect with nature in some way – even a ten-minute walk outside at lunchtime can be restorative. As well as the natural benefits of getting some fresh air, feeling close to the natural world can generally make us feel happier, healthier and more productive during the day."

IMAGES: ISTOCK

Top marks for healthcare masterclass

Over 60 healthcare leaders joined top human factors and ergonomics organisations and speakers at University Hospital Birmingham last month for a human factors and ergonomics masterclass. The evet was designed to support understanding and integration of human factors into healthcare systems to optimise patient safety, staff wellbeing and system performance.

The event was organised by University Hospital Birmingham and supported by the CIEHF, West Midlands Patient Safety Collaborative and the Clinical Human Factors Group. This was the first time that one of the UK's largest acute trusts has facilitated such an event and shared a platform with both the CIEHF and the CHFG with support from their regional Patient Safety Collaborative.

Delegates attended from multiple trusts in the Midlands and beyond, including University Hospitals Birmingham, The Royal Free London, Worcester Acute Hospitals NHS Trust, West Midlands Ambulance Service, Birmingham Women's & Children's NHS Foundation Trust and Cambridge University Hospitals NHS Foundation Trust.

The event received brilliant feedback from the delegates with 97% stating that the session had made them reflect on current approaches in healthcare and that they would approach aspects of healthcare differently in the future. Peter Isherwood, Consultant in Critical Care & Anaesthesia at University of Birmingham NHS Foundation Trust and CIEHF Midlands Regional Group Lead, said the masterclass was "a further step towards integrating human factors and ergonomics into healthcare systems in this region and beyond".

The time given up by the organisers, delegates and speakers reflects the increasing awareness of human factors as a discipline that has important contributions to make to healthcare systems and a desire to integrate human factors into healthcare systems. This has already resulted in a conversation between human factors specialists and multiple healthcare professionals and initial plans are being made for a further forum to share ideas and develop strategies for the future.

Over 70 years of defence collaboration

Over 150 defence specialists met in Florida to discuss 'Special/ Specialized Operators – Personnel, Training, and Acquisition Challenges' at the US Department of Defense Human Factors Engineering Technical Advisory Group's 72nd meeting in May.

Technical representatives from the US Department of Defense (DoD), NASA, the Federal Aviation Administration and the Department of Homeland Security, exchanged views on 12 key topics: Human Performance Measurement; Design: Tools and Techniques; Safety, Survivability and Health Hazards; Mixed Reality; Extreme Environments; Innovative Training Solutions; Human Factors Engineering/Human Systems Integration; Personnel Selection and Classification; Modelling and Simulation; Cyber Warfare; Healthcare; and Trust in Autonomy.

The DoD HFE TAG was implemented in November 1976 and its major goal is to provide a mechanism for the timely exchange of technical information in the development and application of human factors by enhancing the coordination among government agencies involved in human factors technology research, development and application.

Engineering your future

Recently BAE Systems Air Sector hosted more than 200 students over two 'Engineering Your Future' open days at their bespoke Academy of Skills & Knowledge (ASK) in Samlesbury, Lancashire. The events aimed to inspire the 15 to 18-year olds, providing them with an insight into the exciting world of engineering, including human factors. This event was a great opportunity for BAE's Human Factors Engineers to raise awareness about the diversity of the human factors domain and provide more information about career routes for budding ergonomists or human factors engineers.

This year the Engineers had two stands, one focused on the application of human factors in military aviation and the other on the application in sport, both with a variety of hands-on technologies, equipment, videos and presentations. Practical demonstrations focused on two elements: the physical environment, giving the students an opportunity to try on flight suits and protective equipment to understand the restrictions such life-saving equipment can have on the pilot's ability to operate within the cockpit; and the cognitive environment, where students could test out novel interaction technologies such as an eye tracker and a bone conductor communication device.

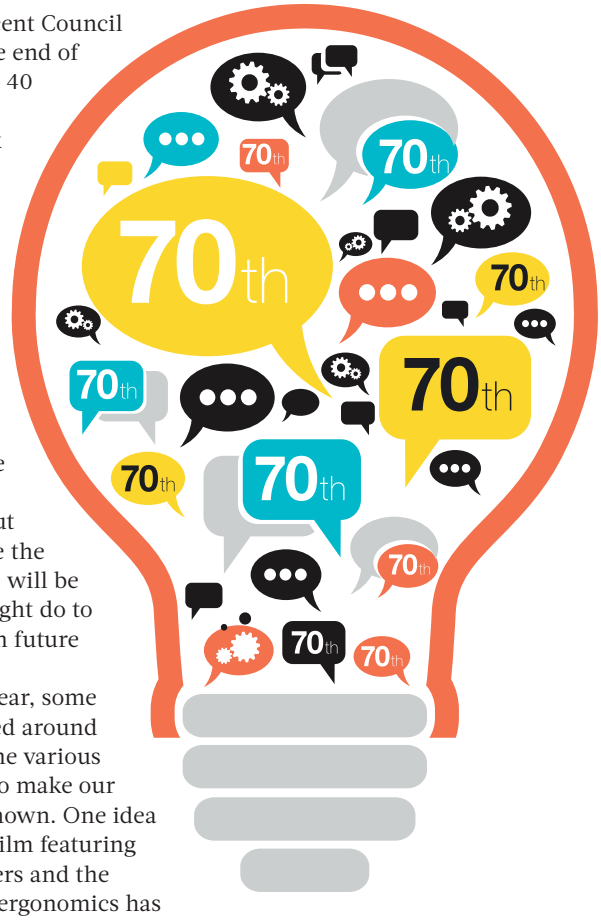
Ergonomics over aesthetics

Inclusive gaming is on the cards at Microsoft as it gets set to release a brand new 'accessible' Xbox controller this summer. Codenamed Project Z, the controller has been designed for ease of use, replacing the typical curvaceous palm-hugging format and button/trigger overload with a more simplistic design.

An image leaked on Twitter clearly shows two large pads and light-up icons to provide visual feedback to the user.

CHIEF EXECUTIVE'S PERSPECTIVE

Marking time



At our most recent Council meeting at the end of May, we spent 40 minutes or so discussing ways to mark our 70th year in 2019. The feeling was that it would be right to do so, and to illustrate in some way the impact of our discipline on the world around us. The sentiment was also that our 75th year provided a larger opportunity to do something even more impactful, and that we would need to plan about two years ahead to make the right impression. So, we will be considering what we might do to mark that anniversary in future meetings.

Meanwhile, for next year, some interesting ideas emerged around the theme of '70', and the various channels we could use to make our discipline's successes known. One idea was to produce a short film featuring past and current members and the tangible difference that ergonomics has made, perhaps knitted together from one-minute shorts taken as mobile 'phone footage. Other ideas suggested included developments in our discipline over 70 years, perhaps featuring key members past and present. Or perhaps a par-70 golf tournament for members and clients. The list continued and was impressive, enthusiastic and passionate.

If you feel you have an innovative idea for bringing this milestone to the notice of the world in an impactful way, then please share it.

Steve Barraclough
Chief Executive of the CIEHF
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A DAY IN THE LIFE OF A...

NOMADIC WORKER

Juliet Raine, Physiotherapist and Ergonomics Consultant at EPF Ltd

Turquoise sea, blue skies, wonderful food, smiling faces. This is what I can see as I sit in a café just a moment from my new home. I'm a true nomadic worker. I now call Sardinia my home, but I provide services for clients over the Internet with regular trips back to the UK for meetings and project work. My office is wherever I open my laptop. I could never have managed this without the recent advances in technology. Sometimes it feels a little like a dream. Is this a typical day?

There is no typical day for me at the moment. I'm happy with how work continues though and that cheap flights make the journey back to the UK easy and affordable for me and my clients. I've just returned from a packed two-week business trip to the UK, working with Grand Central Rail, Sainsbury's and others.

As a qualified physiotherapist and ergonomist, I've spent the past 13 years preaching the benefits of a healthy work-life balance. However, as is so often the case with those who preach, I had failed to follow my own good advice and worked long hours, often involving travel and work in less than ideal postures.

In addition to my full-time work, I was also completing my Masters in Health Ergonomics with the University of Derby. Poor planning often led to last-minute chaos as I worked to hit deadlines that always seemed to coincide with important work projects. I got a real wake-up call in 2011 when I suffered a bad snowboarding accident. I was forced to re-evaluate my own lifestyle as I found I was suddenly unable to maintain the hectic routine I was used to. I made the decision that I would never fail to put my own health and wellbeing first again.

I already practised Pilates, so I upskilled and trained as an instructor to allow me to adopt a more hands-off approach with my physiotherapy clients. By 2012 I was a physiotherapist and Pilates instructor and was half way through my Masters degree. My employer had been great, allowing me to take more of a management role while I recovered from my injury but pressure was mounting to get back to my previous role as our clinic was under-staffed. I made the decision to leave full-time employment and strike out on my own, with a focus on my work in ergonomics. I found I could combine my passion for health and wellbeing, calling upon my knowledge as a physiotherapist and even my Pilates knowledge, while delivering consultancy services for a variety of clients. I loved my work and the challenges it presented.

Having lived in Newcastle-upon-Tyne for 11 years, I found more and more of my work was in London. I decided to relocate, and two weeks later I arrived with what I could carry to start a new chapter. Between 2013 and the end of 2017 I worked with Sainsbury's Supermarkets PLC as their in-house physiotherapist and provided ergonomics consultancy services for them. I continued to work with a variety of other companies providing consultancy services, training packages and health and wellbeing interventions. I found myself being called upon regularly to help companies with employees who worked in confined or inflexible work environments. My mantra has always been the benefits of movement and a focus on training that helps people understand the small changes that can make a big change both at work and at home.

I've spent 13 years preaching the benefits of a healthy work-life balance and now I've got it!

I had finally found my perfect work-life balance. I worked flexible hours, cycled around London, was able to exercise most days and teach Pilates, which forced me to really practise and stretch thoroughly most days. I was in complete control of my lifestyle. My work was once again changing slowly, away from the standard DSE

Marina and view over La Maddalena, Sardinia, Italy

assessment work which had provided a wonderful base for my work initially, and more towards the larger projects, involving a few days with a client and then a lot of behind-the-scenes work which was completed at home.

In 2016 I met Gianfranco, a Sardinian man who had been living in London for a few years. His work-life balance was completely non-existent, as is so often the case in London. He worked long hours in a basement under a hotel on Park Lane as a Purchasing Manager. Although he didn't complain about his long hours, I could see how the daily grind, lack of natural light and stress was so detrimental to his health. It's hard to see someone you care for so exhausted and unhappy with their work. Very quickly we decided we had to change our future and started to hatch a plan to work towards creating our perfect work-life balance together.

I had never been to Sardinia before. I fell in love with it on my first trip to visit friends and family: the weather, the culture and the people. It felt like home, the 'Yorkshire of Italy'; unbelievably friendly people saying hello to everyone in the street, smiling and welcoming strangers into their homes with a generosity I'd never seen before. One of my dreams has always been to run a bed & breakfast. My nomadic way of working would allow me to live almost anywhere in the world. However, in Italy, there were fewer options for Gianfranco to work but he was already building a home in Sardinia, so with a few adjustments to the plans we'd be able to create a perfect B&B to allow us to move over! We spent 18 months planning, I started learning Italian and we created the plans for our future.

So now here we are: Springtime in Sardinia. We moved over completely in January this year to oversee our building work. Gianfranco has spent three months completing an excursionist guide qualification, hiking frequently. The change in him is magical to see. Fresh air, a healthy diet and lack of stress suits us all! We are in the final stages of our construction work, with plans to open our B&B in June.

We're based in a town on the East coast of Sardinia called Tortolì. It's well known by Italian and German tourists, but relatively untouched by Brits. We'll be offering tourists an insight into the real Sardinia, away from the resorts of the North and South of the island, perfect for those who want to escape the chaos of normal life. The world travels at a different pace here. On our doorstep we have the most amazing beaches, and spectacular mountains for hiking. Gianfranco will be using his local knowledge, passion for his culture and qualifications as a sommelier and excursionist guide to offer guests all the information they need to get the most out of their holiday.

I continue to work online and in the UK. I will be offering guests Pilates and physiotherapy, helping them return from their holiday feeling renewed. Finally, we are both combining our passions with a healthy outdoors lifestyle. I'm a very happy nomad!

Juliet Raine is a physiotherapist and ergonomics consultant at EPF Ltd. Visit www.epf.online or see LinkedIn www.linkedin.com/in/juliet-raine-EPF-Limited. See also www.go-comida.com.

IMAGES: ISTOCK/GETTY/SHUTTERSTOCK

OPINION

The inclusion of technology in all aspects of life and work, such as in transport, healthcare, manufacturing and agriculture is continual and increasing in pace. What will be the impact of these changes on people, jobs and society in general? **Murray Sinclair** and **Carys Siemieniuch** explore the issues and the need to develop greater understanding of the future roles of people in these complex systems

Our cyber-physical future is coming

We are moving into a sustainable world with ever-larger Cyber-Physical Systems (CPS). These are systems with embedded software such as might be found in a device, building, means of transport, transport route or a production, medical, logistics or management process, for example. A CPS has dedicated interfaces between people and the system. They are complex networks for getting things done, with many more interactions in parallel between communities, industry, trade and governing bodies, where these interactions will be mediated by software and intelligent agents (human and non-human), with humans having ultimate responsibility and authority, and liability for decisions that are required. It's likely that there will be never-ending floods of data over these networks that will be managed to deliver the diverse goals that the decisions are intended to reach. This will involve layer upon layer of software intervening between people and the world, where we, as human factors experts, will be involved in building 'Joint Cognitive Systems' (in the US) and 'Cyber-Physical Systems' (in the EU), with people becoming supervisors, issue-solvers and resilience providers.

It's likely that many jobs will be subject to automation, and will feature Artificial Intelligence or AI, unless human interaction is required, such as between carer and patient or the task has unpredictable aspects, for example in project-based tasks, such as in construction or there are capability re-arrangements necessary, such as resilience management within organisations. A current estimate by the Organisation for Economic Co-operation and Development is that the UK may lose 12% of jobs to automation, in addition to job losses for other reasons. On the other hand, it's expected that job creation due to new opportunities to use data will be significant.

A known problem of complex, inter-operating, real-time networks is that they become brittle, indicating that humans, when executing their newly-defined tasks through layers of software, will have to do so through the use of inter-operating models and simulations, firstly for situation awareness, secondly to communicate their decisions, and thirdly to ensure that these decisions will not cause some sort of break-down in ongoing, perhaps safety-critical processes. And the people performing these tasks are likely to need a variety of support inputs in these new roles. This support is what human factors professionals must provide, in addition to the high-quality support for workplace operations that they already supply.

Additional education and training will be needed, firstly for new entrants into our discipline, and secondly for our existing professionals through CPD, supported by more and different research and development in our field. Also, it seems reasonable that most other engineering professions involved in this new interconnected and multidisciplinary world of 'software everywhere for ordinary people' will have to become more knowledgeable about socio-technical systems engineering. One way of achieving this is by an outreach programme, both to provide other engineering professions and the organisations that make use of their services with appropriate knowledge and awareness of key human factors issues, and also to enable us, working with these engineering professions, to identify and provide the support, models, tools, etc., that will be needed in the workplace. There is also a need for a substantial R&D effort to develop the tools and infrastructures our professionals will need. Perhaps all this activity should be managed by CIEHF because of the scope of the effort and the need to maintain the high standards with which we currently comply.

This scene was set by the authors in a discussion session attended by 13 delegates at the CIEHF's Ergonomics Human Factors 2018 conference in April. The delegates were then asked three key questions.

1 Is this perspective on the likely roles of humans in future CPS networks realistic?

There was agreement that people are inevitable in future systems although the nature of their future roles and the task to be undertaken by both humans and intelligent agents or robots within CPS was not entirely clear and needed further investigation; roles such as support, maintenance, upgrading systems, rectification, error recovery, coaches or mentors of 'learning AI' and repositories of wisdom were mentioned. There was also a case made that professionals need to be more focused on the social side of human factors such as cultures, ethical aspects of tasks and roles, corporate social responsibilities, etc. Similarly, supervisory control of automation implies monitoring for emergent challenges (hacking being one example, process change another) that in turn requires re-design solutions. Lurking here are issues of visualisation, situation awareness and support for distributed re-design. Lurking even deeper, increasing systems complexity will preclude any one individual or technical specialist having the necessary range of skills and capabilities, and teams will be required. This points again to the need for outreach and collaboration.

There will be layer upon layer of software intervening between people and the world

Points raised focused particularly on the nature of the human/CPS interface: the need for White rather than Black Box AI; the development of neurological interfaces; the key challenge for these interfaces of 'contextually sensitive anticipation' by technology; visualisation not being about just designing interfaces; how to include the work context/environment on which you are trying to have your effect; constraints of the capability of human-machine-interface on the nature of the jobs to be done; how to design to ensure trust. →

IMAGES: GETTY

2 What are the main challenges to our profession that arise?

Comments covered the obvious need to equip our professionals to learn new areas as fast as possible but how would this need be met by training (aimed at competencies, not just skills and knowledge), where would the training come from and how would this be reflected in changes to CIEHF strategy?

Comments about how this training might be addressed covered a wide range: the need to encourage development of more degree programmes; the introduction of human factors modules in other undergrad and postgrad courses; the need for short courses aimed at other engineering professionals; the need to engage with other professional and industrial bodies regarding certification aspects; the need to ensure that whatever human factors training is provided, it enables practitioners to understand the deep issues of human-system interaction. Some concerns were expressed too: if we keep adding to the list of skills and competencies, are we expecting human factors specialists to do it all? Do we need to look at how we teach as well as what we teach? We need to ensure we don't dilute the specialist nature of the human factors professional.

R&D is needed for a better understanding of this altered paradigm for human-system work, together with better tools to implement this understanding. Given the pervasion of software into the world of work, new tools will be required to augment those we use today, to discover software-mediated problems and to demonstrate that provisional solutions will not cause adverse side-effects in extensive, interconnected networks. Tools are needed both to demonstrate the trustworthiness of the solutions and to train operational people to achieve the required level of trust in performance. Such tools would be very useful to train our own professionals too but the market there is too small; it would require the mainstream professions and big organisations to express this need for it to be addressed by tool developers.

Software integration

A second part of the discussion focused on the tools available to our profession, which were considered too paper-based and static in what they present as results, and too focused on particular aspects of work. There is a need for tools that could be integrated into current dynamic tool chains as used in the automotive and process industries, and for more software-based tools to facilitate simulation and visualisation and to improve situation awareness. A further requirement is to identify clearly what types of resources human factors professionals need and how to source them.

Thirdly, the perennial issue of recognition of our profession was mentioned, in order that we can better ameliorate the evident needs that we see in our societies. Suggestions included the development of more management and strategic skills, the demonstration of competencies through the use of modelling and simulations of real situations, and, perhaps most pertinent, the development of human factors as a systems engineering discipline. Should we train human factors professionals to take leadership roles in complex engineering projects or to remain in more bounded specialist roles?

3 Is our proposal enough to address the gaps? If not, what can we do?

The proposal in the presentation centred around further outreach by our Institute to cognate organisations to integrate our specialists more fully into the work of other professions, and to gain assistance in meeting some of the needs expressed in the discussion. As a part of this, it was suggested that there could be specific human factors tracks set up in cognate conferences and vice versa for ours.

Becoming more assertive in our outreach efforts would lead to more engagement with other parties, such as INCOSE and BPS, to support their aims as well as ours. An important goal would be to include human factors roles to arrive at better, more rounded solutions to problems; a Human Factors Integration Management module might be relevant to this. Outreach should include further involvement with schools, universities and exam bodies to ensure that curricula embrace human factors concepts to prepare students better for the demands of future work.

So what happens next? There was general agreement that the CIEHF membership should be involved in a wider discussion, probably in conjunction with the current effort by the CIEHF CE to obtain a more rounded picture of our future needs, that the needs already outlined in the discussion are important and should be addressed, and that outreach will be very important for our future. It was also recognised that the needs of our future 'clients and customers' should be re-examined to ensure the support, and the delivery process for this support that we think they need, is in fact what they actually need.

Murray Sinclair and **Carys Siemieniuch** are retired members of the CIEHF and are Visiting Fellows in the Wolfson School of Mechanical, Electronic and Manufacturing Engineering at Loughborough University.

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Working with

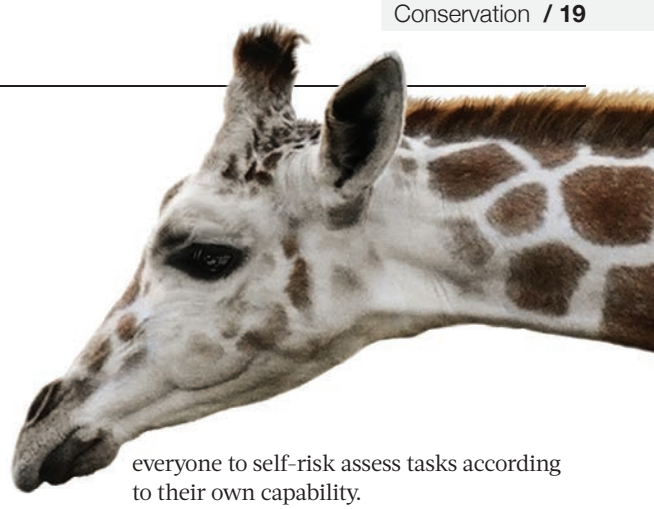
Viewers of the Channel 4 *Secret Life of the Zoo* documentary will have witnessed the remarkable behaviour of the animals at Chester Zoo. **Rebecca Dutton**, the zoo's Occupational Health Advisor, sheds light on the complex and exotic environments, and the passionate workforce that look after the animals and visitors

Home to more than 21,000 animals and set in 125 acres of award-winning zoological gardens and habitats, the UK's most popular zoo at Chester hosts over 1.9 million visitors each year. As summer temperatures rise and school holidays approach, the zoo relies upon its 400 permanent employees, and another 400 seasonal workers, to deliver an extensive range of features and exhibits. From very physically demanding roles such as keepers and feeders, to the more desk-based roles such as finance, HR, marketing and occupational health, everyone works tirelessly towards the zoo's mission to prevent extinction.

With 500 different species to look after, many of which are endangered in the wild, the age, skills and levels of experience of the workforce differ greatly. From those who have worked with the zoo for over 30 years, to those joining for a season or for their first employment out of education, one common theme unites them, and that's a robust, even passionate, level of engagement with the zoo's conservation aims.

Equally unique, is the working environment which involves the regulatory and self-imposed compliance of care standards for all the wild and exotic animals in the collection, combined with naturalistic environments for them to live in. The ownership for design, planning, education and management of human factors in the zoo environment lies over a wide range of people, from the CEO to each individual employee.

Floor surfaces within enclosures may be muddy, sandy, uneven and wet. Tasks may be repetitive and carried out under specific time constraints; for example, the distribution of supplies both for the animal teams and the commercial operations must be completed by 10am, before the zoo is open to the public.



A zoo worker counts ring-tailed lemurs during the annual stocktake of animals at Chester Zoo

wildlife

Certainly, there's little, if any, manual handling training which includes the safe transfer of up to 55 bales of hay (handled twice a day), carcasses, fruit, branches and other feed, often in large sacks weighing up to 25kg, and often to places to which motorised vehicles have limited or no access. Unsurprisingly, this has led to some interesting risk assessments and standard working procedures.

The Site Operations team consists of 46 staff, who work to ensure that the zoo and its wider estate, its assets, staff and animals are kept safe and secure, and have well maintained and operational work areas. For the staff this includes the vehicles to help them carry out their daily tasks. Staff help ensure that visitors have the best experience possible, beginning with the warm welcome from the security team, to ensuring that, through a planned and controlled system of work, the zoo is efficiently maintained.

The Health & Safety team ensure that the zoo's visitors have an extremely safe and low risk visit. Should an accident occur, from a minor graze, to something more serious, our highly qualified and award-winning first aid team are there to help. As the estate continues to develop, the Site Operations team become more involved in the strategic management of the 610-acre site, waste and environmental management, a fleet of 60 vehicles and all of the statutory compliance obligations we face.

Safety is an inherent part of our daily work and we strive for continuous improvement, which is vital when the pace and pressure at which we work can be challenging. By having a close working relationship with each other, an open-door policy and the ability, through training, to recognise and report near misses, we can quickly see contributing factors either on-site or with each other. This enables us to effect change to prevent an incident occurring again or to break the chain of events which could lead to one.

The Capital Development team is responsible for delivery of all the major refurbishments and new builds within the zoo, from inception through design and construction, to use. The zoo has a strategic development plan which sets out its ambitions for the physical development of the zoo for the next 15 years. The team receives detailed briefs from a wide variety of end users and has to consult and communicate with multiple stakeholders. The requirements from the brief are developed into designs and 3D software is used to help end-users understand the physical spaces that are to be built. We consider the animal welfare needs, keeper access and operations, visitor experience and maintenance access requirements, in addition to health and safety during the build, operation and ultimately decommission of the exhibit.

The role of Occupational Health in this challenging ergonomic environment is complex. From repetitive strain, slips, trips and falls, and back and other musculoskeletal injuries from lifting animal feed and moving sedated animals or other heavy loads, the risks can be high. The team must assess each employee's overall physical and mental wellbeing, their individual ability to undertake specific tasks and advice regarding ongoing strategies to avoid, amongst other workplace injuries, musculoskeletal issues.

The role of occupational health in this challenging ergonomic environment is complex

The team is also responsible for the provision of a health surveillance report by providing feedback to Site Operations such as the Health & Safety team as to whether work systems appear to be appropriate based on the level of referrals of staff with workplace injuries. These health surveillance needs are as varied as everything else. Meeting the requirements for working at height, hand-arm vibration and noise control, the keepers surprisingly, are not top of this list. It's often the Animal Supply department, maintenance and the many horticulturists, and it's the role of all line managers to undertake risk assessments for tasks within their team, and indeed for everyone to self-risk assess tasks according to their own capability.

All of this leads to an ongoing assessment and redesign of tasks to meet ergonomics need. For example, the size of the bins has been changed to make them easier to empty by the Guest Experience team, the design of the toilet cubicles has been changed so that maintenance have easier access, motorised wheelbarrows have been provided, and design alterations have been made to access small enclosures so that cleaning and maintenance can be done more easily.

Our Health, Wealth and Happiness Project is designed to encourage ongoing employee engagement and increase both physical and emotional resilience. Utilising the unique hobbies and skills of all employees, a variety of activities are offered throughout the year. These vary from Pilates classes designed to promote and maintain strength and balance, engagement with Active Cheshire projects such as 'Playfest 2018', psychological wellbeing in the workplace sessions and fun courses such as cooking healthy meals and photography. These are all offered alongside robust employment policies designed to support employees and retain their specialist skills within the zoo.

In this golden era for Chester Zoo, there is much rebuilding and redesign being carried out to help us achieve our mission of 'preventing extinction' and the health, safety and wellbeing of the people working so hard to achieve this is paramount.

Rebecca Dutton has been an Occupational Health Advisor at Chester Zoo for nearly two years. The aim of Occupational Health in this context is to ensure that it helps support the Zoo in its mission of "Preventing Extinction" by promoting the physical, mental and social wellbeing of all employees.

IMAGES: GETTY

Refinery restarts

Planned refinery maintenance outages come with an array of safety challenges, but restart is the most hazardous time. **Simon Monnington** reflects on ways that human factors work is helping to bring an added layer of safety to such a disruptive and complex operation

Over 120 million litres of petrol and diesel are sold every day in the UK to support a staggering 318.5 billion vehicle miles driven every year. Accounting for nearly 40% of final energy consumption in the UK, the transportation sector relies on petroleum products to meet 96% of its energy needs, and this process relies upon the raw material, crude oil.

Coming onstream in the 1950s, there are now just seven operational crude oil refineries in the UK, some of the largest in Europe, refining millions of gallons of crude oil each year.

Operating 24 hours a day, 365 days a year, refineries are periodically required to shut down to allow for preventive maintenance, renovations or upgrades. Known as turnarounds (TARs), these planned shut downs occur every three to five years to help keep operations safe and comply with legislation. This process can take anywhere from a few weeks to a few months dependent on the extent of the project or issues arising.

Turnarounds present a multitude of challenges for safety and involve workers carrying out many tasks which are not routine and may be being performed for the first time. However, the most dangerous time in turnaround is towards the end, when units are being brought back online.

The risk of material releases can be greater at that point because of the complexity involved with keeping track of the status of all parts of the system and the dynamic manner with which work activities are completed towards the end of large

maintenance activities.

A 2016 study found that personal exposure to benzene was higher during facility turnaround operations than during normal operations. This could be attributed to the fact that there are more people on site, and most of them are engaged in non-standard operations, such as cleaning, flushing and repairing equipment.

Effective collaboration between maintenance and operations on safety issues is crucial during the planning process and throughout the turnaround. Along with the complexity of most turnarounds is the pressure to complete them in a timely manner. Operations personnel must get units restarted on time but face challenges in confirming every bleed has been closed, every line-up is correct, and every instrument is functional.

The process of verifying the system is hydrocarbon-ready is also a challenge. During one refinery's last major turnaround back in 2012, two reportable Loss of Primary Containment (LOPC) events occurred due to improper line-ups and drains being left inadvertently open. Additionally, restarts have been delayed due to breakdowns in communication between areas about proper valve line-ups.

IMAGE: SHUTTERSTOCK

In preparation for the same refinery's 2016 turnaround, an operations completions programme was developed. The aim of this programme was to eliminate LOPC incidents at start-up associated with human performance. In addition, the programme would provide Operations with the confidence that every stretch of pipe had been checked and that the unit was ready to bring in hydrocarbon.

Walk the Line

'Walk the Line' is a programme that focuses on the human factors that lead to LOPCs. The programme at our refinery was designed to apply the principals of Walk the Line specifically to the time between maintenance handing over the unit to Operations and hydrocarbons entering the unit.

A circuit drawing was developed for each of the refinery's 18 units that underwent maintenance during the turnaround. Designed to be used in tandem with circuit checklists, the drawings helped operations workers to verify that each circuit was ready for hydrocarbon entry. Handover checklists specific to restart were also added to board and field operator logs a few weeks before restart to facilitate clear communications within and between shifts.

Successful turnarounds require the safe completion of all tasks, which means that safety has to be everyone's responsibility. Building and sustaining engagement in the programme was a key objective during preparations and execution of the turnaround. Each area TAR lead, area superintendent, TAR operations lead, and operations manager impressed upon operations personnel the importance of the programme.

To assist teams in continually providing definition and clarity, posters were developed and hung throughout the units, acting as a reminder about human factors and the Walk the Line approach. A helmet sticker was also designed and issued.

Initial training was delivered to Operations prior to shut down and refresher training was given to each shift a week before the end of maintenance. Human factors-themed toolbox talks were also given to reinforce the importance of the programme and shared with crews near the end of maintenance.

Once Maintenance handed the unit back to Operations at the end of the TAR, the shift supervisor assigned operators circuits to walk down. Using the circuit drawing as a reference, operators walked down their assigned circuit and completed the associated checklist. Hydrocarbon could not be brought into the unit until a copy of all completed circuit checklists had been sent to the shift manager and reviewed for completion at the Operational Readiness Review.

Turnarounds represent a multitude of challenges for safety

Use of this programme helped the site achieve its primary goal: a refinery restart without a single LOPC or environmental permit deviation. It also helped reduce misalignments during start-up by improving communication channels. Following the turnaround, users of the programme were able to give feedback on the aspects of the programme they found to be effective and ineffective. This feedback was used to develop a set of recommendations to improve the programme going forward.

Details of the programme, learnings and recommendations were compiled and passed on to other sites to aid in future turnarounds.

Simon Monnington is a Human Factors Advisor at BP. This case study was published in the CIEHF's *Human Connection II* document, a second series of case studies demonstrating how a better understanding of people can make a positive difference across the major sectors. Download a free copy at www.ergonomics.org.uk.

Understanding the science of sport

As awareness grows about the impact wellbeing can have on individuals, businesses, the economy and society, workplaces are increasingly offering free fitness initiatives such as gym memberships and cycle to work schemes. **Jessica Köhne** answers questions about the opportunities this brings for sports scientists and ergonomists to understand each other's roles and to collaborate more closely

How did your interest in sports science begin?

My appreciation and participation in sport started from a young age, sparking my interest into the science behind sport. I enrolled to study human kinetics and ergonomics and thoroughly enjoyed learning about how the human body works, both during exercise and in the workplace. I then enrolled for an MSc in Sport Science and fell in love with research. Since completing my MSc, I've had the privilege of working as a contract sports scientist at Prime Human Performance Institute, in Durban, South Africa, whilst lecturing at a private college.

I've worked with an array of world-class sports medicine doctors, physiotherapists, biokineticists, chiropractors and sport scientists, in addition to working with professional and recreational athletes. Trying to understand how the human body can respond and adapt to its external environment fascinated me and fuelled my ambition to keep finding the best way of integrating the science into day-to-day training programmes and lifestyle for my clients.

How do you apply science to sport?

Considering all aspects of a sport when undertaking scientific testing is challenging as some tests may need to be adapted to suit the athlete. Understanding all aspects of each sport is equally as challenging as, of course, not everyone participates in every sport. However, understanding the needs of the athlete and what they require from the testing in order to achieve performance improvements helps to provide the best testing protocols and outcomes.

Just like ergonomics, sport and exercise science is concerned with understanding how an athlete interacts with their environment. Whether it's their hockey stick, rugby ball, football or swimming costume, other players or athletes around them, the crowds, or the weather, we apply certain principles, theory and data to optimise their wellbeing and overall performance.

IMAGE: GETTY

How do you help get the work/sport/life balance right?

You can consider each athlete, whether professional or recreational, to be a 'worker'. Most of them will have full-time careers and have chosen a particular sporting discipline that they are passionate about and want to excel in. This poses a challenge, as training for big events can become time consuming and physically demanding, in addition to the athletes having to complete a nine to five job. By utilising the principles of ergonomics, we can take a more holistic approach to providing training recommendations and adapt the programme to the athlete. This has proved to make the balance of sport life and work life more achievable, whilst still performing well in both.

Additionally, you can also view those in the workplace as athletes; just like you would train an athlete to perform their chosen sport, you should train an individual in the workplace to be able to perform their day-to-day tasks. Even if an individual is sitting at a desk every day, this will require a certain element of muscular endurance, core stability for back support, and can lead to some postural discrepancies. Training an individual in the workplace, to improve their physical wellbeing, will help enhance their productivity and overall work output, whilst reducing their risk of being absent from work due to an avoidable work-related injury.

Where has ergonomics helped in sport?

There have been many successful applications of ergonomics principles in sport, for example incorporating biomechanics and anthropometric elements into design, such as for bicycle set-ups, hand grips of tennis rackets and running shoe development. Setting up bicycles to match the biomechanics and anthropometrics of an athlete helps them experience less lower back strain, improve equal contribution and recruitment of their quadriceps and hamstrings during the ride, and reduced shoulder tension.

Technology advances and the increasing use of wearable or portable devices for monitoring an individual's performance whilst training, provides further opportunities for ergonomists. This may take the form of designing improvements in the control and interface of the device to allow easier access to readouts whilst on the move, for example. Both recreational athletes and professional athletes are increasingly relying on these devices to provide them with parameters related to their training.

You can make the balance of sport life and work life more achievable, whilst still performing well in both

How does the holistic approach help?

The gap between the two disciplines is narrowing with the increased interest in integrating fitness and wellness programmes into the workplace. Ergonomics plays an important role and contributes significantly to the design of sporting equipment, yet there is still a gap in awareness and knowledge about how the two professions can complement each other.

The holistic approach taken by ergonomists can help sports scientists incorporate all aspects of the sport and environment to ensure that the performance improvements are seen. While the sports scientist may understand the physiological demands of a sport on the athlete, an ergonomist can add to this by identifying the organisational, psychosocial and cognitive demands placed on them.

Jessica Köhne is an exercise scientist and ergonomist, email kohnejessica@gmail.com

Working at height: A moving experience

Working at height is a common occurrence in the construction industry. Elevated platforms are often used for temporary access but they need careful risk assessment and training to ensure safe operation. **Amy Jones** discusses how important ergonomics work has resulted in a new draft international standard to reduce operator errors

Mobile Elevating Work Platforms or MEWPs are powered access machines commonly used across all industry sectors by a whole variety of trades as a temporary method of working at height. They are successful in reducing the overall number of falls-from-height incidences but fatal accidents are still occurring.

Back in 2009 I'd never heard of a MEWP. I'd noticed the occasional scissor lift, but that was all. That soon changed when I helped a colleague to review 290 MEWP incidents from many countries including the UK, and seven years later, I'm totally immersed in the world of MEWPs and notice them everywhere and even recognise some of the models!

Operating a MEWP requires skills, knowledge and experience which are gained from specific training. However, operating a MEWP will often be secondary to the operator's main job, for example, for an electrician needing to access ceiling lights in a factory or warehouse. Additionally, operators may have to use a range of models produced by different manufacturers, where control and functionality can vary widely between them.

Our incident review revealed that there are significant numbers of accidents where operators of MEWPs have become trapped or crushed between the MEWP platform and nearby obstructions particularly when working in confined areas. In some cases, people had been pushed against the controls and therefore had been unable to stop the machine running or to move it away to free themselves. A causal factor in a significant number of these incidents was error when operating the controls. Just last June, contractor Pyeroy Ltd was fined £130,000 after an employee using a MEWP became fatally trapped between a roof beam and the machine's control panel. Other factors included poor ground conditions, poor MEWP

maintenance or condition, and operators working alone.

To explore this issue further, we worked with our colleagues in other parts of the Health & Safety Executive – regulatory inspectors in the construction sector and ergonomics and human factors specialist inspectors – to focus research on MEWP control panel design. We developed an 'ergonomics template' to help appraise MEWP control interface designs for aspects of anthropometry, usability, human error and reliability using information gathered from a literature review, familiarisation visits and task analyses for MEWP operations.

Issues identified in our sample of MEWPs have the potential to contribute to accidents, including entrapments. Many of the MEWPs examined lacked design features to help prevent an operator inadvertently activating the controls. On the MEWPs studied, we found some specific aspects of design which were unlikely to match operator expectations. For example, indicator lights illuminated red when there were no problems but weren't illuminated when there was a problem, and arrow labels on controls did not correspond to control movement.

Identification of control function was also a common problem with the MEWPs assessed. This was not just the result of ambiguous labelling (some positioned above controls, others below or to the side), but also with wear and tear degrading symbol legibility, guarding obscuring the operator's view of some controls, and differences in control panel layout and control design which could lead to the operator selecting the wrong control, with potential implications for accidents, including entrapment.

So, what are potential barriers to achieving better ergonomic design? A literature search that went beyond MEWPs found evidence that financial considerations and pressures within manufacturing companies can lead to them being unwilling to spend money to comply with good ergonomics practice at the design stage, especially if managers judge that there will be marginal or no financial benefit. Organisational constraints such as a requirement to bring a product to market in a fixed timescale can also restrict ergonomic design. The need in most design projects to disperse tasks across a range of specialists and organisational units creates a situation in which compromises must be negotiated between individuals and teams with different goals, and ergonomics considerations may not be clearly represented or may be considered less important than others. Personal factors may also influence the use of ergonomics, particularly in terms of commitment from individual senior managers who need to perceive its value to the business. Lack of specific ergonomics knowledge among many designers and design engineers means they may be unable to identify when ergonomics could benefit the products they design. They may also be unaware of how to access specialist advice if it's not immediately available to them.

Focusing on MEWPS, we knew we needed to work collaboratively with the manufacturing industry to better understand the challenges to integrating ergonomics appropriately. Key players from the UK, Europe and North America formed an interest group called the MEWP Industry Manufacturers' Group specifically to contribute to the project. We wanted to gain an understanding of the industry drivers for reviewing and changing MEWP design, to clarify aspects of the design process, and the methods, information and current standards used. This information was gathered initially using a questionnaire, and by maintaining an ongoing dialogue with members.

Collating relevant ergonomics literature on design processes and features for controls and control panels was challenging and time consuming. However, it served to highlight that integrating ergonomics into design is not a simple process; there is weak signposting to the detailed ergonomics standards information available to engineering designers through the machinery standards that they routinely work with, and a lack of clarity about when this detail should be considered within the design lifecycle.

We held a workshop with the manufacturers' group to identify and understand the differences between the information gathered from both parties. This gap analysis was intended for a discussion on where the current standards could be developed further in order to aid the integration of ergonomics. Over 180 ergonomics issues were collated and categorised by: Further information / definition required on the factor for the manufacturers; Factor currently considered in MEWP design; Area for further development or standardisation; Further research required by the manufacturers; Factor not applicable (with justifications provided). We agreed priorities for each of the ergonomics issues identified to focus future effort.

Operating a platform will often be secondary to the operator's main job

As a result of this work, the MEWP industry is currently developing a new draft international standard: ISO 21455: Mobile elevating work platforms – Operator's controls – Actuating forces, displacement, location and method of operation. This standard aims to improve operator safety by integrating ergonomics into the MEWP design stage and so reduce the likelihood for operator errors.

Amy Jones is an ergonomist at the Health and Safety Executive's Health and Safety Laboratory. The HSE project team consists of Jon Bohm, Ray Cooke, Andrew Pinder, Kerry Poole and David Riley.

Further reading

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Disclaimer:

This article and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy.

IMAGE: ISTOCK

JOURNAL EXTRACTS

The CIEHF's membership package incorporates instant online access to all issues of seven leading journals, including those highlighted here

Calling the shots

1 As the Wimbledon Championships get underway next month, every shot played will be scrutinised by over 470,000 fans, (while enjoying over 33,000kg of strawberries and 10,000 litres of fresh cream!) during the 13-day tournament.

While shots are an essential part of the language of tennis, little is known about the distinct types of shots in the professional game. In a recent study, researchers have built a taxonomy of shots for elite tennis players using tracking data from multiple years of men's and women's matches at the Australian Open.

Researchers constructed their taxonomy using model-based multi-stage functional data clustering, an unsupervised machine learning approach.

Among 270,023 men's and 178,136 women's shots, they found 13 distinct types of serves for male players and 17 for female players. More variety was found among serve returns and rally shots compared to the serve, with less variety on the backhand than forehand. There was also more overlap in the physical characteristics of groundstroke shots between male and female players than on serve.

Shot type was strongly associated with winning points and shots in the highest speed and lowest net clearance categories tended to be the most effective.

This data-driven dictionary of shots provides a framework for analysis of elite player performance, characterising playing style, and designing more representative practice.

S Kovalchik & M Reid (2018). A shot taxonomy in the era of tracking data in professional tennis, Journal of Sports Sciences, DOI: 10.1080/02640414.2018.1438094

Are you a weekend warrior?

2 Stuck in Friday traffic, your air conditioning's broken, you're being tailgated – do these situations sound familiar? Driving on Britain's congested roads can be stressful at the best of times, and researchers have now revealed that driving may be detrimental to health, with one hypothesis suggesting that driving may elicit an acute stress response and, with repeated exposures, may become a chronic stressor.

Research shows that almost one in five British drivers experience stress because of driving. And according to the road safety charity Brake and the insurer Direct Line, around 70% of drivers have admitted losing their concentration at the wheel because they were feeling stressed or lost their temper.

So how would you feel about getting in a quick run or workout before hitting the road? Researchers believe this could be the answer to lowering stress levels. During a recent study, researchers examined the stress response to driving and the effectiveness of a prior exercise bout in dampening this response. Twenty healthy adults performed three tasks: control, driving and exercise plus driving. Heart rate, heart rate variability, blood pressure and a stress hormone, cortisol, were measured to quantify the acute stress response to each condition.

Data has indicated a stress response to driving: heart rate was elevated, and heart rate variability was reduced during the driving task compared with the control. Heart rate was elevated and heart rate variability was reduced comparing the exercise plus driving with the driving condition. BP and cortisol were no different among conditions. The potential of interventions, such as exercise, to counter daily stressors should be evaluated to safeguard long-term health.

The study confirms that driving induces a stress response, with the exercise intervention providing mixed results. Given the known consequences of stress, and evidence that exercise can mitigate acute stress, further

evaluation of exercise interventions is recommended.

This research has now been followed by ergonomists from Texas Tech University who have found that despite the expectation that automated vehicles will make drivers' jobs easier, state-of-the-art automated vehicles will probably not relieve stress. While the new systems are designed to relieve considerable burden associated with driving, drivers are expected to continually monitor the systems and be available to take control at any time.

Exercise has long been considered vital for maintaining mental fitness, and it can reduce stress. Even five minutes of aerobic exercise can stimulate anti-anxiety effects. If it can help us cope with those gridlocked commuter moments, surely, it's worth trying out? ●

M Antoun, D Ding, E E Bohn-Goldbaum, S Michael & K M Edwards (2018) Driving in an urban environment, the stress response and effects of exercise, Ergonomics, DOI: 10.1080/00140139.2018.1468494

Night shift sleepiness

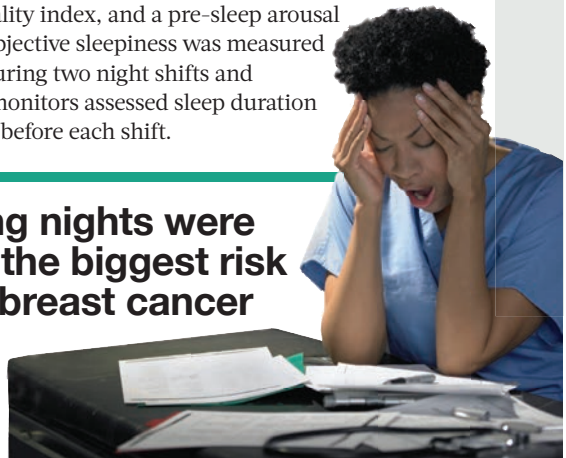
3 One in eight people in the UK now work nights as the number of night shift workers rises to 3 million and two thirds of this figure are women, following an increase in care work and nursing, say the TUC. And just this January, Sichuan University in China revealed that nurses working nights were found to have the biggest risk of developing breast cancer - 58% higher than in those who only worked days.

As thousands of nurses fight against their circadian clocks every day, they can experience many symptoms including restlessness, sleepiness on the job, fatigue, decreased attention and disruption of the body's metabolic process. Past research shows exposure to light at night decreases levels of melatonin which can disrupt the internal clock that regulates sleepiness. Now, human factors researchers have conducted an important study to identify biopsychosocial factors associated with subjective sleepiness during the night shift.

Ninety-two female nurses working rotating shifts completed a sociodemographic questionnaire, a specific questionnaire for shift workers, a sleep quality index, and a pre-sleep arousal scale. Subjective sleepiness was measured hourly during two night shifts and activity monitors assessed sleep duration 24 hours before each shift.

IMAGE: ISTOCK/SHUTTERSTOCK/GETTY

Nurses working nights were found to have the biggest risk of developing breast cancer



Findings showed that increased sleepiness was associated with increased age in nurses with early chronotypes (the propensity for the individual to sleep at a particular time during a 24-hour period) and with more children. High cognitive pre-sleep arousal, but not sleep, was associated with increased sleepiness, especially in late chronotypes. The impact of biopsychosocial factors on night shift sleepiness is complex and depends on mutual interactions between these factors.

Researchers concluded that nurses most prone to increased sleepiness must develop personal strategies for maintaining vigilance on the night shift. ●

N Zion, A Drach-Zahavy & T Shochat (2017) Who is sleepier on the night shift? The influence of bio-psycho-social factors on subjective sleepiness of female nurses during the night shift, Ergonomics, 61:7, 1004-1014, DOI: 10.1080/00140139.2017.1418027

Changing the culture of construction

4 As the global move towards smart cities see the construction sector booming, recent statistics reveal that 1.3 million workers were suffering from work related ill-health in 2016/17, and there were 609,000 workplace injuries in the UK according to the Health & Safety Executive in the latest Labour Force Survey. And there were 137 fatal injuries which is a 5% decrease on the previous year but construction remains a high-risk industry. Although it accounts for only about 5% of the employees in Britain, it represents 27% of all accidents recorded.

Historically, the construction industry has always based the safety performance of a company on statistics from past incidents but they only tell part of the story. Researchers are now looking into the issue of safety culture by identifying the factors that affect it. They then ranked occupations on job sites based on those factors to proactively improve the safety culture of construction projects and subsequently promote safety conditions on work sites.

In this recent study, findings demonstrated that the project manager, site superintendent and supervisor occupations had the highest, and labourers had the lowest level of safety culture in the high-rise construction industry. Furthermore, factors such as safety supervision and training must be considered more seriously to create a positive safety culture among workers. ●

A Ardeshir & M Mohajeri (2018) Assessment of safety culture among job positions in high-rise construction: a hybrid fuzzy multi criteria decision-making (FMCDM) approach, International Journal of Injury Control and Safety Promotion, 25:2, 195-206, DOI: 10.1080/17457300.2017.1416483

Intelligent mobility

Technology makes possible a future where journeys are on-demand, easy and seamlessly integrated. **Claire Williams** and colleagues explore the human factors requirements of connected transport systems and whether they will be truly accessible.

Rarely a day passes without a news story about the future of transportation, stories which, without saying so explicitly, are about a raft of issues on which human factors professionals have been working for decades. We read about what we recognise as allocation of function, situation awareness and usability, in what we know to be complex systems. As such, Intelligent Mobility is a domain of interrelated sociotechnical systems, a domain crying out for human factors expertise, and a domain without a large enough representation of human factors practitioners.

Intelligent mobility is about shaping new and existing technology to transport people and goods via 'seamless', end-to-end journeys with the multiple goals of optimising efficiency, enhancing environmental 'greenness', improving safety and maximising health and wellbeing.

Examples of new technology include autonomous cars, drones and digital platforms. Intelligent Mobility or IM, like human factors, is a field defined by its content, its approach and its goals.

Mobility as a Service

Mobility as a Service (MaaS) offers new ways to plan and make journeys. It can truly transform our use of transport services as it connects people to the physical transport options like network infrastructure and operator services, via digital environments such as smartphones, payment transactions and journey planning tools.

This connection is made possible by the wealth of new digital products such as Citymapper, and the increased penetration of smartphones, meaning more people can access these digital products which link them to the physical services. This link creates the possibility for provision of real-time, personalised travel options, based on all kinds of preferences including activity levels, environmental impact, journey duration and cost.

In a 'MaaS world' push-notifications are received and alternative options given when disruptions or opportunities occur. Transport is more flexible and can be 'on-demand', providing the possibility for seamless journey experiences.

Given this backdrop, delegates were invited to a workshop at the CIEHF's recent Ergonomics & Human Factors conference in April, the aim of which was to give participants an overview of the IM domain and provide an opportunity to see where and how their human factors expertise could make a difference.

The content focused on Mobility as a Service and the introduction of Connected Autonomous Vehicles (CAVs). A short teaching session was followed by a problem-solving exercise, during which participants were asked:

- What human factors issues can you see in this area?
- What tools and techniques would help to address these issues?
- If you could only choose one, on which issue do you think the UK Government should focus its resources?

Participants were asked to consider the human factors challenges of MaaS and to discuss how they might use human factors approaches to resolve them. A systems-thinking tool, called 'The Seven Samurai of Systems Engineering', was also provided to aid the discussion.

The discussions centred around three main themes:

1 Making it easy to do the right thing

Both physical and digital systems of the MaaS architecture must be designed taking a human-centred approach or it will fail to account for the real needs, desires, capabilities and limitations of people and will therefore fail to deliver the MaaS benefits.

2 Assuring benefit for all

Accessibility and inclusivity were discussed for a number of different user groups. For example, many considered that MaaS would be easier to use and understood by the younger, smartphone generation, whilst older consumers, whose quality of life might more likely by enhanced by the on-demand, end-to-end journeys of MaaS, could find the digital access less intuitive or even out of reach, due to lack of hardware.

3 Trust

Ultimately, the ability to trust that the services promised would indeed be delivered, both overall and journey by journey, and that the level of data sharing required for MaaS would be safe and secure, were the focus of much of the discussion. This trust discussion led back to the debate around inclusivity and benefit for all: Millennials may be ready for this, but a percentage of the population who don't own smartphones or are uncomfortable with cloud transactions may not be.

Connected and Autonomous Vehicles

Connected and Autonomous Vehicles (CAVs) are vehicles capable of performing the driving function without the need for a human

driver. They are expected to deliver significant economic and social benefits including increased safety, reduced congestion and reduced emissions. For the 'no-longer required' human driver, the deployment of CAVs could provide opportunity for other activities, from catching up on emails to watching TV.

With various levels of Autonomous (Self-Driving) Vehicle (AV) technology, from driver assist through to fully automated driverless vehicles, it's important to understand the different terminology used. The SAE International Standard J30163 sets out the taxonomy used when discussing the levels of autonomy. It's easy to think that this technology is new but our vehicles have been increasingly automated since the 1980s. Common features include automatic airbag deployment and power steering whilst newer vehicles feature functions such as lane departure warning, driver alertness monitoring and automatic braking.

Automation is defined by SAE on a six-point scale from Level 0 (no automation) to Level 5 (full automation). Most vehicles being produced today are either at Level 1 or 2 which means they have limited automated assistance features such as parking assistance or adaptive cruise control. However, at these levels the human occupant must actively monitor the road and be ready to take over the driving function immediately.

At Level 3 (conditional automation), the vehicle can perform the whole driving function in certain scenarios such as driving down a motorway, so in principle the human occupant can perform secondary tasks such as reading. However, the human driver does need to be ready to take over within a given timeframe when the driving scenario changes.

Many vehicle manufacturers are aiming to deliver Level 3 vehicles by the early 2020s, encouraged by Chancellor Philip Hammond's challenge to have driverless vehicles on the UK's roads by 2021.

There are three types of connectivity that can be used in conjunction with, or independent from, automated technologies:

1 **Vehicle to Vehicle (V2V)** involves two or more vehicles communicating. Examples include communicating intentions, for example, I'm going to turn at the next junction, or information, for example, there's an obstruction in the road ahead. A typical use case is an emergency response vehicle informing vehicles around it of its approach.

2 **Vehicle to Infrastructure (V2I)** involves a vehicle communicating with the environment around it. Typical use cases include vehicles communicating with traffic signals, being informed of when the next green phase will commence, or allowing an emergency response vehicle to request a green phase at a junction.

3 **Vehicle to Everything (V2X)** involves connections between the vehicle and all other appropriate technologies and includes V2V and V2I and cloud connectivity. V2X is expected to deliver significant traffic management and optimisation benefits.

When thinking about CAVs it's easy to focus on the car as we know it today, forgetting that autonomous technologies are being applied to a range of modes, including pods, freight vehicles, drones and marine vessels.

A short teaching session about Connected and Autonomous Vehicles was provided for our workshop delegates which fuelled discussions for a second problem solving session. Participants were asked to consider the human factors issues around the development and introduction of Level 3 CAVs, and what human factors tools and approaches could help address these.

Four themes emerged during the discussions:

1 **Driving handover**
Participants were concerned about how drivers will retain their situational awareness when released from the driving task by the vehicle. →

Illustration: MaaS representation from https://landormaas.blog

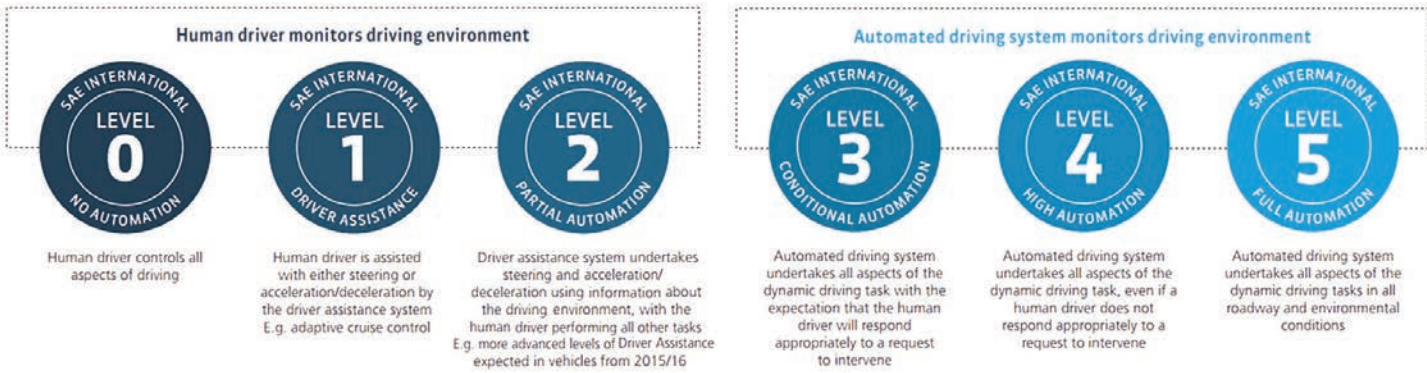


Illustration: Levels of Automation

Suggestions included the use of human-machine interfaces with handover assistance features and advanced warnings (audio, visual or haptic). Linked with this was concern about the stress impact of increased mental workload during handover. Delegates thought this could be further studied using frameworks such as NASA's Task Load Index.

2 CAV uptake

A participant who enjoys driving and would not want to lose it, raised the issue of how this might affect CAV uptake. It was suggested that such individuals, as well as people with a general mistrust of technology, would need incentivisation (including training and education) to be persuaded to move to a CAV.

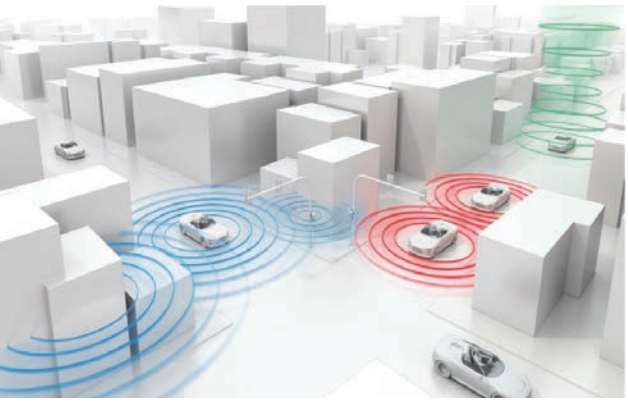
3 Over-reliance and de-skilling

The discussion moved from lack of uptake to over-reliance on CAVs, and the fear that some CAV users would relinquish their responsibility for the safety of their vehicle and those around them. Suggested solutions included education around the limitations of CAVs and where liability falls in the event of an incident. Additionally, the use of an interface or warning system to inform users about performance and trust was proposed. Linked to over-reliance, concern was raised about the de-skilling of CAV 'drivers' for which shadow-driving or minimum driving hours were seen as one way to retain core skills, with limited licences being another possible intervention.

4 Reliability and cyber security

There was general agreement that independent research, testing and modelling of CAVs is required to assure the technology is safe and secure.

Illustration: Connectivity http://analysis.tu-auto.com/autonomous-car/us-government-gets-gear-investing-connected-cars



Mobility as a Service can truly transform our use of transport services

Government focus

A light-hearted opener to the discussion about where the Government should focus and what it should do was "as little as possible". It was felt that Intelligent Mobility was a domain where innovation and competition were paramount and there should be as little 'interference' as possible. However, it was felt that there was a requirement for Government to play a role in intervention and regulation, which would lead to the following outcomes:

- Sufficient and 'fit-for-purpose' infrastructure to allow the realisation of Intelligent Mobility benefits.
- Integration of the IM services which have developed in a competitive market to allow them to work together seamlessly.
- Conditions that support behaviour change in the UK population, to ensure take up of the new services and technologies, so as to achieve the efficiency, productivity and environmental goals for IM.
- Equitable access and provision to IM solutions both regionally and individually.

What did we learn?

As well as an enjoyable and lively time of discussion, participants offered several thoughts from the session. Firstly, there are countries already well invested in connected services and joined up information provision from which the UK could learn many lessons. (This was an international conference and there were delegates from a variety of nations including Switzerland and Sweden.) Secondly, Level 3 CAVs raise significant safety challenges and the human factors profession has a lot to offer to system design and performance as well as asking the right questions, including, 'why?'. And finally, this is an important domain and one to which human factors can make important contributions.

This article was inspired by a workshop held at the CIEHF's Ergonomics and Human Factors 2018 Conference in April in Birmingham, delivered by three of SNC-Lavalin Atkin's Intelligent Mobility & Smart Technology Team, **Claire Williams** (Technical Director), **John Bradburn** (Senior Consultant) & **Louise Lawrence** (Practice Director). Find out more at www.atkinsglobal.com/im

Further reading

MaaS representation from https://landormaas.blog

Q&A

MEMBER PROFILE

Tina Worthy talks to **Katie Cornish**, a Senior Human Factors Engineer at Cambridge Consultants, about how her ergonomics career combines with her passions

How did you get into ergonomics and human factors?

While many people I speak to in the industry have found that they've 'fallen' into ergonomics and human factors later in their careers, it was something that I first came across when studying GCSE product design. Following the advice of my parents, I took a combination of A-levels that I found interesting: human biology, psychology and design. When I saw the description for the BSc in Ergonomics at Loughborough University I jumped at the chance to do a degree which combined these passions, and I've never looked back! I now work as a Senior Human Factors Engineer at a technology consultancy called Cambridge Consultants, where I'm involved in the human factors surrounding exciting medical technology development.

Who or what influenced your early career?

One of the aspects that I enjoyed most about the ergonomics degree at Loughborough was the breadth of subjects that I was exposed to. From human-computer interaction, to systems design, and anthropometrics to organisational behaviour, we were always being given opportunities to try something new. However, the biggest influence on my early career was taking an inclusive design module. It was an interesting module for many reasons on top of the challenge of designing for the full range of physical and cognitive capabilities. One aspect that I found particularly thought-provoking, was the concept of inclusive design and whether a one-design-suits-all approach is ever possible. In cases where it isn't, it was interesting to question whether straying into the realm of special products for the extreme ends of a user population could be stigmatising and risk development of an unsuccessful product. This module inspired me to complete a PhD in inclusive design at the University of Cambridge. This subsequently realised my passion for product development and landed me my role at Cambridge Consultants.

What projects are you working on now?

Most of my projects are within medical technology development, however I'm occasionally asked to help with consumer product projects in other divisions. At Cambridge Consultants, human factors within medical product development is applied throughout the development process, from concept generation and understanding user needs, to demonstrating that a final product is safe and effective to use and producing the relevant regulatory documentation to support this. Besides safety and effectiveness, we also ensure that the product provides the best user experience. Subsequently, human factors engineers are involved at all stages of development, alongside many other disciplines including industrial design, mechanical engineering, fluidics and software.

Where do you start with medical device design?

Human factors within medical device design adopts a risk-based approach, and there are a range of underlying methods and tools that we draw upon to understand the risks associated with a product. Failure Mode Effects Analysis (FMEA) and Fault Tree Analysis (FTA) are just two that we use. This might also involve conducting searches of known use problems with similar or existing products, and understanding the intended users, use scenarios and environments. We then work closely with the rest of the team to mitigate risks, making iterative design changes until we consider a product to be safe and effective to use, through user validation testing. Alongside the human factors work, we also get involved in wider tasks to help support the business.

We often write new project proposals for prospective clients as well as get involved in recruitment, business development activities, training and mentoring new starters.

What do you enjoy most about your job?

Conducting user studies. No matter how carefully you've developed your product and considered the risks, you never really know how it will be used until you put it in front of a range of representative end-users. I've conducted countless interviews in my first few years at Cambridge Consultants, and every study still produces some surprising participant feedback. I don't think I'll ever get bored of doing this!

What's the most challenging project you've been involved in?

During my placement year I was responsible for measuring and controlling the noise and vibration exposure of individuals, which involved taking objective measurements and recommending suitable personal protective equipment. Justifying the need for it was a challenge as not all the stakeholders had the necessary buy-in. Conversely, one of the refreshing things about working at Cambridge Consultants and in developing medical devices is that the regulations stipulate that a device has to be 'safe and effective' to use in order to be approved for market. Consequently, our clients (more often than not) are already aware of the need to consider the user and the associated risks of their device and are generally aware that they need to allocate budget and time for human factors. Determining the best methods and processes for implementing human factors in medical device development and adhering to tight budgets and time-frames is challenging, but this keeps the job interesting!

Where do you see your career going in the future?

The landscape of medical devices has seen major changes over the past few years with regard to digital health. There is an increasing push to utilise smart technology to allow patients to track and monitor their medication use, with the ultimate aim of improving patient adherence. There is also a vast amount we can learn from research in behavioural economics and behaviour change. I'm keen to see my future role develop by helping to apply important concepts such as the 'Nudge Theory' to connected devices and the development of medical apps.

What advice would you give someone considering a career in human factors?

Go for it! If you find people interesting, then you'll never get bored. I'd also recommend that you consider all the avenues you could go down in your human factors career. There are many different industries and they all have their own specific challenges and opportunities. It's also worth considering whether you'd like to work for a consultancy or in-house, as this could shape the job tremendously. If in doubt, get in touch with someone and ask a few questions – human factors engineers are a friendly bunch! ●

IMAGE: ISTOCK

One area I found particularly thought-provoking, was the concept of inclusive design

Museum of Army Flying Middle Wallop in Hampshire

REGIONAL NEWS

SOUTHERN ENGLAND

Human factors in army aviation

We are delighted that 667 (D&T) Squadron at Middle Wallop, Hampshire have agreed to host a Southern Regional Group event on Tuesday 18 September. 667 Squadron are the development and trials unit for Army Aviation and are the de-facto lead in testing and evaluating new items and modifications being brought to into service by the Joint Helicopter Command.

The aim of the visit is to gain an insight into the significant amount of human factors challenges associated with maintaining operational readiness for the fleet of helicopters operated by the Army Air Corps. The day will also include a visit to the Army Engineering Flight Safety department for a tour of their hangar containing crashed aircraft and to hear about the sequence of events that caused some of these accidents.

Rail Investigation Studies

The Rail Accident Investigation Branch have very generously offered to host a Southern Regional Group event on Wednesday 17 October at their site in Farnborough in Hampshire. Visiting Professor Paul Salmon from the University of the Sunshine State has agreed to share some of the rail-related research that he has conducted particularly with regard to railway level crossing designs. We may also get access to the crash site at the RAIB.

For both events visit **http://events.ergonomics.org.uk** for more details as they become available and to book.

ACROSS THE UK

Discovery and discussion

No less than five Regional Group events are taking place around the country where CIEHF members have a chance to take part in an organised visit at a great venue and to discuss ideas and suggestions for CIEHF's activities that will form part of its Delivery Plan for the coming year. Come along and have your say.

- **Region: Midlands**
  Date: Monday 2 July
  Venue: Coventry Transport Museum
  Details: See the largest publicly-owned collection of British vehicles in the world. The museum tells the fascinating story of Coventry and its people through the rise and fall of its biggest industry.
  Booking: Museum entrance and private tour, £7.50 +VAT. See http://events.ergonomics.org.uk/event/coventry-transport-museum/

- **Region: London & South East**
  Date: Tuesday 3 July
  Venue: Acton Depot, West London
  Details: Run by London Transport, the Depot houses over 320,000 items of all types, including a poster collection, vehicles, signs, models, photographs, engineering drawings and uniforms.
  Booking: Private, guided, two hour, behind the scenes tour, £7.50 +VAT. See http://events.ergonomics.org.uk/event/acton-depot/

IMAGE: SHUTTERSTOCK/ALAMY

- **Region: South West & South Wales**
  Date: Wednesday 4 July
  Venue: Bristol Aerospace Museum
  Details: Discover a century of incredible aviation achievements including aeroplanes, helicopters, missiles, satellites, engines and fascinating tales of human endeavour, with Concorde as the stunning centrepiece.
  Booking: Group visit to the museum, £7.50 +VAT. See http://events.ergonomics.org.uk/event/aerospace-bristol/

- **Region: North West & North Wales**
  Date: Thursday 5 July
  Venue: Imperial War Museum North, Manchester
  Details: Explore the conflicts that Britain and the Commonwealth have been involved in since the First World War to the current day through a timeline of objects that have borne witness to historic events.
  Booking: Group visit to the museum, £7.50 +VAT. See http://events.ergonomics.org.uk/event/iwm_north/

- **Region: Scotland**
  Date: Friday 6 July
  Venue: Riverside Museum, Glasgow
  Details: See an incredible array of objects from skateboards and vintage cars to prams and powerful locomotives. Walk down an old cobbled Glasgow street with shops dating from 1895 to the 1980s. Berthed outside is the Tall Ship, Glenlee, the UK's only floating Clyde-built sailing ship.
  Booking: Free group visit. See http://events.ergonomics.org.uk/event/glasgow-museum-transport/

CIEHF events at a glance

For more details of all CIEHF events, see our website at **events.ergonomics.org.uk**

Eligible for CPD Lifelong Learning

EVENT	WHEN & WHERE	DETAILS
Road transport through time	2 July 2018, Coventry	See the largest collection of publicly owned British vehicles in the world.
History of urban transport	3 July 2018, London	View thousands of transport-related signs, documents, uniforms and other memorabilia.
The home of Concorde	4 July 2018, Bristol	Discover a century of incredible aviation achievements including supersonic flight.
Exploring conflict	5 July 2018, Manchester	Explore a timeline of objects from the First World War to the current day.
Glasgow's transport history	6 July 2018, Glasgow	Experience recreated streets, climb aboard vehicles and see fascinating images and films.
International Ergonomics Association 20th Congress	26-30 August 2018, Florence	'Creativity in Practice', transforming the results of research on innovation into concrete actions to improve the quality of life and work.
Human Factors in Army Aviation	18 September 2018, Middle Wallop	Insight into the human factors challenges associated with maintaining operational readiness for a fleet of helicopters.
Human Factors in Health & Social Care Workshops & White Paper Launch	October 2018, London, date and location tbc	Gaining a better understanding of how human factors can support and benefit patients, staff and their organisations.
Rail Investigation Studies	17 October 2018, Farnborough	An exploration of rail-related research, particularly with regard to railway level crossing designs.
Human Factors in Aviation Safety	12-13 November 2018, Gatwick	Presentations, discussion and debate on human performance issues in military and commercial aviation.

Please note that some events details may be subject to change after publication. Please check the events website for up-to-date information.

MEMBERSHIP

Our latest professional members

We congratulate the following members whose applications for professional membership of the CIEHF over the past four months have been successful. All have submitted comprehensive details about their qualifications, experience and achievements. Those listed as Registered Members and Fellows also have Chartered status.

Technical Members

- Paul Grady
- Graham Carvlin

Registered Members

- Thomas Winski
- Jordan Smith
- Nikki McCann
- Isabel Holtby
- Lizzy Gallwey
- Hazel Stewart
- Fionnuala O'Curry
- Chris Avis
- Nic Bowler
- Phil Day
- Peter Marston
- Nu'maan Kala
- Thomas Britland
- Brendan Hazlett

Fellows

- Rob Hutton
- Karen Priestman
- Will Tutton







Human Science Research

- Human Factors Research and Engineering
- Cultural and Behavioural Analytics
- Cyber Influence
- IoT, Smart Cities and Smart Communities Impacts
- Social Media Effects

Pleased to announce the opening of our two new offices in Llanelli and Gloucester

K Sharp Ltd - Head Office
Suite 2, West End Yard
21-25 West End
Llanelli,
Carmarthenshire
SA15 3DN

K Sharp Ltd - Gloucester Office
13 Wheatstone Court,
Waterwells Business Park,
Davey Way,
Quedgeley,
Gloucestershire,
GL2 2AQ

www.KSharp.co.uk
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No. 567 | Sep-Oct 2018

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managing the human element of risk

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- ... want to work in a team with Ergonomists, Psychologists and Human Factors professionals?
- ... wish to work closely with clients at their sites?
- ... feel passionate about Human Factors?
- ... wish to work in nuclear safety?
- ... enjoy working on diverse topics?
- ... want to be at the heart of a small business?
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Greenstreet Berman Ltd has grown for over 20 years to become one of the UK's largest independent Human Factors, Safety Management and Safety Culture consultancies, working across many sectors.

We are recruiting to support our growing nuclear sector work and help us deliver a high volume of interesting work.

Our diverse work includes design & assurance of new power stations, safety case support, leadership & management for safety, human performance, safety culture, competence, delivering training, conducting research and many more topics.

You will have a first or second degree in Psychology or Human Factors and Ergonomics or other relevant degree.

- For **Junior** grade you will be enthusiastic, willing to learn, able to apply yourself and work towards Chartership.
- **Consultants** have some relevant experience, preferably in safety critical sectors.
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Chartered Institute of Ergonomics & Human Factors
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CIEHF NEWS

Chartered Institute of Ergonomics & Human Factors

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FROM THE PRESIDENT

Identifying future needs

Neil Mansfield
CIEHF President

@profnjmansfield

Over the past year or so I have spent a lot of time working with my university at Nottingham Trent and our business partners on identifying the future needs of technical professionals. We are all agreed that things are likely to be radically different in the future, when core components of automation, Artificial Intelligence (AI), big data, cloud computing and robotics start to combine and realise the promises of 'Industry 4.0'.

Industry 4.0 is a term growing in popularity, the premise being that we are entering the fourth industrial revolution:

- **1st Industrial Revolution:** Mechanisation, water power, steam power
- **2nd Industrial Revolution:** Mass production, assembly lines, electricity
- **3rd Industrial Revolution:** Computer control and automation
- **4th Industrial Revolution:** Cyber-physical systems, AI, Internet of Industrial Things

Human factors has a lot to contribute as we transition into the next phase of our digital future. We will be considering issues of automation, issues relating to situation awareness, challenges related to new Human Computer Interaction interfaces, as well as the problems associated with Virtual Reality and head-mounted displays.

Many of these issues will be familiar to CIEHF members and some have been studied for many decades; the journals provide an archive of the fundamental studies. What has changed is the context of use and the nature of the technical integration.

There is a great opportunity for members to take the lead in this growing domain. We should strive to ensure that 'human factors / ergonomics' is included in the list of core components of Industry 4.0.

Human factors has a lot to contribute to our digital future

FROM THE EDITOR

Out and about

There's a definite transport feel to this month's issue which includes two important transport research projects. One is from Katie Plant about a multi-national effort to increase road safety through a seven-pronged approach, and the other is from Jonathan Twigger, who reports on an air traffic control simulation exercise ahead of the opening of a new airport which will feed into already congested airspace on Turkey's border with Bulgaria. Nick Gkikas writes about human factors approaches in military jet cockpit designs and Graham Forman explains his work as a wide-ranging human factors professional in the Scottish ambulance service. Finally, we also announce the availability of the programme for our Aviation Safety event in November.

Our main feature this issue is about accessibility and safety in and around historic buildings. Arthur Stewart and Cameron Campbell roam far and wide in explaining the challenges of moving large numbers of often ill-prepared people around buildings whose architects could never have foreseen the sheer volume of foot traffic they would one day attract.

Lithuania is the focus of our regional perspective, a country many of us know little about, but much effort is being made there to put ergonomics on the map.

Helen Vosper provides us with great insight into the very valuable skill of mentoring and how much it meant to her as she embarked on her career into human factors. Vicky Gliddon tells us about how her career began, and where it's taken her – in Vicky's case, all the way to Australia!

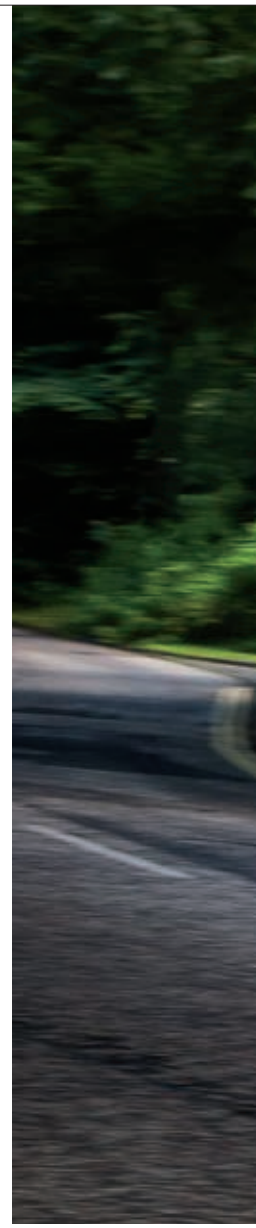
Enjoy the rest of your summer.

Tina Worthy
editor@ergonomics.org.uk
@ciehf

A DAY IN THE LIFE OF AN...

AMBULANCE SERVICE ERGONOMIST

Graham Forman from the Scottish Ambulance Service



Flick between channels later in the evening and there invariably will be a programme involving ambulance crews being dispatched by a busy control centre to jobs the length and breadth of Britain.

I work for one of these organisations - the Scottish Ambulance Service. We cover from Gretna Green in the south, to the furthermost island off Shetland in the North. We have 530 front-line emergency ambulances and paramedic response units, 480 patient transport vehicles and a further 130 specialist vehicles, ranging from Polaris all-terrain buggies, to incident forward command units. Two fixed-wing Beechcraft Kingair air ambulances, two EC 145 helicopters and staff a charity air ambulance also fall under our operation.

We provide specialist trauma and paediatric retrieval units, and our specialist operations team respond to a range of chemical, complex extrication and police-led operations. We have workshops dotted across Scotland to repair and maintain the Fleet. Three 24/7 control centres oversee emergency responses and plan patient journeys. In addition to our own staff of over 4000, we coordinate community responder teams and contracted staff working on small islands off the north and west coasts.

So, what might then be a 'typical day'? As we're a 24/7 service, incidents will arise overnight, or managers working the small hours will have had the opportunity to clear some of their own inbox and reply to earlier queries. So usually, over an early cup of coffee, I'll go through emails and voicemails and prioritise what needs to be done, by whom and by when.

The plan for the day may be to meet with colleagues in fleet and operations to review a new type of wheelchair backrest, the proposed layout of a bariatric response vehicle, or preferred location of a grab handle for patients who might suffer poor vision or rheumatoid arthritis. Alternatively, I might be travelling to meet a member of staff planning their return to work after shoulder surgery, attending a committee assessing new radio handsets, discussing a forthcoming case with our legal team or running a training session. I could also be proof-reading proposed training manuals or operating procedures, drafting an e-learning module on workstation set ups for office staff, or writing a position paper on a range of human factors and wellbeing topics for the executive team.

On my commute home, I could pop into the control room to meet with a member of staff who came off the road due to injury or illness but is finding a 12-hour shift at a desk difficult. I might then be required to write a report recommending adaptive changes to furniture, such as a sit-stand desk, or alternative input devices.

In recent years, the importance of human factors has been championed by NHS Education for Scotland

However, an incident reported the previous day or night may require immediate action. A safety bulletin may need to be written, or a decision made whether the withdrawal of a piece

IMAGE: SMC PHOTOGRAPHY

of equipment across the board from use until further notice is a proportionate response. This will require urgent conference calls with colleagues, suppliers and often sister organisations. Perhaps I'll need to travel to the location of the incident that day. Therefore, earlier plans may need to be revised at short notice.

To continue challenging my own knowledge and assumptions on how staff will use equipment, I frequently 'book on'. This can often see my original plans diverted by control to manage a complex emergency extrication of a patient, or less frequently, a chest pain or cardiac arrest as a First Responder, pending arrival of the nearest crew. Sometimes I may need to respond under blue lights and siren; making progress through a city centre in rush hour whilst organising resources with control is always a timely reminder of the principles of cognitive workload! The high stress nature of the job means that staff are required to receive, process and respond to information in complex situations, over 12-hour shifts with interrupted meals breaks and overruns due to high demand.

There really is something for everybody in respect of human factors within ambulance-related work. Those with an interest in software can be involved in the design of software interfaces used by control rooms to prioritise incoming calls and assist allocation of vehicles to jobs. At the other end of the spectrum is providing information to a committee on thermal values of winter weight jackets, best tread for safety boots or the importance of ease of putting on and taking off personal protective equipment.

Design is also an important area. As overall vehicle safety standards increase, it can paradoxically become more challenging to design practical layouts. For example, cab-based data screens were traditionally mounted on gimbals to allow the attendant, who typically sits in the passenger seat, to better read and reach touch screens in transit. →

An air ambulance helicopter prepares to receive a patient at Fort William, Lochaber, Scotland

These were well received by crew. New standards advise that they must now be in a fixed position. This causes difficulties with glare and imprecision of hand movements due to greater reach. Staff now complain about having to sit at an awkward angle and how they could be tempted to slide the seat belt off their shoulder to view the screen. This not only impacts on occupant safety, the error rate retrieving and entering data on the screen increases too.

Another challenge with vehicle layout, is that major new equipment and practices are introduced during the average seven or ten-year life cycle of a vehicle. The service is currently piloting satellite systems to allow crews in remote areas to perform scans and conduct video consultations, from allergic rashes to open fractures, with specialists at main hospitals. It's then back to the drawing board in respect of re-evaluating the 'least bad option' where displaced equipment might need to go.

Often, as is the case in many different industries, we're met with opposition by staff when recommending the correct location for or choice of equipment. We must work with crews to identify a suitable compromise between theory, culture and practical application.

Things do go wrong and staff and patients can very occasionally sustain harm. In recent years, the importance of human factors has been championed by NHS Education for Scotland. Working groups now explore how we might raise our profile in respect of contributing to Quality Improvement work and the management of clinical risk. On top of basic training, human factors colleagues now competently apply the principles to investigate potential drug errors, why compliance with record keeping may falter during peaks of activity, or why a crew might not fully apply a safety restraint in a vehicle.

Whilst many academic and consultancy services will become involved with human factors projects within the healthcare sector, there are still relatively few of us working at the coalface, which is a great shame. But with the challenges come the professional rewards. You may be sitting in traffic letting an ambulance through a junction when you recall the debates on choice of siren tones that can be best distinguished by other road users, the position of beacons to be seen but not blind other drivers, or that the angle of a grab handle on the rear ramp door was chosen to reflect the neutral position of a hand held at shoulder height.

You watch the air ambulance crew preparing to load a patient and understand why that unduly large bag was, in the end, the best option for the attending air ambulance crew to use. You pass a Patient Transport Crew loading a patient up a ramp and remember how, in the past, you pulled out Stephen Pheasant's book on anthropometrics or Snook's Tables to try and quantify clearances and efforts to load that patient onto that tail lift or ramp.

Being the service lead for prevention of musculoskeletal injuries does mean much of my time is centred around devising systems of work for the safer handling of patients. Whilst there are some techniques which can be borrowed directly from other care environments, safe patient handling in the pre-hospital context is usually more complex because of the infinite number of variables faced by crew with limited equipment and therefore an overly prescriptive approach is generally unhelpful.

There really is something for everybody in respect of human factors within ambulance-related work

So how did one of the few ergonomists working full time in the NHS move from hospital-based work into the pre-hospital sector? About 12 years ago the organisation recognised the need for a structured approach to the control of musculoskeletal injuries, and as one of a number of CIEHF members who started their professional life as a Chartered Physiotherapist, I had the skills mix they were looking for. I really haven't looked back! ●

Graham Forman is an Ergonomics Adviser with the Scottish Ambulance Service.

IMAGE: GETTY/SMC PHOTOGRAPHY

HUMAN FACTORS

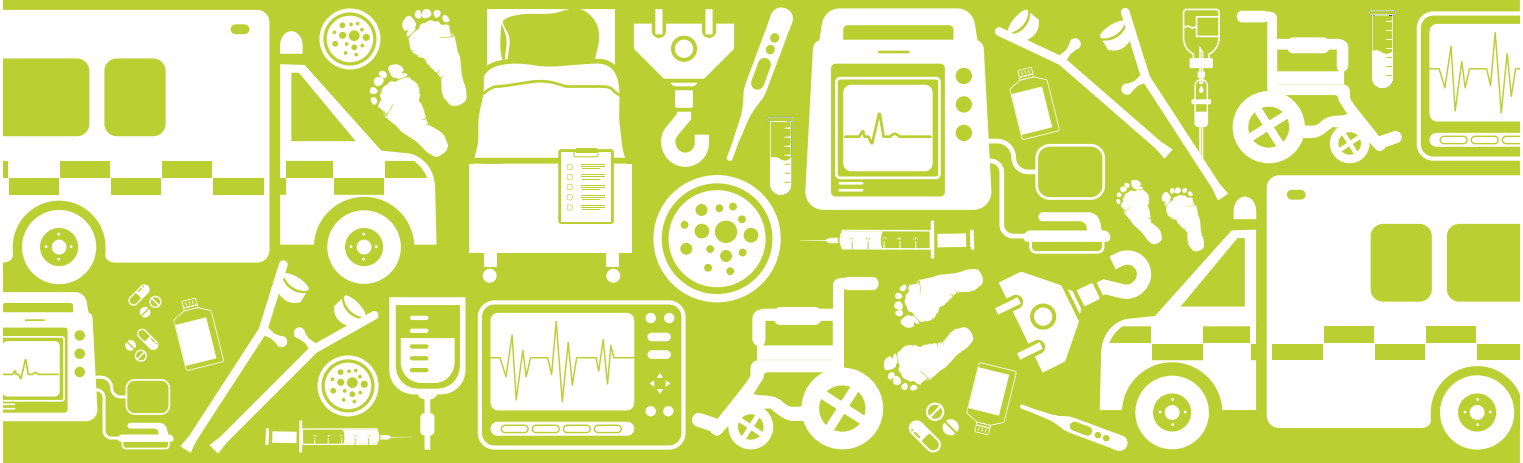
FOR HEALTH & SOCIAL CARE

Chartered Institute of Ergonomics & Human Factors

FREE EVENT including a copy of the White Paper

4 October 2018 | LONDON

This event, at the prestigious Royal Society of Medicine, will showcase through the launch of its White Paper, the CIEHF's vision for integration of Human Factors in Health and Social Care.



Programme

16:00 Two hour taster workshops to raise awareness and understanding about Human Factors and its practical application.

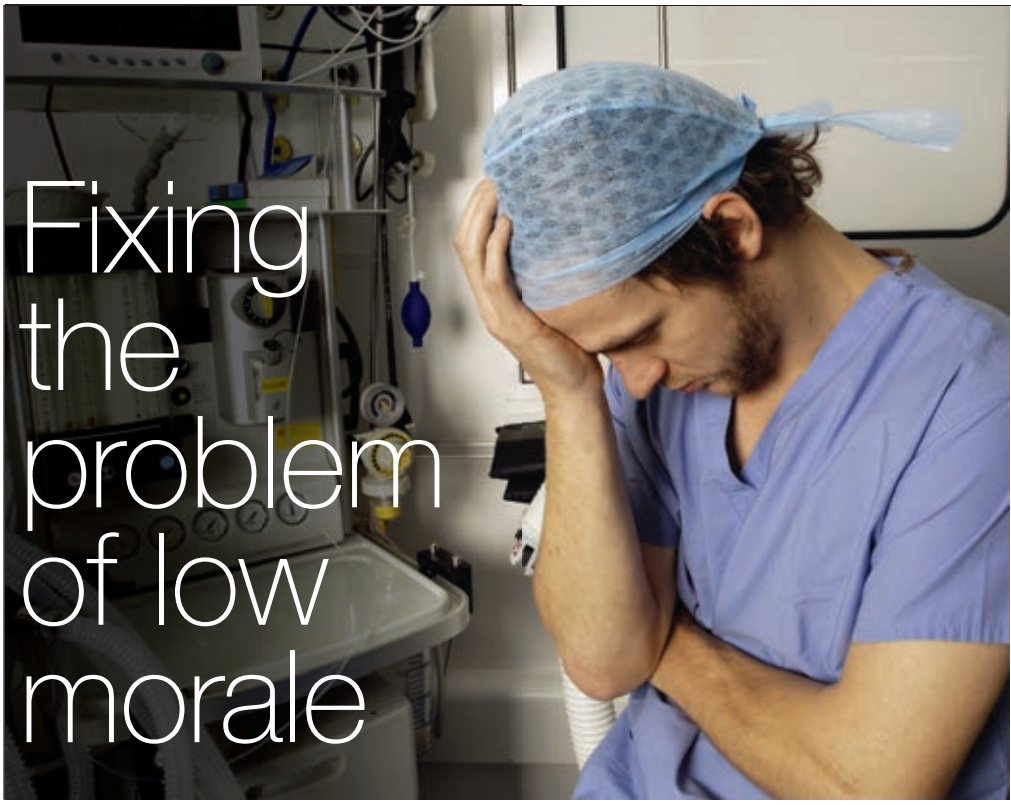
18:00 Drinks reception and networking

18:30 An evening of talks, case studies, panel discussions and networking.

Taster workshops

These include case studies of how Human Factors has been used in a range of different health and social care settings. You will gain an understanding of the importance of Human Factors and how it can be applied practically to resolve problems that prevent the delivery of efficient, high quality and safe care.

events.ergonomics.org.uk



Fixing the problem of low morale

BBC Radio 4's Matthew Taylor presents a series called 'The Fix' in which 12 of the country's brightest young minds gather to solve difficult social problems. One episode focuses on junior doctors and the problems they face with low morale. CIEHF member Saskia Revell, who has a background in healthcare and aviation, was invited to participate to add insight from a human factors perspective.

When they arrived, with little in the way of introduction, the participants were split into two teams of four, each with a facilitator and were set the task of finding a solution in just a day. Before they began, they spoke with a junior doctor, a consultant and the Chair of the Royal College of Physicians to find out more about the problem. Even armed with this information, the task was understandably difficult.

Saskia said: "Myself and one other member of my team tried to look at the problem from a high level systems perspective. It was certainly a challenge to pull ideas together in the time available and to come up with a sustainable solution."

The two teams presented their solutions to a panel who then selected what they judged to be the best idea. Find out who the winning team was and how Saskia fared, at the BBC Radio 4 website at **https://www.bbc.co.uk/programmes/b0925737**

Trials on military exoskeleton

Lockheed has developed a military-grade exoskeleton for the legs ready for trials at the end of this year. On the move, the ONYX exoskeleton takes weight off the wearer's body, reducing fatigue and the risk of injury without limiting range of motion. This innovation comes off the back of ten years of solid development at Lockheed. It will go through three rapid cycles of test, user feedback, redesign, and test again before the end of 2020, when Lockheed believes it will be ready for real-world operations.

There are several companies developing and selling civilian versions, both for rehabilitation and for load-bearing, but they all present problems in that exoskeletons are the ultimate challenge for physical human machine interface ergonomics. Read more about Lockheed's innovation at **https://tinyurl.com/y9vyzw4k**

Global value of occupational health

Well implemented occupational health services can generate a strong return on investment, say the Society of Occupational Medicine, the International SOS Foundation and KU Leuven University, as they launch 'Occupational Health: The Global Value and Evidence'. This white paper discusses the value of occupational health from a global perspective and provides a synthesis of global evidence on interventions and cost effectiveness.

The global burden of occupational health issues is considerable. Fatal and non-fatal work-related injuries and illnesses worldwide equate to a cost of around €2680 billion, equivalent to 4% of the global GDP. Consequently, organisations, their workforce, and society must bear a substantial cost.

€2680 billion

The cost of injuries and illnesses worldwide

The paper demonstrates that occupational health services have a clear value: they improve the health of the working population; contribute to the prevention of work-related illnesses; prevent avoidable sickness absence through the provision of early interventions for those who develop a health condition; and increase the efficiency and productivity of organisations. They can also play a major part in protecting and revitalising the global economy. For more information visit **www.som.org.uk**

IMAGE: GETTY

CHIEF EXECUTIVE'S PERSPECTIVE

Moving with the times

How people work has undergone a good deal of examination and change in the past decade, in particular from a human factors perspective, and significantly due to advances in technology. However, what works for each and every individual, standing or sitting, paramount will be a safe, conducive, inspirational working environment in which the best work possible can be delivered at the right time. To that end your Institute has recognised that bringing people together every single weekday under the same roof in the same circumstances probably does not tease the best from the group as a whole.

We have created the ability to now move away from a locally-based administrative group with fixed infrastructure to a business model drawing on great, flexible expertise, wherever that's located, working at times to suit each individual but delivering on a common purpose, our agreed strategy. That strategy is shaping up and will be due a refresh before 2020, and that means acting quite soon. More on that next time.

As such, and effective this month, the Institute is reflecting on the fact that those who do great work and support our efforts as an 'office' actually live in Nottinghamshire, Essex, Bedfordshire, Surrey, Warwickshire and in London, so drawing these folk together in Loughborough, given advances in technology, no longer makes much sense, either for the people themselves or for the Institute. Without increasing our costs, we now operate from flexible office space located around the country, convenient for bringing together individuals and teams at the right times to do the right things in support of our aims as a Chartered body.

So, and in addition to flexible workspace, we have a new light and bright operational office in Warwickshire at which we receive our routine hard mail, something which has dwindled significantly over time and a new Registered Address in Temple Row in Birmingham, a central location and a vibrant city with many connections to the manufacturing, healthcare and transport sectors in particular, ahead of our 70th year. Both addresses are available on our website; a website hosted on a server located remotely and like the remainder of our computing capabilities, to be located in the cloud by the end of the year. Another significant step, alongside our physical premises solution, that improves our resilience as an organisation and our ability to deliver service to our members.

We say a huge thanks to our favourite (if we were allowed to have one) Registered Consultancy, Human Applications, and in particular to Jim, Nigel, Matt, Jo and the team, who have given us a home over the past dozen years at Elms Court in Loughborough, and who have so generously supported the Institute in many ways over the years. We shall miss you just as much as you will miss us. Changing times call for changing circumstances and I am confident that our new arrangements are sensible, cost-effective and conducive to great support.

Steve Barraclough
Chief Executive of the CIEHF
s.barraclough@ergonomics.org.uk

A significant step that improves our resilience and our ability to deliver service

Birmingham city centre at night, showing Centenary Square and the new library

IMAGES: SHUTTERSTOCK/ALAMY

Ergonomics & Human Factors 2019

29 April – 1 May 2019 • Stratford-upon-Avon

Chartered Institute of Ergonomics & Human Factors

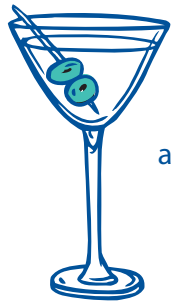
Learn. Meet. Discuss. Be inspired.

The conference will start with a day of six special CPD training workshops on a variety of topics and a bigger and better Doctoral Consortium where students can present their ongoing research.

This will be followed by two days of keynotes and a parallel programme of presentations, posters, workshops and discussions about research, developments and applications from leading professionals working across all sectors.

Call for submissions | Deadline 1st November 2018

1. **Research and practice**
   Design • Healthcare • Occupational health • Rail • Aviation • Technology
   Green/eco ergonomics • Autonomy • Cyber security • Behaviour change
   Cognition • Safety culture
2. **70 years of ergonomics**
   Ergonomics practice across the decades • How roles have changed over time
   Historical milestones
3. **Doctoral consortium**
   Abstracts describing student research



Join us there for...

70th anniversary cocktails & BBQ with a Shakespearean twist

Annual dinner
Anniversary cake
Entertaining quiz

Next year is also the CIEHF's 70th anniversary of its formation as the Ergonomics Research Society in 1949. We're celebrating that achievement with a great line up of social activities in the evenings, giving you a chance to relax in a truly lovely riverside setting in Stratford-upon-Avon.

70 years OF ERGONOMICS 1949-2019

events.ergonomics.org.uk

Awareness campaigns

Celebrated in October each year, Global Ergonomics Month is an international outreach campaign promoting human-centred design through the science, application and profession of ergonomics or human factors. The CIEHF has three events currently organised for October but much of our effort is being put into raising awareness throughout 2019 as part of our 70th anniversary celebrations. Watch for more details of this in our next issue.

The Federation of European Ergonomics Societies is an official campaign partner of the EU-OSHA Healthy Workplaces Campaign which in 2018 and 2019 focuses on managing dangerous substances. Exposure to dangerous substances is much more common in Europe's workplaces than most people imagine. Dangerous substances at work can cause a wide range of health problems and diseases, as well as posing safety risks. The 2018-19 campaign aims to raise awareness of the risks posed by dangerous substances in the workplace and to promote a culture of risk prevention. For more details, see **http://bit.ly/2NN2qPU**

A pioneering aviator

Mary Ellis, one of the last surviving British female pilots from the Second World War, has died aged 101. She was a member of the Air Transport Auxiliary, which employed civilians to deliver planes from factories to airfields. She said it was "sometimes frightening" because the aeroplanes were all different with major variations in cockpit design and equipment: "You'd get out of a Tiger Moth into a Wellington bomber and then into a Spitfire". For more details of Mary's wartime career, see **https://www.bbc.co.uk/news/uk-england-hampshire-43518517**

Looking back, the ATA did an amazing job in incredibly difficult conditions. The planes and their pilots have led us to a situation today where we are fortunate enough to have the time, knowledge and funding to ensure aviation is as safe as it can be. For the fourth year in a row, the CIEHF's two-day Human Factors in Aviation Safety event will bring together professionals from around the globe to present and discuss human performance issues so we can continue to ensure safety in the skies in an increasingly digital age.

IMAGES: GETTY/ALAMY/SHUTTERSTOCK

Messing about in cars

Whilst the focus on so-called self-driving cars is mostly on the technology and the safety of the passengers and other road users, give a thought to what travelling might be like in the first generation of self-driving cars used as shared taxis. Companies like Uber are giving serious consideration to their development.

Without needing to worry about actual driving, many passengers might use the time to eat, and whilst not deliberately leaving rubbish in the vehicle, there is usually always some tell-take sign that someone's been eating or drinking. And what about those that suffer from car sickness? Would you still be able to stop a car quickly to pull over to the side of the road if you needed to? An article explores this issue in all its uncomfortable detail here: **https://slate.me/2AhldAW**

Worklessness and health

The combined costs from worklessness and sickness absence amount to over £100bn annually. There are many compelling reasons to regard work and worklessness as important public health issues both at local and national level. To help inform crucial local conversations, Public Health England has created an infographic slide set for every county and unitary authority in England, presenting data on work, worklessness and health in an accessible format.

Magdalene Mbanefo-Obi, of Public Health England, said: "Helping people with health issues to obtain or retain work and be happy and productive within the workplace is a crucial part of the economic success and wellbeing of every community."

The work, worklessness and health local infographic tool can be accessed at: **https://tinyurl.com/y7xlyrp2**

Ergonomics perspective from Lithuania

Despite its low population, Lithuania is a thriving nation, and is just starting to develop education, standards and resources in ergonomics, as **Aušra Stankiuvienė** explains

Lithuania is one of three states in the Baltic region of northern-eastern Europe, situated along the south eastern shore of the Baltic Sea, to the east of Sweden and Denmark. It's bordered by Latvia to the north, Belarus to the east and south, Poland to the south, and Kaliningrad to the southwest. Lithuania's capital and largest city is Vilnius.

Lithuania covers an area of 65,300 square km and has an estimated population of 2.8 million people. (The UK has an area of 93,000 sqkm and a population of 66 million.)

The state of Lithuania was created in 1253 and the modern Republic of Lithuania in 1918. After a period of Soviet occupation, it declared itself independent in 1990. It's now listed by the United Nations as a 'very high human development' country.

The three largest sectors in the Lithuanian economy are services (68.3% of GDP), industry (28.5%) and agriculture (3.3%). Main exports are from agricultural products and food, chemical products and plastics, machinery and appliances, mineral products, wood and furniture.

The biggest challenges for ergonomics in Lithuania are currently in construction, agriculture and forestry, although ergonomics is already widely applied in many areas of human activity, for example, in industry, rail transport, services, design, education and other fields.

EN and ISO ergonomics standards are in place and have been embedded into Lithuanian legislation. The Lithuanian Standards Board develops and improves the national system of standardisation and sets up technical committees for the preparation of Lithuanian standards and other publications. It also coordinates the preparation of standards, and establishes procedures for the adoption of international, European and foreign standards as Lithuanian standards.

The scope of the Technical Committee TK 64 Ergonomics includes standardisation of ergonomics terms, working systems taking into account the ability of humans and machines to function normally in the environment, design requirements and risk assessment in the workplace. Interested parties on the Technical Committee, such as producers, consumers and representatives of state, scientific and public organisations, make decisions by consensus.

The Lithuanian Ergonomics Association (LEA) was established in 2013 in Vilnius for ergonomics specialists and those in allied professions such as occupational medicine, occupational safety, workplace psychology and engineering. In 2016, LEA became a member of the Federation of European Ergonomics Societies.

The founder and first President of the LEA is Associate Professor Kazys Algirdas Kaminskas and the Vice President is Associate Professor Aušra Stankiuvienė, both of Vilnius Gediminas Technical University. The LEA Council consists of 11 elected members and makes all major decisions concerning the LEA including rule changes, general policy, activities, admissions, election of officers and budget.

There are five grades of membership of the LEA: Member; Student Member: anyone enrolled in the study of ergonomics or related occupations; Associate Member: anyone active in the field of ergonomics; Sponsor: anyone who is financially supporting an association for the development of ergonomics in Lithuania; and Honorary Member. Currently, there are 32 members, three of whom are businesses.

LEA members are university teachers and students, practitioners in ergonomics as well as health and safety services, and companies which are actively applying the principles of ergonomics in their workplaces. A general assembly is organised each year, together with four to six Council meetings. There are also four regional branches.

The mission of the LEA is:

- To develop and advance communication between ergonomics specialists and allied professionals.
- To actively promote and coordinate the development of a professional ergonomics approach.

Road workers in Ignalina, Lithuania

IMAGES: ISTOCK

- To promote professional qualification in the evaluation of risk factors.
- To develop ergonomics and psychosocial risks assessment methods leading to standardisation and dissemination.
- To develop a professional ergonomics approach in society.

Two international ergonomics conferences have been successfully organised by the LEA so far. The first, 'Ergonomic Workplaces for All Ages', was held in Vilnius in March 2017. This conference, organised by the Lithuanian Focal Point of the European Agency for Safety and Health at Work together with the LEA, was dedicated to the importance of ergonomically designed workplaces, particularly for the ageing workforce. Scientists, doctors and ergonomics experts from the UK, Latvia and Lithuania discussed successful solutions and their adaptations for individual workplaces and workers. The conference promoted sustainable working lives and highlighted how to prevent work-related injuries through ergonomics as well as other creative solutions for workplaces.

The second conference, 'Ergonomics: Creativity, Innovation and Good Practice' was held in Vilnius in April 2018. The conference was organised by the LEA in association with UAB Verslo Aljansas and was dedicated to the 100th anniversary of the restoration of Lithuania. The aim of this conference was to present problems and show how they could be solved by creativity and innovation integrated with ergonomics.

The biggest challenges are currently in construction, agriculture and forestry

In 2017, Associate Professors Kazys Kaminskas and Aušra Stankiuvienė published a book called 'Ergonomics Methods and their Application'. It presents the most effective ergonomics methods that help to protect and promote the health and wellbeing of people. It's aimed at a wide audience including managers and designers, ergonomics specialists, occupational safety and health professionals, educational institutions, employers and workers.

Since 2016 LEA has organised a competition in Lithuania called 'Best Ergonomist of the Year'. The winner in 2016 was Inga Buzienė, a safety engineer from AQ Wiring Systems UAB in Panevėžys, the fifth largest city in Lithuania. The winner in 2017 was Dainius Puzinas, a safety engineer from UAB Mars Lietuva in Gargždai in western Lithuania.

Members of LEA together with the Institute of Occupational Medicine in the UK, COWI in Denmark and Milieu Ltd in Belgium, have conducted several EU studies:

- Evaluation of the EU Occupational Safety and Heath Directives.
- Safer and Healthier Work at Any Age.
- Occupational Health Concerns and the Existence of Stress-related and Psychological Problems Associated with Work.
- EU-OSHA 2016-17 Campaign: Healthy Workplaces for All Ages - Development of an Online Multilingual e-Guide.

In order to help companies and institutions reduce or avoid health and safety problems, many LEA members conduct bespoke one to two-day introductory ergonomics training. In such cases, training is linked to the company's specific needs. Sometimes the company asks the LEA's specialists to conduct an overview of the ergonomic study of workplaces.

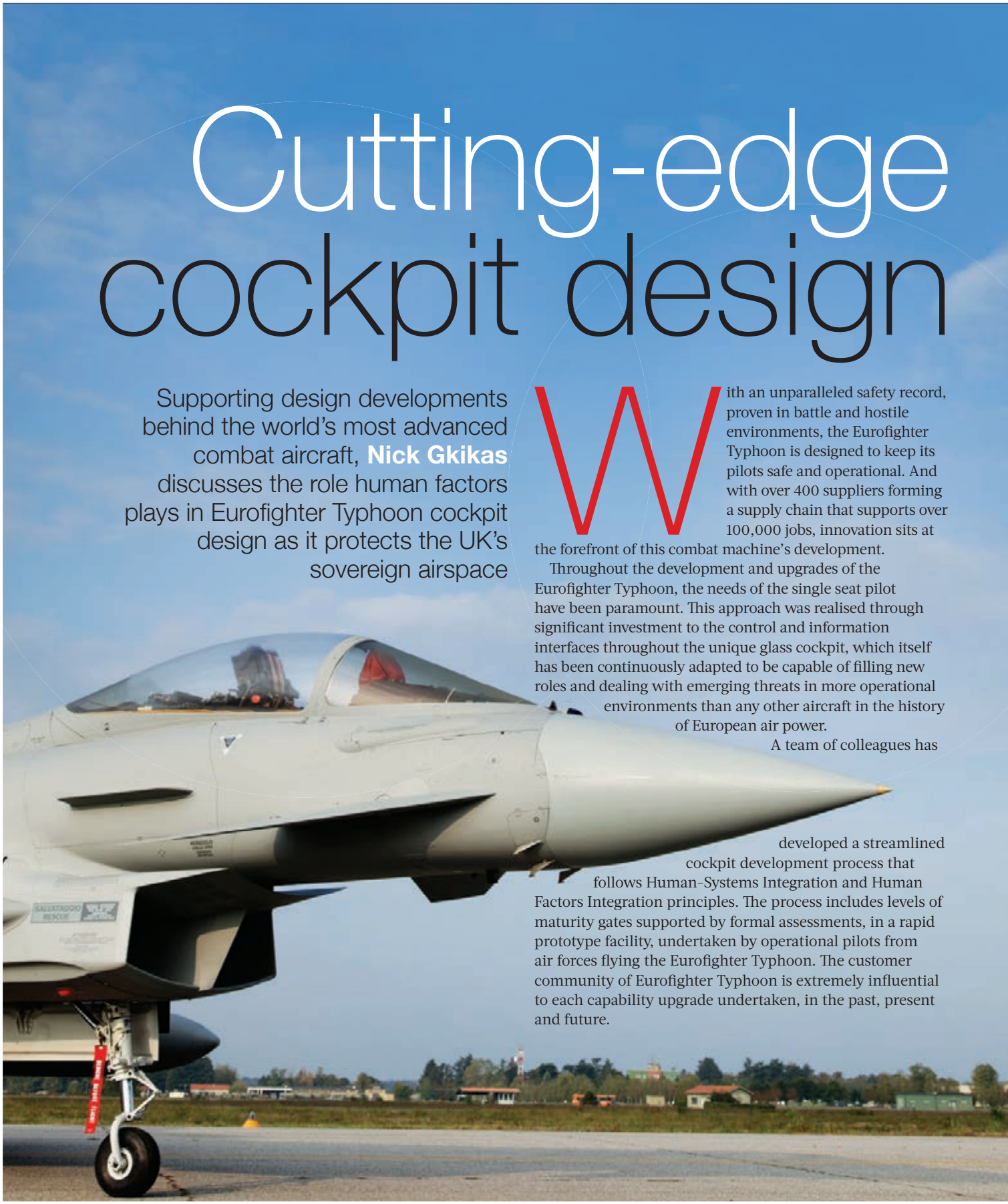
A training course in Ergonomic Risk Factor Assessment has been developed in Lithuania and has been running since March 2014. So far more than 150 people have completed the course. Many enquiries for help from LEA specialists come from companies who have completed this course and then actively go back and examine the ergonomics problems of the company, realising that further ergonomics studies of their workplace would be beneficial.

The LEA also works closely with the other Ergonomics Societies in Latvia, Estonia and Austria. ●

Aušra Stankiuvienė is an Associate Professor in the Department of Building Materials and Fire Safety at Vilnius Gediminas Technical University

Cutting-edge cockpit design

Supporting design developments behind the world's most advanced combat aircraft, **Nick Gkikas** discusses the role human factors plays in Eurofighter Typhoon cockpit design as it protects the UK's sovereign airspace



With an unparalleled safety record, proven in battle and hostile environments, the Eurofighter Typhoon is designed to keep its pilots safe and operational. And with over 400 suppliers forming a supply chain that supports over 100,000 jobs, innovation sits at the forefront of this combat machine's development.

Throughout the development and upgrades of the Eurofighter Typhoon, the needs of the single seat pilot have been paramount. This approach was realised through significant investment to the control and information interfaces throughout the unique glass cockpit, which itself has been continuously adapted to be capable of filling new roles and dealing with emerging threats in more operational environments than any other aircraft in the history of European air power.

A team of colleagues has developed a streamlined cockpit development process that follows Human-Systems Integration and Human Factors Integration principles. The process includes levels of maturity gates supported by formal assessments, in a rapid prototype facility, undertaken by operational pilots from air forces flying the Eurofighter Typhoon. The customer community of Eurofighter Typhoon is extremely influential to each capability upgrade undertaken, in the past, present and future.

Eurofighter Typhoon 2000

Early design considerations

For the last decade, human factors has been formally included in aviation safety and military equipment standards. On that basis, it's usually included in the conceptual stages of development but it's rarely a priority when compromises between engineering requirements and targets must be made during development. This is not a complaint; I think it's us, as ergonomists and human factors engineers, who should do a better job at collecting evidence and demonstrating the competitive edge human factors integration offers in terms of capability, cost savings, customer value and delight, reputation and brand building, and safety excellence.

Typically, the digital assessment is followed by a quick and dirty mock-up, followed by cockpit rig, with the old-school development-aircraft phase – building a prototype aircraft to use for testing and physical development – only used as final overall confirmation of performance and safety characteristics. Times between each phase vary from a few months for minor updates to years for white sheet designs; the latter are extremely rare. Except for the digital phase, where digital human models are used to assess against the occupant packaging specification, the other phases involve real pilots – both test pilots and customer representative pilots. We try to assess dynamic operations within quasi-mission environments as early as possible, rather than static anthropometrics, because we see huge advantages in terms of cost, time and capability on delivery.

For the last decade, human factors has been formally included in aviation safety and military equipment standards

Simulation technology

Nowadays, there are fully-digital suites for development, test and productionisation. Some customisation is necessary, as the driving markets for those digital suites were mainstream, mass-produced commodities and services, for example IT, telecommunications and motor vehicles. But in theory we could have fully digital, model-based platform development and test, with flight test being there to confirm and finalise only, as Formula 1 car development has done for a good few years now.

The changing way that aircraft are piloted, for example, with increases in automation, and new display and control technologies, affects ergonomic design in cockpits and this is probably the biggest difference between commercial and military aviation, particularly fast jets. Tradition, legacy and a bit of military 'hero culture' dictates that pilots have a huge influence in every programme. And pilots want to fly the aeroplane. A bit like drivers who hate vehicle automation, most fast jet pilots hate any automation that touches the skill-base, or basic flying skill level of the pilot task. Automation itself is extremely good at performing tasks reliably in a pre-determined manner. It's inflexible though and that's where a lot of the frustration comes from. The real game changer is Artificial Intelligence but that comes with many other connotations and requires a very different approach, not least in testing and qualification.

Much of what we consider as 'new' control and display technologies, are not that new at all; head-up displays are Augmented Reality and have been in-service for many years. Displays have better resolution (more pixels) so they appear more 'real' and this determines our accuracy threshold for human-machine interface adoption. Qualitative improvements have been made in terms of flexibility over where that Augmented Reality function can be integrated, for example images projected on the helmet visor can be made to 'appear' anywhere the pilot looks, be it something massive miles away, or minuscule right in front of their eyes. And finally, we can now take our neuro-ergonomics knowledge and capabilities and exploit them in tandem with physiological measures and controls.

Comparable design

In terms of the human factors knowledge and skills required, there is actually very little to choose between the aviation and automotive industries. The exact same methods - anthropometric tools, task analysis, cognitive work analysis, experimental methods, and quantitative methods - are necessary to inform system and product development. However, the priorities are different. The focus on specific areas of human factors is shaped by the historic legacy of each industry and the different expectations of internal stakeholders, external customers and social stereotypes associated with them.

A car company can justify the investment to a complete digital development suite within months, due to the number of vehicle programmes and the shorter, streamlined, two to three-year development cycles which necessitate a lot more simulation and digital development and testing, with physical testing included for confirmation only.

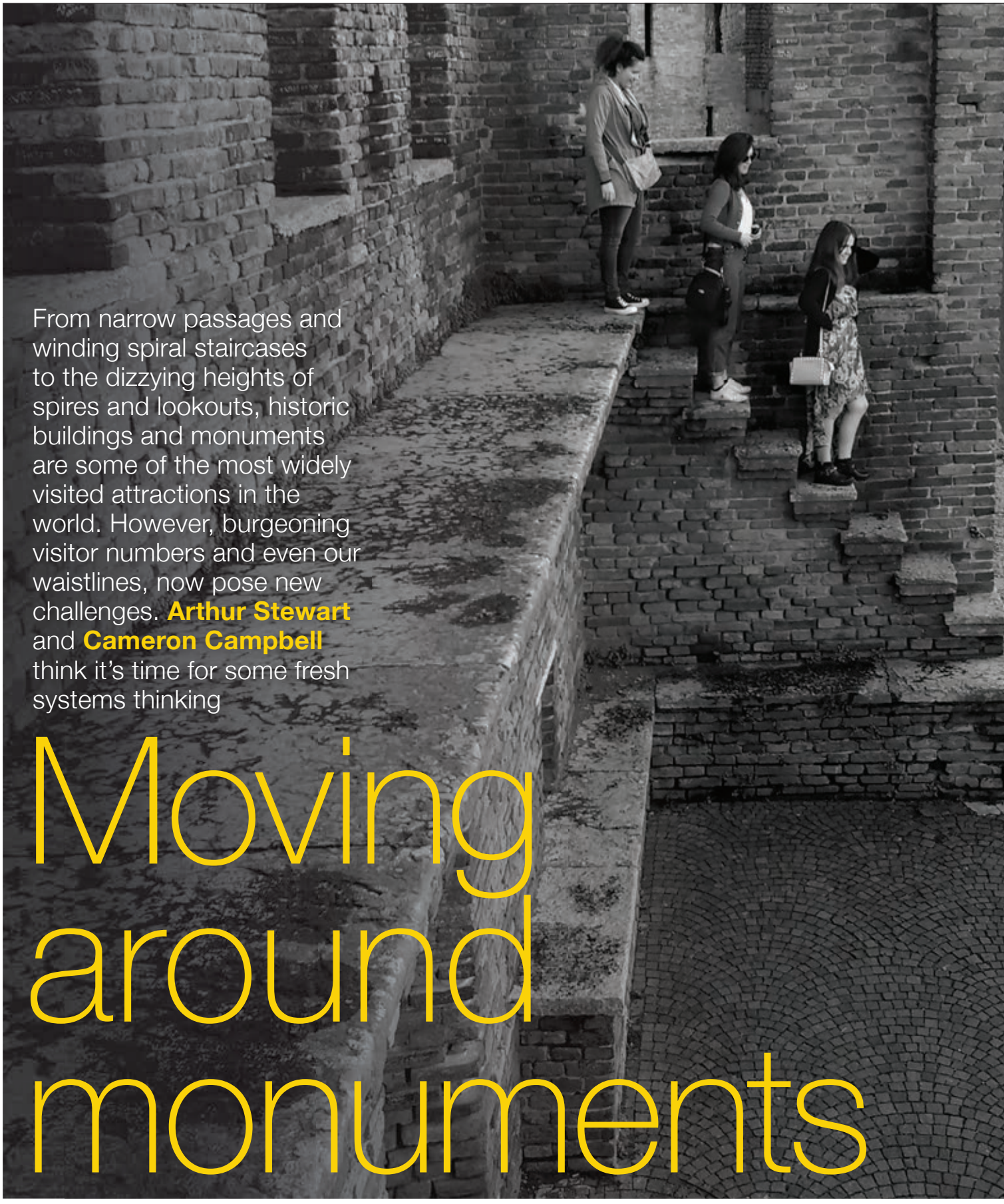
In the much longer development cycles for a new airborne platform, with many non-technical factors coming into play, such as the ever changing social, political and military influences, there is much less gain to be had from digital development and testing. The weight falls more on the human judgement of stakeholders and customer or operator representatives, who tend to be more comfortable basing their decisions on physical evidence.

Nick Gkikas is a Senior Systems Engineer at BAE Systems. His role is focused on the design and development of cockpit system updates to support its capability upgrades and to support colleagues with the human factors integration elements of cockpit system design.

Further information

Gkikas N, Chesham P, Partridge D & Ridge E, (2016) From HCI to HSI – the journey in a fast jet cockpit. *Proceedings of the International Conference on Human-Computer Interaction in Aerospace 2016*

IMAGE: ISTOCK



From narrow passages and winding spiral staircases to the dizzying heights of spires and lookouts, historic buildings and monuments are some of the most widely visited attractions in the world. However, burgeoning visitor numbers and even our waistlines, now pose new challenges. **Arthur Stewart** and **Cameron Campbell** think it's time for some fresh systems thinking

Moving around monuments

IMAGES: A STEWART/C CAMPBELL

The Ponte Pietra bridge in Verona, Italy, far left and a sign for the challenging ladder system at St Helen's Church in Ranworth, Norfolk

In the UK and around the world, there is a rich cultural heritage of historic buildings, directly experienced by millions of visitors each year. Such cultural assets are not only central to each country's history but are pillars of the local economy, employing staff directly for operation and management, and indirectly in a growing global tourism industry.

As the world's most visited city, London hosts the top 10 attractions in the UK, with the British Museum at the top of the list, attracting almost six million visitors in 2017. Scotland's foremost tourist attractions, The National Museum of Scotland and Edinburgh Castle were 11th and 12th in the list, hosting more than two million visitors each, an increase over the previous year of 20% and 16% respectively.

One of the biggest challenges these sites face is striking the delicate balance between encouraging access and ensuring safety, a challenge further exacerbated by rising visitor numbers each year, in addition to seasonal variation.

Demographic changes are also an important consideration. On average, a typical adult has become larger and heavier as a result of the global obesity pandemic. In the USA, obesity tripled between 1986 and 2010, while 'super-obesity' increased 10-fold. This pattern, echoed throughout the western world, means that average body size has gone up, while the available space per person has remained constant, and 'super-sized' individuals have become more common. In addition, less agile individuals are more prevalent because of the rapid expansion of the senior tourist market. So, not only are there more people, there are also a rising number of 'extra large' and slow moving individuals as part of the tourist demographic.

Accommodating more visitors

High visitor numbers require carefully managed access, circulation and egress in buildings, especially those designed for defence and not mass visitation. In many instances, archaic configurations, narrow passageways and steep staircases constitute convoluted visitor paths which loop back on themselves such that the way in is also the way out, and the way up is also the way down.

This challenge of passing manoeuvres becomes considerably more complex when large, slow-moving or mobility-impaired visitors are considered, and exacerbated when factors such as variable group size and language are also prevalent. Such challenges to normal operation may be addressed, in part, by scheduling and queueing control. Under adverse circumstances such as a fire or medical emergency, this will become much more serious. This presents a major dilemma for operators of historic buildings because the continual growth in visitor numbers is ultimately unsustainable without threatening public safety and the quality of the visitor experience.

Crowd science highlights that within the constraints of a fixed-sized environment, greater numbers of visitors affect crowd density and person flow rate. Under normal building operation this may be merely inconvenient, with greater time spent queueing. However, in non-normal building operations such as medical emergency, fire or terrorist activity, it might become very important indeed. Firstly, increasing density reduces movement speed and increases evacuation time, and makes it harder for groups to stay together. Secondly, overtaking and counter-flow movements in narrow corridors may become highly problematic or impossible, which is a threat to common visitor movement pathways inside several historic buildings. This means that the position of a slow-moving person in a queue pivotally affects the evacuation time of all those behind. Thirdly, vertical movement is likely to induce major bottlenecks, especially steep or spiral staircases which require careful negotiation.

The challenge is a classical human factors problem: how can we deliver the optimum experience to increased numbers of individuals without compromising safety? Consideration of this requires a typical human factors solution: systems thinking. Different systems include: the visitor access, circulation and egress within the built environment; the operating staff facilitating public access inside the building; management staff facilitating maintenance, compliance, cleaning, etc.; non-normal operation systems involving partial closure or restricted access; emergency operation involving rescue, fire or full evacuation.

There's a delicate balance between encouraging access and ensuring safety

While each historic site may have its own unique set of circumstances utilising systems and experience of operating staff, there are some common principles which prevail. These involve the interaction of three factors within the building itself and its environs: the visitor path, movement capability and operator constraints. For instance, a castle may be partially ruined or damaged by adverse weather and safety legislation prevents access to a portion of the site. These inter-relationships critically balance freedom and safety, personal and corporate responsibility, operational practice and pragmatism at several different levels. →

Visitors queue for long periods at the Uffizi Art Gallery in Florence

Physical challenges

1 **Unprotected drops.** The Ponte Pietra bridge in Verona, Italy is a UNESCO World Heritage site. It has open steps up to an unguarded parapet and is a thoroughfare within the ancient city. Visitors climb to this parapet to take photographs of the river and the old city. They necessarily pass one another with one person on the unprotected side. Individuals taking 'selfies' here do so at considerable risk.

2 **Large-scale queueing.** Like many of the most popular sites, the Uffizi Art Gallery in Florence requires 'unreserved' visitors to queue for long periods during busy times. Here, visitors shuffle along in a covered loggia, which can take up to three hours or longer to gain access to the ticketing booth. This queue can be by-passed for a hefty surcharge but both queues converge inside. While queueing is tiring and frustrating at the best of times, in the summer of 2017 temperatures reached 50°C .

Tomb of the Eagles, Orkney

3 **Steep spiral staircases.** A visitor struggles to see the steps in a spiral staircase with low ambient light. While spiral staircases are ubiquitous in ancient churches, visitors are particularly at risk moving from bright sunlight into poorly lit interior spaces, especially where the floor may be uneven or damp from rain. However, there are other aspects to consider. Staircases may be open, such as London's Monument, which carries a small but real danger of individuals falling down the central void in the event of a crush or railing failure. Closed spirals, such as the Scott Monument in Edinburgh, are usually narrower and get narrower still towards the top. In this location, the entry stair is 92cm wide, narrowing to just 46cm at the top. Larger individuals might not fit through the turnstile at the entrance, although passing manoeuvres are highly problematic further up the 287 steps because the observation areas are 63 steps apart with no passing spaces in between. Due to the enclosed nature of the tower, it's possible to hear others yet not know whether they are on their way up or down.

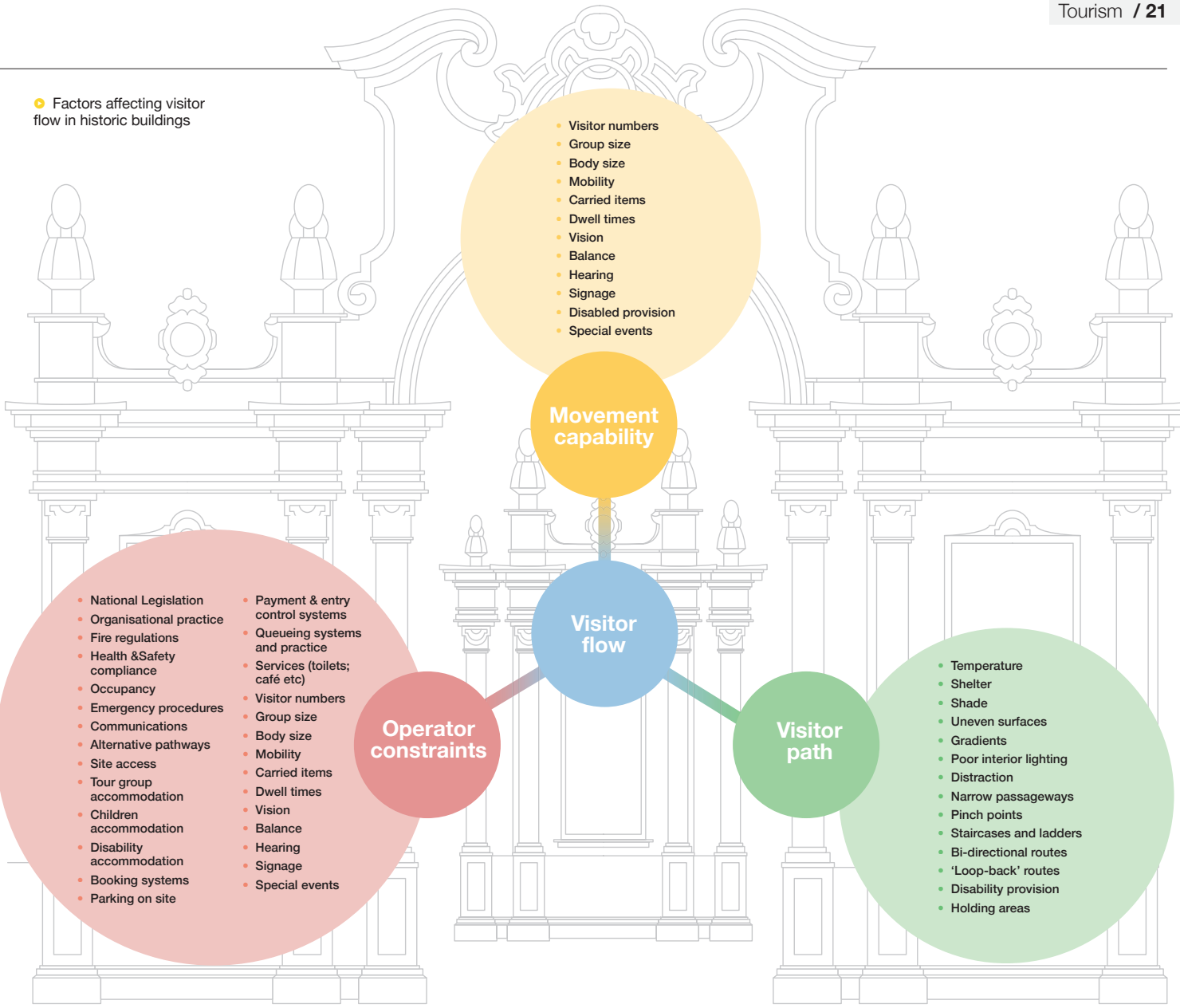
4 **Prolonged restricted width.** In The Duomo in Florence, visitors climb to the elevated walkway via a one-way spiral staircase. Access to the top is between the two skins of the dome which requires the visitors to navigate the tightest of spaces which can be both exhausting and disorienting for them after their ascent. Passing is a challenge, particularly if group members are trying to stay together. At the top of the dome is a viewing platform which can hold as many as 100 people and has only one narrow entry and exit point.

5 **Ladder access and egress.** The challenging ladder system at St Helen's Church in Ranworth, Norfolk, allows people to climb to the top of the tower. Usually there is no on-site staff presence to facilitate this, and visitors generally climb at their own risk. The last person to leave on any given day is asked to close the heavy trapdoor. Those with a fear of heights would be highly unlikely to ascend the tower in the first place but looking down is usually more daunting than looking up, so a level head is essential.

6 **Lying space only.** In the Tomb of the Eagles, Orkney, a visitor negotiates the narrow access to the burial chamber on their back via a trolley board and rope. The tunnel is a little over 3m long is definitely not for the claustrophobic. The way in is the way out and each person is asked to return the trolley board for the next when entering or leaving. The physical restrictions of the entrance may be compounded by the psychological insecurity associated with the dependence on others to facilitate a safe exit.

Taken together, these scenarios convey something of the challenges visitors, and attraction organisers, face. In none of the locations was safety information prominent but in aesthetic terms this may be a good thing because the very nature and meaning of the heritage site could be compromised by incorporating such signs.

Unquestionably though, many sites have unseen safety systems such as a turnstile the exact size of the narrowest aperture, as in the Scott Monument. In other



sites, safety may be the product of past practice and common sense, yet they lack the capacity to deal with a steady increase in numbers or unforeseen events. Culturally, the balance between individual and corporate responsibility may differ between different countries, organisations and contrasting experiences of good practice and misadventure.

But learning from incidents – the crucible for developing operational safety across a range of industries – has the potential to contribute substantially to cultural heritage and tourism. However, we can also learn from other areas as well, for example, the ergonomics of confined spaces has much to contribute from empirical research and safety planning, while most important of all is to recognise best practice, emulate it, and share it. And while common sense may not always be common practice when it comes to managing every visitor attraction, we now have the formidable weapon of modern media, including Trip Advisor, to collect visitor feedback. Astute operators of historic buildings would ignore this at their peril, but perhaps be unaware that this feedback is another dimension of systems thinking.

Arthur Stewart is a senior researcher in ergonomics and health and Cameron Campbell is a lecturer in contextual and critical studies with a specific interest in ancient buildings and architecture. Both are at Robert Gordon University, Aberdeen.

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IMAGES: GETTY/ PHOTO A STEWART

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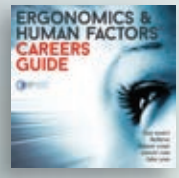

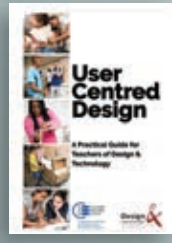

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Realistic road safety solutions

As road traffic accidents continue to claim more than 1.25 million lives each year, with 90% occurring in low-and middle-income countries, **Katie Plant** introduces the STARS project set to address global road safety

As the ninth global leading cause of death, road traffic injuries represent a major pandemic. Low and Middle-Income countries (LMIC) have more than twice as many road traffic fatalities, compared to high-income countries. Whilst these countries represent 82% of the global population, they only represent 54% of registered motor vehicles, so they have a disproportionate number of deaths relative to their level of motorisation.

To address this issue, a consortium has been formed with four LMICs via the Socio Technical Approach to Road Safety (STARS) project. These countries represent a range of economic development: a least developed country (Bangladesh), a low-income country (Kenya), a lower-middle income country (Vietnam), and an upper-middle income country (China).

We didn't set out to impose a westernised view of road safety, instead we sought to capture the current challenges facing these countries and, in collaboration with our LMIC partners, develop and evaluate relevant and realistic solutions.

Traditional road safety research has been characterised by the '3 Es' of Engineering, Enforcement and Education. Although these provide guidance to engineers and policy makers, they don't provide a holistic and integrated approach to road safety and fail to consider fully the wider system factors that shape road user performance and outcomes. The STARS project will tackle road safety from a '7 Es' perspective, with the inclusion of Economics, Emergency response, Enablement and Ergonomics.

The overall aim is to reduce the number and severity of road accidents in LMICs through the underpinning philosophy of 'local solutions for local problems'. We reviewed the '7 Es' of Road Safety from the UK perspective, applying the Actor Map component of the Risk Management Framework method to model the road safety system. Each LMIC partner country is currently undertaking the same status review.

The '7 Es' approach

1 **Engineering.** The engineering approach to road safety can be split into two principal categories: road environment engineering and vehicle engineering. In terms of road engineering, there are many ways of constructing the road environment to improve safety, from speed bumps to the layout of road crossings that ensure a pedestrian looks the right way to search for vehicles. Built-in separation of different road users is another method of engineering safety into the road system. One example in London is the Cycle Super Highway, there to protect vulnerable road users, while encouraging higher cycling rates,

an inherently healthier travel choice, both for the user and for the people around.

For crash barriers, guidelines have been in place for years, including the notion that barriers should have a degree of flexibility to them, thereby minimising the chance of injury should a collision occur. In terms of the vehicle, there are many ways in which safety is engineered into the system. New vehicles sold in the EU are built to high safety standards; all cars have air bags, seat belts and crumple zones, for example. However, systems such as automatic emergency braking, collision avoidance systems, intelligent speed assistance, lane keeping assistance, headway maintenance assistance, antilock braking systems, active cruise control, etc. are necessary to get the highest safety ratings.

The aim is to reduce the number and severity of road accidents through the philosophy of 'local solutions for local problems'

2 **Enforcement.** Many engineered safety systems are now legal requirements throughout Europe. Crumple zones, driver airbags, child restraints, seat belts, and general vehicle design all have strict and detailed laws governing them. Furthermore, in the UK, existing vehicles over three years old are required to pass an MOT test.

Just as is the case for many countries, the UK has many laws governing the behaviour of road users, such as laws concerning driving whilst under the influence of alcohol or drugs, driving speeds and the general safety of driving. To enforce these laws on motorways and inter-urban main routes, the UK's police forces each have a road policing unit that specifically polices certain sections of roadway. For laws to be effective, they must be enforced, and this requires a police force to be consistent and honest.

3 **Education.** Education for road safety can be split into two primary areas: education of the driver and education of the public. Education of the driver includes all driver training, from the pre-licence training and gaining a driving licence, to advanced driver courses. Each road user is trained specifically for their type of vehicle, for example lorry drivers and bus drivers must pass additional tests to legally drive these larger vehicles.

4 **Economics.** Road safety has the potential to have a significant impact on the economy. In 2015 it was estimated that the value of the prevention of all reported road accidents was £15.3 billion, rising to £35.55 billion when considering unreported casualties.

The road network is England's most highly valued asset, estimated to be worth around £344 billion and to keep the road network safe, it must be well maintained. According to 2016 data, one in six roads may need to be replaced within the next five years, the one-time cost to catch up with all road maintenance is estimated at £12.06 billion, yet there is a £730 million shortfall in annual road maintenance funding.

IMAGE: GETTY

5 **Emergency response.** The police, fire brigade and ambulance service work together to ensure interoperability in emergency response situations but each one also has its own guidelines.

The NHS plays a vital role here: improving care standards leading to reduced road fatality rates has also been demonstrated statistically. In Britain, research has shown that the fall in casualty rates from road traffic incidents across the years 1978 to 1998 can be explained, in part, by lower in-patient lengths of stay, higher per-capita levels of NHS staffing, and lower numbers of people per-capita waiting for hospital treatment.

6 **Enablement.** Enabling road safety research and translating this into practice does not refer only to the level of funding available, but to the ease with which data is made available, the levels of communication and interoperability between agencies and research institutions, the general culture of support for research expenditure, and the governmental, public, academic and commercial support for road safety initiatives.

7 **Ergonomics.** With regards to human factors and ergonomics research in road safety, focus has traditionally been on the individual driver. Support for the systems approach has been less forthcoming, though this is beginning to change with the adoption of the 'safe systems' perspective. One of its central themes is that humans are fallible and that responsibility for road safety should be moved away from road users and placed on road system design.

The STARS project aims to address global road safety through the application of the '7 Es' approach, with a focus on ergonomics and the systems perspective that this can bring. The Actor Map reveals that the UK road safety system is facilitated by over 120 organisations, each sharing responsibility for the performance of the system. This highlights the potential complexities that exist within the system, which will be demonstrated by completion of the Accimap, whereby the interactions between the organisations will be considered. This will be applied to the road safety system in our four partner LMICs to enable a consistent comparison of the similarities and differences that exist within each system. This will enable improvements and countermeasures to be developed in line with a socio-technical systems perspective based on the local data. Other work currently being undertaken includes a large cross-cultural survey on attitudes and beliefs in the context of road safety and more localised 'think aloud' studies are being conducted at accident hot spots in each partner country.

Katie Plant is a Lecturer in Human Factors Engineering within the Transportation Research Group in the Faculty of Engineering and the Environment at the University of Southampton.

Further information

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Ensuring a safe future for air travel

The UK's aviation network handles a staggering number of flights each summer. **Jonathan Twigger** discusses a research project that shows the key role human factors plays in determining whether control can be maintained in this increasingly busy safety-critical environment

As we hit the UK's busy summer holiday period, Britain's aviation network will handle over 770,000 flights in July and August alone. And as one of the busiest airports in the world, London Heathrow will welcome over 75.7 million passengers into its terminals this year.

With industry-wide predictions that UK air traffic will continue growing from 2.5 million flights in 2017 to 3.1 million by 2030, the UK-based air traffic control company, NATS, has warned that the UK needs to 'modernise' its air space and is spending an estimated £600 million on new technology to help boost capacity. So, what can be done to ease this burgeoning pressure on global airspace and growing potential for congestion around the country's busiest airports?

The Air Traffic Management (ATM) industry is continually innovating in systems and procedures, to manage growing passenger numbers, maximise efficiency and improve the passenger experience. However, to successfully implement these new capabilities within a safety-critical environment, human factors plays a key role in determining what is 'fit for purpose'.

While the influence of human performance has gained recognition within the ATM industry in the last decade, its knock-on effect on all key performance areas is less

acknowledged. There remains a widespread attitude that the assessment of human performance (along with safety) is a simple obligation and sits apart from the more tangible performance indicators such as airspace capacity and flight efficiency.

In fact, human performance dictates the benefits yielded by any new concept - a new system or set of procedures is of little value (and potentially detrimental) if the human component in the system (the controllers) is not able to function as required. This 'fitness-for-purpose' assessment lies at the heart of the concept validation process that all new technologies and working practices must undergo. In Europe, this is the European Operational Concept Validation Methodology.

Our team at Think are specialists in leading our clients through this process, our managing director having co-written the original methodology. We're a multidisciplinary group of professionals that operate worldwide and provide services to a wide range of Air Navigation Service Provider (ANSP) and airport clients. These services include concept development, modelling, simulation and data analysis.

My recent validation project began as the ANSP for Bulgaria (BULATSA) was preparing for the opening of what will become the world's largest airport in Istanbul later this year (LTFM). As this new airport will be close to the boundary between Turkish and Bulgarian airspace, the resulting increase in traffic volume will greatly impact BULATSA's control operations.

The proposed solution is an extension of Turkey's existing arrival manager system to incorporate the airspace above the Southeast Sofia flight information region. This system identifies inbound flights for Istanbul airports and generates an optimal arrival sequence. By expanding the horizon of this tool across the boundary, controllers can begin sequencing these arriving flights earlier, improving both flight and fuel efficiency whilst reducing workload for Turkish controllers.

Due to the proximity of LTFM to the boundary, in comparison with pre-existing destinations like Istanbul Atatürk Airport, the current letter of agreement between the two ANSPs is no longer viable. This agreement dictates the altitude at which flights should attempt to cross the Bulgaria-Turkey boundary. To achieve efficient descents into LTFM, flights must cross at a lower altitude. This meant that the validation process was effectively assessing two concepts simultaneously.

A Real-Time Simulation (RTS) is referred to as a 'human-in-the-loop' validation exercise, meaning that actual controllers operate from workstations within a simulated scenario. The intention is that real-life conditions are replicated and that participants respond exactly as they would in the operations room, both with and without the concept in place. Based on this advantage, this exercise type was selected to assess the concepts.

A new system is of little value if the human component can't function as required

It was found that BULATSA could use their in-house training facility to host the simulation, rather than booking a third-party specialised facility, as is the typical approach. An RTS was planned and conducted in Sofia over two weeks in February 2018 to establish whether the system was suitable for implementation.

As the human factors expert on the validation team, I set about identifying the key human performance areas to include in the validation plan. This had to ensure that the effects of each concept on the controllers could be determined through data analysis. The areas selected were controller workload, situational awareness, user acceptance, trust and teamwork. Each were measured using several qualitative and quantitative methods.

All the selected methods were low-cost and maximised the input from the air traffic controller participants, while keeping them engaged. For example, it was important that post-run questionnaires took just a few minutes to complete and avoided mandatory open text responses so that participants would continue to provide useful feedback towards the end of the 48 runs.

These methods were both trialled and iterated ahead of the exercise, providing opportunities for the format and wording to be improved. This was especially important given that the participants weren't native English speakers. The method by which the simulation platform data would be analysed →

IMAGES: ISTOCK

Engaging with users is vital to a successful change management and implementation process

was also planned in advance to ensure it could be efficiently processed and the final data would be valuable.

A 'shake-down' week was held just prior to the RTS itself. This is where all aspects of the exercise were brought together for a final test with the participants to confirm that there were no unforeseen issues or technical limitations and that the exercise could take place as planned. Due to time constraints, this final testing doubled as a training period for the participants. This provided an opportunity for the controllers to familiarise themselves with the new procedures, traffic levels and human-machine interface. This heavily mitigated the risk of false negative results.

To measure the benefits of a concept through comparison, an RTS should include at least two scenarios: a reference and a solution condition. In this case, it was decided that six scenarios (two reference, four solution) were needed to independently validate the arrival manager system in a basic and advanced configuration, and the letter of authorisation.

During the execution phase in Sofia, my primary responsibility was the successful collection of qualitative data. This included coordinating the questionnaire submissions at the end of each measured run and reviewing them for errors. I also moved between the controller positions during the runs, recording over-the-shoulder observations and comments made by participants. In the final validation report, these observations added valuable support to the quantitative statistical results.

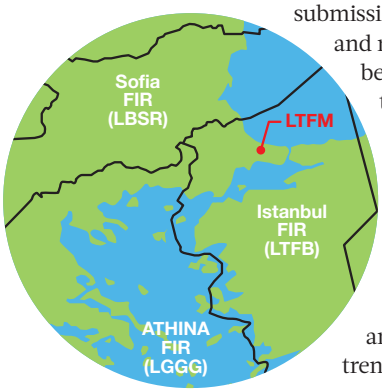
Once back in the UK, the collected data was processed using a proprietary analysis and visualisation tool to identify trends and key findings. The effects of the concept on the controllers' performance were largely consistent across the chosen metrics.

Human performance was just one of six validation objectives, covering standard key performance and focus areas that included flight efficiency, capacity and safety. Each of these were assessed using both objective and subjective results, with human performance findings acting as support to many of them. These conclusions were then written up as a detailed validation report which has since been delivered to BULATSA.

The client will soon decide on whether to proceed with implementation, request additional validation exercises, or to reassess the suitability of the concept based on the report recommendations. This was just one example of where straightforward and inexpensive actions ensured that the concepts' impact on the controllers and the subsequent effects on overall performance were fully understood.

Whatever the outcome, it has been demonstrated to BULATSA that they are able to use their existing equipment to conduct simple but worthwhile human performance assessments on-site to trial various ideas and concepts. Engaging with users and presenting their acceptance of a concept alongside the performance impacts is vital to a successful change management and implementation process.

So, with the number of aircraft in the skies set to more than double by 2037, according to the latest Global Market Forecast by Airbus, could this innovative approach help the aviation industry to solve problems, handle pressure and adapt to changing situations?



Map showing the location of Istanbul's new airport, LTFM, in relation to the controlled airspace of Bulgaria to the north and Turkey to the south

Jonathan Twigger is in his second year as an Air Traffic Management consultant with Think, following his graduation from the Loughborough BSc Human Factors course in 2016. He's currently working with NATS to support the validation of four operational concepts within the SESAR 2020 programme.

JOURNAL EXTRACTS

The CIEHF's membership package incorporates instant online access to all issues of seven leading journals, including those highlighted here

Driverless motion sickness

IMAGE: SHUTTERSTOCK

1 In the UK, more than two thirds of people currently suffer from car sickness. And at the height of the summer with drivers planning more journeys around the country, for those unlucky enough to experience vomiting as a passenger in someone else's vehicle, motion sickness is no joke.

So, how will we cope in the automated cars of the future? Expectations are high that people will be able to do other things, such as reading or working on a laptop when riding in such a vehicle, but how likely is this if we still experience queasiness?

Carsickness is associated with a mismatch between actual and anticipated sensory signals and so occupants of automated vehicles, especially when focusing their attention inside the vehicle reading or watching a display, are at higher risk of becoming carsick than those in conventional vehicles.

Researchers are now working to evaluate the impact of positioning of in-vehicle displays, and subsequent available peripheral vision, on carsickness of passengers. They estimate that increased peripheral vision during display use would reduce the problem.

Seated in the front as a passenger, 18 participants were driven a 15 minute long zigzag route on two occasions while performing a continuous visual search task. The display was positioned either at eye-height in front of the windscreen, allowing peripheral view on the outside world or the height of the glove compartment, allowing only limited view on the outside world. Motion sickness was reported at one minute intervals.

The research highlighted that using a display at windscreen height resulted in less carsickness compared to a display at glove compartment height.

O Kuiper, J Bos & C Diels (2018), Looking forward: In-vehicle auxiliary display positioning affects carsickness, Applied Ergonomics, Vol 68, https://doi.org/10.1016/j.apergo.2017.11.002

Being part of the crowd

2 Following a summer of exhilarating sporting events and a round of popular music festivals to go to, chances are we've all witnessed, if not experienced being part of a very large crowd.

A commonplace encounter, yes, yet the experience can result in both negative and positive experiences for those involved. Crowds are a complex sociotechnical phenomenon, affected by many interacting factors. Little is known, however, about how those responsible for organising crowd situations approach their responsibilities.

Understanding how to optimise the participant experience of crowds is important. Researchers have now conducted a study with organisers responsible for different aspects of the design, planning, management and operations of crowd situations. They aim to understand organisers' priorities, along with the consideration given to the experience of people in the crowds.

Five focus groups were conducted and 55 real crowd situations observed. Influences on participant experience in crowds included the physical design of crowd space and facilities, crowd movement, communication and information such as signage, wayfinding, comfort and welfare, and public order.

The interviews revealed that organisers generally prioritised finance, security and health and safety aspects, whilst giving limited explicit attention to other important factors that affect participant experience.

Organisers tended to approach their planning and decisions based on their own experience and judgement, without accessing training or reference to guidance. It's suggested that the non-use of guidance is, in part, due to problems with the guidance currently available, both its content and its form. The organisers of infrequent or small-scale events have the greatest knowledge and experience gap.

Researchers concluded that to achieve a consistent, high quality experience for crowd participants, there needs to be improved understanding among organisers of the complexity of crowds and the multiple factors influencing participant experience. Guidance and tools need to be usable and tailored to organisers' requirements. Organisers of infrequent or small-scale events are especially in need of support.

V Filingeri, K Eason, P Waterson & R Haslam (2018), Factors influencing experience in crowds - The organiser perspective. Applied Ergonomics, Vol 68, DOI 10.1016/j.apergo.2017.10.013

The value and power of mentoring

Mentoring programmes contribute to the development of a better-trained and engaged workforce and are much needed in healthcare. Building sufficient capacity in human factors is a huge challenge says **Helen Vosper** and mentoring is one of the most valuable methods of support

How did it start for you?

Fifteen years ago, I gained my Private Pilot's Licence, something which I thought was the beginning of a career change. I was quite correct, just not in the way I imagined. With visions of an airline job in mind, I completed my commercial licence and flight instructor rating. Life (and cost!) got in the way of this dream but another avenue opened up in the form of human factors and ergonomics. Pilots get a grounding in human performance and limitations and this fascinated me, so I developed my knowledge far beyond that of most pilots. When I moved into academia, where I began teaching pharmacy students, I realised that human factors had much to offer healthcare and I have now been teaching this for over a decade.

ORIGINS

The term mentor comes from the Greek legend of Odysseus in which Mentor taught Odysseus's son, Telemachus. Mentor eventually came to mean 'experienced and trusted advisor'.

What's your experience of mentoring?

One problem human factors practitioners face in healthcare is the conflation with 'factors of the human'. There is a common misunderstanding that human factors means teamwork and crew resource management. I spent many years trying to help colleagues see that teamwork and communication are emergent system outcomes. We needed to support healthcare students in developing systems competencies, allowing them to contribute to the design of better systems in their future workplaces. This required strategic change and I decided it would help my credibility if I gained an accredited qualification, and I completed the MSc at Loughborough. Professor Sue Hignett was my supervisor for the final project and I found her support so valuable that I asked her to act as my professional mentor. Sue's mentorship has given me many things. One of the most important has been confidence; she has always trusted me to lead on projects, providing gentle guidance that ensured successful completion as well as nurturing my own leadership and management skills.

How has that helped you as a mentor?

Human factors has so much to offer healthcare, and it goes far beyond patient safety. In the current financial climate, optimising all system outcomes is the only way forward. To achieve this, human factors must become embedded within practice and education at all levels.

Mentorship has given me many things; one of the most important has been confidence

IMAGE: SHUTTERSTOCK

Mentoring is key to this, as is role modelling. I have learnt so much simply from watching Sue in action, and this was only possible because she was happy to open up her practice in this way. Related to this was the generous sharing of contacts and other opportunities. Through Sue, I was introduced to Paul Bowie, Programme Director for Safety and Improvement at NHS Education for Scotland. This led to my involvement in the 'Performing well, feeling well' programme for taking forward human factors and ergonomics integration in NHS Scotland. Much of my current work takes place under this umbrella, adding real weight to the work I do within my organisation. None of this would have been possible without mentoring. Bearing this in mind, I try to mirror this in my own practice. My mentoring largely involves individuals with little or no human factors experience, and I try to involve them in my own work, but also 'induct' them into the wider community.

Why is mentoring so important to our discipline?

Human factors is a growing discipline, especially in healthcare. Specialists are thin on the ground and capacity building is a huge challenge. Mentoring offers the best opportunity to ensure that this happens effectively, especially in the face of sector-wide misunderstanding of our profession. I find trying to overcome these misunderstandings very challenging. A recent example was seeing a group of healthcare academics patiently explaining to a Chartered Ergonomist that he'd misunderstood what human factors was! Mentoring offers an opportunity to 'debrief' these experiences and gather strength to return to the challenge.

What's your advice to someone considering mentoring?

If you're thinking about mentoring – go for it. I believe the mentorship programme is one of the greatest benefits the Institute has to offer. However, mentors still need mentors! It's a huge responsibility and you can gain a great deal of support from other, more experienced mentors.

Helen Vosper is senior lecturer for MPharm at Robert Gordon University. She is a Graduate Member of the CIEHF and a member of its Pharmaceutical Special Interest Group. She is a Principal Fellow of the Higher Education Academy.

ADVICE FOR THOSE INTERESTED IN MENTORING

Who can be a mentor?

Almost all applicants for CIEHF Registered Membership are expected to have spent a period of time working under the guidance of a mentor who is an experienced ergonomist or human factors professional. We encourage all senior members of the Institute to provide a mentoring service to less experienced colleagues, and to provide their time for free. The role of mentor involves a good degree of time and effort and as the contribution from the mentor is important to the individual under their guidance, potential mentors should always consider carefully whether they will be able to fulfil the commitment before agreeing to it.

Where can I find a mentor?

Mentors should have professional experience within your area of work, so you should firstly look for a mentor from within your own organisation. If you don't know anyone who could be your mentor, you could attend a CIEHF Regional Group event in your area to meet more people locally or go to the CIEHF's annual Ergonomics & Human Factors conference where there will be many people who might be able to help you. If you can't find a mentor, email the Institute with a paragraph or two about yourself, where you live and work, your professional interests and what you would like a mentor to help you with.

Overseas applicants may not always have access to Institute members. In these circumstances a mentor holding an equivalent grade of membership with another federated society or organisation, recognised by the International Ergonomics Association or a related professional body, may be able to help.

To find out more about becoming a CIEHF mentor, go to www.ergonomics.org.uk > Get involved > Mentoring.

REGIONAL NEWS

ACROSS THE UK

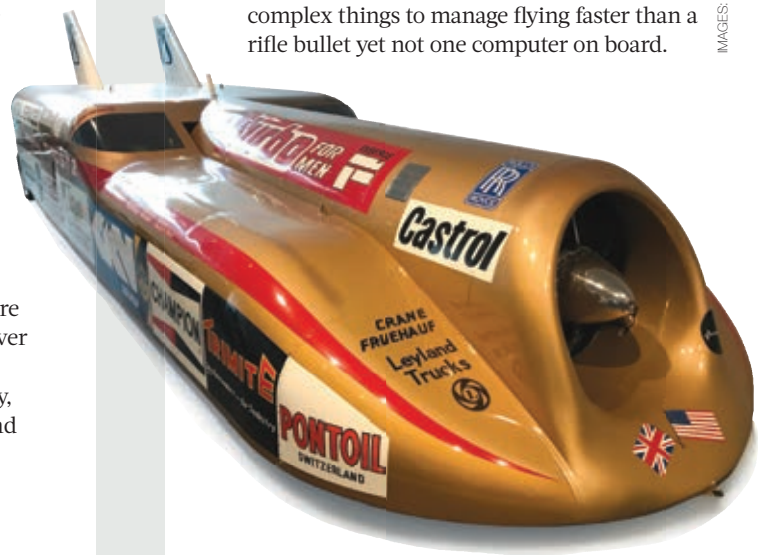
Discovery and discussion

In July five Regional Group events took place around the country giving CIEHF members a chance to visit a great venue and to discuss ideas and suggestions for CIEHF's activities that will form part of its Delivery Plan for the coming year. The venues provided much to discover and to contemplate. Ideas for the Plan were discussed and are moving ahead. The following short reports describe the events.

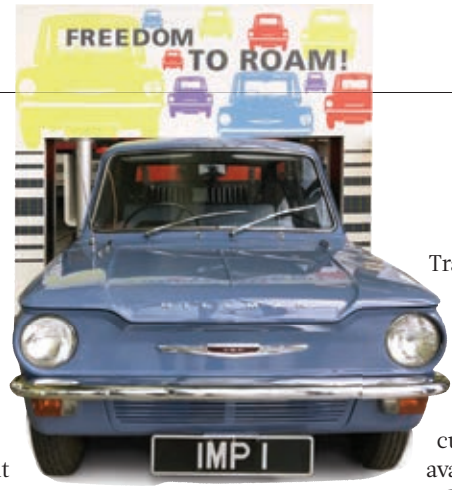
● **Midlands Regional Group** members enjoyed a private guided visit to Coventry Transport Museum, a fascinating interactive place that charts the rise of Coventry as a design and manufacturing centre for early hard-tyred bicycles through early motorcycles and significant volume car making to armoured cars, fire engines and London Cabs to high-speed, record breaking projects and autonomous vehicles. Laden with examples of how designing for people leads to great, effective, imaginative design, this was a further opportunity to top up on CPD and to meet fellow members in an inspiring environment. If you missed it the museum is routinely open to the public.

● **London & SE Regional Group** members enjoyed a private escorted introduction to the inspiring collection of Tube, bus and transport exhibits held at the Acton Depot Museum of London Transport. Far more extensive than the public museum in Covent Garden, and containing over 147,000 individual exhibits, Acton illustrates many facets of the impact transport has on people, cities, conurbations and lives. From upholstery, uniforms and buttons to original maps and schematics, waymarking and many original bus and tube carriages and locomotives, members were able to consider aspects of physical design that impact passengers and staff alike, and the working life of people who maintain the vehicles.

● **The South West & South Wales Regional Group** had the opportunity to take in the sheer depth of aerospace-related expertise illustrated at the Bristol Aerospace Museum. Aircraft, helicopter, missile and satellite developments from early aircraft coachbuilding skills through the development and use of materials such as Perspex to the use of new composites, underscore the significant ingenuity applied by people working in teams facing demanding challenges in uncertain times to construct flying machines. Concorde Alpha Foxtrot, the last to be built and the last to fly in commercial service, is now located, according to one member, right on the spot of some early human factors facilities. The teamworking between groups in two nations, the technical challenges identified and surmounted, the courage of pilots like Trubshaw and Turcat in testing complex, often untried, equipment and the sheer unremitting beauty of what was created never fails to amaze. The most stupendous thing? Three flight crew with a host of complex things to manage flying faster than a rifle bullet yet not one computer on board.



IMAGES: S BARRACLOUGH



● **The Imperial War Museum North** hosted a visit by the **North West & North Wales Regional Group**. Housing a collection of objects and stories that illustrate the quest for peace and reconciliation rather than simply the hardware of war, this impressive building in the waterside Media City area of Manchester is both sombre and uplifting in equal measure. A serving soldier (an interesting inclusion in this working museum) helped the group examine and wear items of military clothing and gave opinions to the group on the weight and design of webbing, armour and head protection, noting in his opinion how little feedback sometimes appeared to reach the specifiers of the kit from those required to use it. Surprisingly, there seems to be no sanction on military personnel using some kit of their own. Interesting too, that modern rations seem to be dehydrated to save weight, so therefore place a critical requirement on carrying, delivering or finding fresh water. The sculpture 'The Crusader' by Gerry Judah which explores the violence of conflict against a perceived righteousness of purpose will live long in the memory.

● **Glasgow epitomises design**, ingenuity and expertise, particularly in shipbuilding, innovative early underground transport and railway building. The excellent and striking Transport Museum proved to be a fitting venue for a meeting by the **Scottish Regional Group**. There was a two-hour discussion in the sunshine on the current strategy and options available to CIEHF as a body and of the ways in which the group could most effectively contribute to this in future, at the same time providing networking and learning opportunities. A project was mooted to bring together three future sessions to be attended either in person or by webinar to include a review of human factors developments in both the academic and practitioner worlds and culminating in a third session debate. Watch out for further details from the group. ●

CIEHF events at a glance

For more details of all CIEHF events, see our website at **events.ergonomics.org.uk**

Eligible for CPD Lifelong Learning

EVENT	WHEN & WHERE	DETAILS
Transport analysis and design	12 September 2018, Edinburgh	A talk about taking a systems thinking approach to transport analysis and design, with a focus on rail. Also the topic of a webinar on 26 September.
Helicopter Fleet Operations	18 September 2018, Middle Wallop	Insight into the human factors challenges associated with maintaining operational readiness for a fleet of helicopters.
Brewery Experience	19 September 2018, Bedford	An ergonomics-related guide to brewing beer with the Beds, Bucks & Herts Regional Group.
Human Factors in Health & Social Care	4 October 2018, Royal Society of Medicine, London	Workshops and launch of White Paper to better understand how human factors can support and benefit patients, staff and their organisations.
Rail Investigation Studies	17 October 2018, Farnborough	An exploration of rail-related research, particularly with regard to railway level crossing designs.
Human Factors in Aviation Safety	12-13 November 2018, Gatwick	Presentations, discussion and debate on human performance issues in military and commercial aviation.
Ergonomics & Human Factors Careers Day	27 February 2019, Birmingham	The very best of careers guidance, options and opportunities, featuring talks about work in different sectors and a lively Jobs Fair.
Ergonomics & Human Factors 2019	29 April – 1 May 2019, Stratford-upon-Avon	Celebrating our 70th anniversary with a line-up including CPD workshops, keynotes, presentations, posters, discussions, doctoral consortium, drinks, BBQ, dinner, quiz and more.

● Please note that some events details may be subject to change after publication. Please check the events website for up-to-date information.

BEDS, BUCKS & HERTS

Brewery experience

The Beds, Bucks & Herts Regional Group will be holding their next event at Marston's Eagle Brewery in Bedford. Marston's operates over 2150 pubs in the UK and is the world's largest brewer of cask ale. This evening event, on Wednesday 19 September, includes a guide through the processes of making different beers and will enable you to learn how the beer is made from start to finish. It will focus on ergonomics-related topics such as maintenance, working at height, workstation design, working postures, reach zones, work equipment design and environmental elements. The private event includes a group tour, beer tasting, a hot meal and a chance to network and chat. What more could you want? ●

Q&A

MEMBER PROFILE

Tina Worthy talks to **Vicky Gliddon**, Principal Consultant at Ergonomie Australia about her career in human factors and life down under

How did you get into ergonomics?

Studying psychology at A-Level fascinated me and led me to follow this on into university. Being active at school and participating in several sports I was interested in Loughborough University, so I went to an open day where Murray Sinclair was hosting prospective students and showing them around the Human Sciences Department. As a prospective student, I sat through Murray's introduction to ergonomics and human factors and was instantly drawn to the discipline. I signed up for the BSc in Psychology with Ergonomics and I've never looked back! Before I picked up a prospectus for Loughborough University, I'd never heard of ergonomics and human factors. I'm glad I decided to give it a go.

What was your first job?

My first job was in the human factors team at the UK Rail Safety and Standards Board (RSSB), which I did as a year in industry as part of my undergraduate degree. This was hugely beneficial to me. I worked on a great range of projects, which really pulled together the study and helped me to understand the application of what we do in industry. I got to work across a diverse range of projects including human factors assessment to reduce human error, advising on the placement of the Global System for Mobile Communications equipment in the train cab, safety culture assessment, developing materials and delivering human factors training, reviewing incident investigations, running workshops for the development of The Rule Book, usability research for a website, and user trials for CCTV displays.
The range was excellent for an undergraduate student and really gave my career a great start.
While at RSSB, I had some great experiences while learning about operations on the railway. I learnt how to perform shunting manoeuvres with rolling stock, drive a train, and most excitingly, stand up front in the cab of a running steam engine as we travelled along the North Yorkshire Moors Heritage railway.
Aside from the fun parts, this experience really set me up well to progress with my final year of study and begin my career in human factors. This placement was optional for students at the time and I think it was the most rewarding experience for me. If you get the opportunity to work in industry while studying, seriously consider it!

What's rewarding about your work now?

I enjoy team working, both with other human factors specialists and wider disciplines, integrating human factors to find solutions together. We can all learn from each other, drawing on a range of skills. Whether you're a human factors professional, or from another discipline, the best solutions are produced from a multi-disciplined approach.
Our offering is so varied; such small and simple changes can make a difference for the better. I like being part of this process, whether that's to make someone's workstation more comfortable to alleviate aches and pains, advising on design iteration to make products more usable, or working on human factors integration into complex design and infrastructure projects.
Our jobs enable real world application of theory in high-risk industries. Human factors input can make a positive difference. For example, the work we do in rail stations and on trains, can make the railway more accessible to disabled users and our design input into systems in the control room can make them more usable and reduce workload for operators. In addition, changes we've made to cab design can reduce distraction for drivers, making the railways safer. All of this can have a positive impact.

What opportunities has this discipline given you?

Consultancy life has led me to work on a huge range of interesting projects with some great people. I've also had the opportunity to work abroad on several projects.

Close-up of rail security monitors, below

Travelling for work often isn't glamourous, going little further than the transport, hotel and work site, but it's enabled me to see places I might never have considered travelling to and I've enjoyed these experiences. I began working in human factors in London back in 2008. Earlier this year I decided to take the opportunity to make a move down under and emigrated to Sydney. This was largely driven by my career choice and the opportunities available in Australia. There are many industries here where human factors is under-integrated but would be of great benefit. It's an exciting time with many opportunities for growth in human factors.

What are you working on now?

At Ergonomie, we're growing technology resources to support our projects. We've recently built our own virtual reality kit and we're already using this with mock-ups of early stage control room designs and for train cab layouts. The use of this technology allows for detailed and insightful assessment of many elements using simple visual mock-ups rather than full scale built testing environments. Importantly for our clients, this keeps the costs down, as design iterations can be made and assessed rapidly. The visual element also helps us gain buy-in from stakeholders who can be immersed in the environment and really get an insight into what it will be like very early in the design stage. This consultation is a powerful tool for influencing the design process and achieving a design that is fit for purpose.

We're also utilising eye tracking technology in various safety critical contexts, from research into signal sighting from the train cab used to influence signal sighting standards in Australia, to healthcare surgical product testing, exploring visual inspection tasks in surgical operations.

Though I work across many industries, my work at Ergonomie is heavily based in the rail sector. Currently in Australia, there are several new rail lines being built and new rolling stock being designed, providing a great opportunity for human factors integration right from the start of these large and complex infrastructure and design projects. Our input can leave a legacy for years to come; our work in rolling stock design will be incorporated into new trains not in service for another 30 years.

IMAGE: GETTY/SHUTTERSTOCK

It's an exciting time in Australia with many opportunities for growth in human factors

How do you divide your time in a typical week?

My week is quite varied, from the management of projects, people and areas of business, to delivery and supervision of technical work. My work involves planning human factors activities to meet the needs of clients, often when they want our input at short notice. As an adviser, I consider the integration of human factors at all stages of development, from concept and strategy and dynamic testing, to operation, ensuring that we apply effective methods balanced with budget, schedule and resource constraints. While this may sound heavy on the management side, I do get stuck in too. I've recently been observing rail safety workers on track at night, completing cab rides with the drivers and running workshops with frontline staff to investigate visual warnings to improve safety on track. I've also been reviewing new rolling stock against standards and human factors requirements and best practice.

What advice would you give someone considering a career in ergonomics?

Get involved! Go to events and conferences, meet people, volunteer, and gain experience where you can. I've attended some great events and conferences over the years, often with opportunities for industry visits as well. I always meet new people and get to see and hear interesting things. I first got involved with the CIEHF when I volunteered to be on the secretariat. Some of the connections I made led to job offers and others became good friends who I've stayed in touch with over the years. It's a great way to stay connected with people and keep up to date with industry developments. They're often very social events and good fun.

Vicky Gliddon is Principal Consultant at Ergonomie Australia



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FROM THE PRESIDENT

A global mission

Neil Mansfield
CIEHF President

@profnjmansfield

Our Chartered Institute is one of many organisations around the world that have a mission to promote ergonomics and human factors. Most of these organisations are affiliated to the International Ergonomics Association (IEA), and that gives us a corporate voice with which to communicate with bodies such as the World Health Organization (WHO). Whilst individual membership of the IEA is not available, members of CIEHF can still participate in their activities - through their events, for example.

IEA's most well-known event is the triennial Congress that was held this summer in Florence. About 50 members from the UK attended the exhausting, but highly successful Congress. In total 1576 participants experienced a programme of 1689 papers with a particularly strong focus on the healthcare sector. Dan Jenkins gave an excellent keynote presentation on evidence-based design featuring the design of a radiotherapy table, which was very well received. The Institute was able to support attendance of Saydia Razak and Kubra Okuyucu, recipients of the CIEHF's John Wilson Student Travel Bursary, who did us proud. Also of note was Roger Haslam's well-deserved Distinguished Service Award from the IEA (see page 32 for more details).

The next IEA Congress in three years' time will be in Vancouver (see iea2021.org). Between now and then CIEHF will have many UK events which I hope you will attend. Regional Groups maintain an excellent programme, and the call for papers is still open for our annual Ergonomics & Human Factors Conference to be held in Stratford-upon-Avon in 2019, our 70th year.

I look forward to seeing you there.

We have a corporate voice through the IEA

FROM THE EDITOR

Research and practice

As always, healthcare features prominently in this magazine, in this case both in research and practice. We marked the launch of our White Paper on 'Human Factors for Health and Social Care' with a well-attended event and you can read a report in this issue. Our 'Day in the Life' series features Lauren Morgan's human factors projects in patient safety, Kubra Okuyucu gives us an insight into the world of midwives and how their work affects their musculoskeletal health, and Saydia Razak explains her research into how high-hazard emergencies are dealt with by frontline hospital staff.

With today's technology, Tim Phillips looks at whether functional allocation such as that laid out in Fitts' List is still relevant, and how it relates to healthcare. An insightful piece from Steve Shorrock and Sarah Sharples sets out examples where they have contributed to key government reports on patient safety and driver automation, and they share their advice with those interested in becoming involved in a similar way.

Our cover article outlines Vicki Wall's fascinating career in both civil and military aviation. As an experienced human factors engineer, she's worked in all areas from civil air traffic control to offshore operations to cockpit design on military helicopters. It's a great perspective on human factors work in this sector.

Safe passing distances for cyclists is discussed by Guy Walker, Bob Webb explores training needs to counteract skills and knowledge fade in different workforces, and we take a brief look at the annual campaign to highlight the many design issues for left-handers.

Finally, we start to reveal our plans for celebrating our 70th anniversary next year and how you can become involved.

Tina Worthy
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@ciehf

A DAY IN THE LIFE OF A...

PATIENT SAFETY SPECIALIST

Lauren Morgan from the University of Oxford

Charlie Massey, Chief Executive of the General Medical Council (GMC) writing for the British Medical Association, recently commented that one of the most profound lessons he's learned is the need to consider human factors in the GMC's work. He wants the GMC to use human factors experts as witnesses in its investigation processes where it had previously used only doctors. I'm proud to have played a role in this recognition. Having led presentations to the GMC on human factors, I'm currently designing the programme of work with the GMC to integrate human factors into their work processes. It's cases like this that highlight how the recognition of the importance of human factors in healthcare is growing.

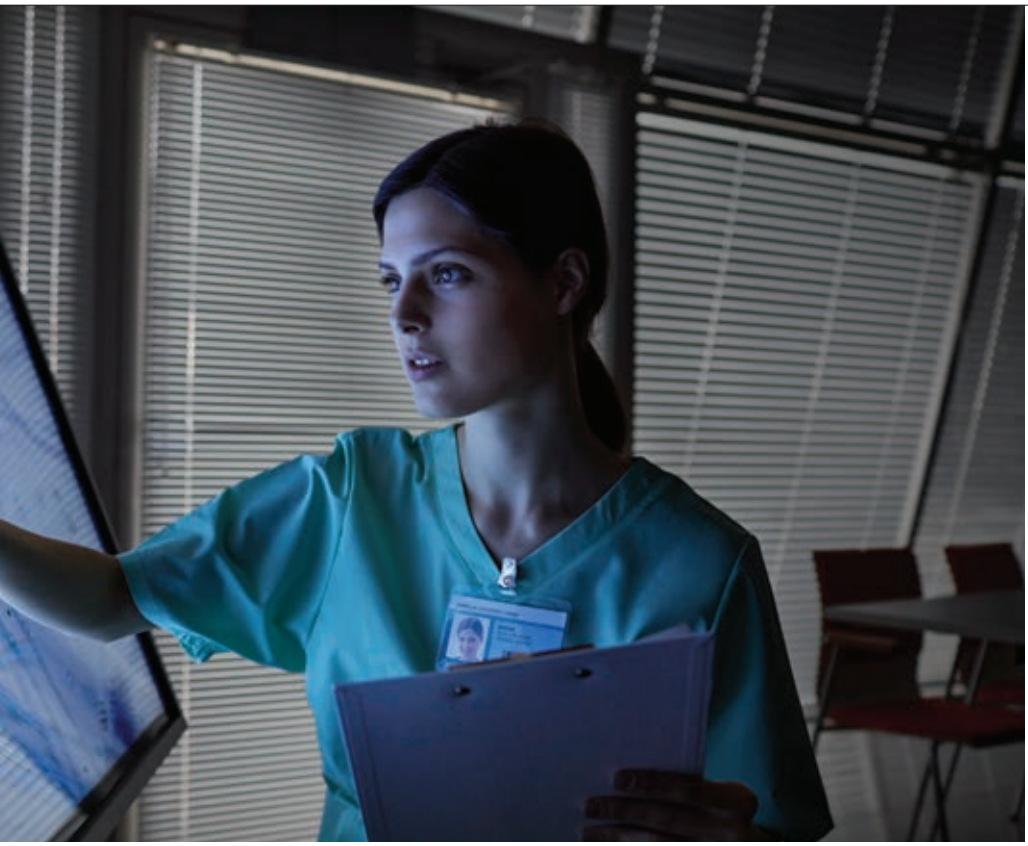
I work for the University of Oxford, in the Nuffield Department of Surgical Sciences. I'm part of a human factors team split between our department and that of Clinical Neurosciences, and we currently have five ergonomists and a couple of clinicians based within the group. The hospital Trust we sit alongside comprises four hospitals and is responsible for over one million patient contacts annually.

I started my academic life as an engineer but transferred to ergonomics because I wanted to be "a bit more applied". I completed my PhD with Neil Mansfield, our current President, and after seeing many other supervisors over the years have now recognised how lucky I was in that regard! I took the opportunity to work in healthcare after witnessing my father spend eight weeks on his back after a bad fall from height in his steel fabrication business and thought that I could make an impact on the delays and mistakes in care I witnessed during his stay.

When I first got a role at the University of Oxford I couldn't wait to be designing the change the NHS so desperately needs from my office looking out across the dreaming spires of Oxford. The location of the John Radcliffe Hospital perhaps lacks the atmosphere of Oxford college life but being based in a live clinical environment adds so much colour to my work, I can't quite imagine being anywhere else. My role is split across multiple pieces of work, the most familiar of those is as a lecturer teaching clinical staff as part of our Postgraduate study programmes in Patient Safety.

Most research work is essentially project based, and it is no different in healthcare. One of the projects on which I'm leading the design and human factors is to develop a way of flagging those hospital patients most at risk of acute deterioration to the clinical teams best placed to manage that deterioration. Once a week in the morning we have a stand up 30 minute meeting where the whole team, including engineers, developers, project managers, clinicians and human factors experts, report their work on the project. As part of the work, we're aiming to better understand the clinical decision-making in the current process, so we've been running cognitive task analysis interviews to underpin our design thinking. Currently we're in the design phase, so we're running user testing of our interfaces in situ, to really understand how they might work in the clinical environment. This is proving challenging as the relevant

Being based in a live clinical environment adds so much colour to my work



Nurse using touch screen computer monitor, viewing microscope slide

clinical data is very variable and much of the information the clinicians actually want is not held electronically (for example, information about a patient's functional status before they came to hospital) so we're having fun investigating surrogate ways of communicating the important messages. We're also tasked with displaying a score that will be 'machine learning' in the background, so exposing how the score is calculated and the relative contributions of the score variables requires some additional thought.

Often, I'll pop up to our other research office to see how the team are doing on the various projects, raid the biscuit tin and have a cuppa. This gives me time to chat through upcoming training courses that we provide through the Patient Safety Academy. We may discuss faculty, location, or tweaking the course for the attendee group, for example swapping out a clinical scenario to one that's more relevant for the attendees. Out of these training courses often come projects where the clinical staff have sought our support in achieving a change in their workplace. Sometimes I'll support those myself, sometimes it'll be one of the team, and I'll help where possible to unpick some of the challenges in doing so.

There is massive variety in my role and one of the main challenges is having the resources to do everything we'd like to, to support the health service. I would estimate that I get at least one project request a week to apply human factors to a problem in my home or a neighbouring Trust. Mostly I try and support remotely but occasionally these projects develop into something for which we can secure funding and then we can properly apply human factors to the project.

One of my main challenges is carving out the time to do the academic work. I've gained many hours of practical clinical experience through doing this job and have worked in most of the clinical areas you can imagine. My time for writing is often squeezed (you can guess how close to the deadline this article was written!). I also have a busy home life with two small children and trying to balance all of this is a challenge I know too well. I've noticed though that there has started to be a greater recognition of this challenge, resulting in a few initiatives (including Athena Swan, a Charter established in 2005 to encourage and recognise commitment to advancing the careers of women in science to support women in academia), and I'm hoping these will help me and others in similar situations to manage things better.

I see the challenges of human factors integration in healthcare as twofold. Firstly, that human factors to many in healthcare still means teamwork training or crew resource management. There are many excellent simulation facilities (including our own simulation centre OxStar here in Oxford that provide training and development for non-technical skills), but as we know there's a whole world of impact that human factors can make beyond this. My own work in focusing on designing and delivering an IT infrastructure that's fit for purpose and improves rather than impedes patient safety, and working on improving the investigation methodologies in use in healthcare, are only a couple of many examples where we can have impact beyond teamwork and communication.

The second challenge is that once that realisation of the benefit of human factors becomes apparent, the projects come forward with very little resource behind them. I've completed several pro-bono projects for the hospital, and I truly believe the staff see great benefit when human factors is involved, particularly in the design of clinical IT systems, but resourcing that human factors input at the start is crucial.

My main observation of the human factors in healthcare community is that there is a genuine drive to work together to make healthcare better. The network of human factors professionals in healthcare is growing in size and strength, and one of which I'm proud to be a part. Although this job is busy, and sometimes frustrating trying to explain, integrate and demonstrate the benefit of human factors in healthcare, doing it alongside the clinicians working here is such a privilege, and one that I'd recommend to anyone.

Lauren Morgan is a lecturer in Human Factors and Patient Safety at the University of Oxford and Director of their Postgraduate Certificate in Patient Safety.

Further reading

See www.patientsafetyacademy.co.uk
https://www.conted.ox.ac.uk/about/postgraduate-certificate-in-patient-safety
www.drlaurenmorgan.co.uk

IMAGES: GETTY/ISTOCK

Ergonomics & Human Factors
Careers Day

27 February 2019 • Birmingham

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What can I do at the Careers Day?

- Visit the **Jobs Fair** with stands from organisations looking for new and enthusiastic talent.
- Listen to **presentations** from those already working in ergonomics and human factors about what they do and how they got there.
- **Network** with other professionals, new graduates and students from across the UK.
- **Talk to the team** from the CIEHF who will answer your questions about career options, CPD and how to get from where you are now to where you want to be.

Who should attend?

- Undergraduates, new graduates and postgraduate students.
- Those whose jobs require them to upskill and take on responsibility for human factors work.
- Those who are already established in a field such as engineering, design or psychology but who are looking to change career.
- Those who have already taken their first steps in their ergonomics and human factors career but are looking to find out about work in other sectors.
- Careers advisers who want to guide people towards an exciting and rewarding career.

events.ergonomics.org.uk

Just £30 including a copy of the CIEHF's Careers Guide

Chartered Institute of Ergonomics & Human Factors

70 YEARS OF ERGONOMICS 1949-2019

Photo from left to right: Dr Alex Lang, Dr Paul Bowie, Dr Ian Randle, Dr Brian Edwards & Professor Sue Hignett

Healthcare White Paper launches

Download a free copy of the White Paper here: http://bit.ly/HSCWhitePaper

Professionals from across the healthcare system gathered this month to witness the launch of the CIEHF's White Paper on 'Human Factors for Health and Social Care'. The paper has been published as a contribution to the national improvement agendas on patient safety and high quality, compassionate care. The purpose of the White Paper is to provide an authoritative guide to aid understanding of how human factors can and should be used, and the competence and experience needed to manage effort, solve problems and make decisions.

This White Paper is aimed at Health and Social Care service managers, leads, commissioners, regulators and human factors champions in care settings, as well as anyone interested in ensuring health and social care is the best it can be. It was prepared in consultation with CIEHF's Healthcare Sector Group, CIEHF's Pharmaceutical Special Interest Group, NHS Improvement, NHS Education for Scotland, Health Education England, the newly-formed Healthcare Safety Investigation Branch, together with many Royal Colleges, NHS Foundation Trusts and others.

The paper sets out ways in which human factors can be used to positively impact the health and social care sector, as well as strategies for integrating human factors effectively. It also outlines CIEHF's vision for increasing human factors competence and capacity.

The launch, on the evening of 4th October, helped professionals from many organisations including Bupa, the General Medical Council, the British Association of Urological Surgeons, consultancies and universities, better understand how human factors expertise can benefit patients, staff and organisations.

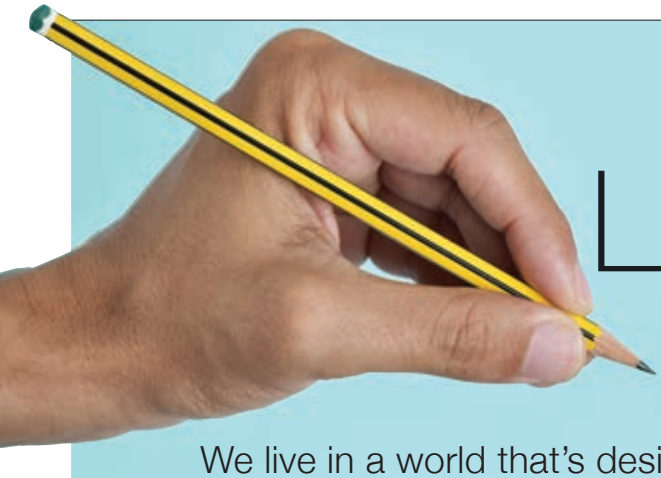
Attendees were treated to taster workshops designed to raise awareness and understanding about the discipline and the practical application of human factors, including case studies of how human factors has been used in a range of different health and social care settings.

A lively networking session was followed by the evening's talks, introduced by Dr Ian Randle, CIEHF President 2016/17, who sponsored the White Paper initiative.

Two presentations were given by the lead authors of the White Paper, Sue Hignett, Professor of Healthcare Ergonomics and Patient Safety at Loughborough Design School and Dr Alex Lang, Human Factors Research Fellow at the University of Nottingham, who outlined the CIEHF's vision for human factors in health and social care. They discussed the content of the paper and its importance as a strategic landmark in the push for increased knowledge and competence within the health and social care sector.

Dr Brian Edwards gave a talk outlining the multi-faceted work of CIEHF's unique Pharmaceutical Special Interest Group and its growing influence in a number of important areas such as manufacturing, technology and device design.

Finally, the evening's keynote was given by Dr Paul Bowie of NHS Scotland who discussed the strategies and initiatives being put in place to help ensure human factors becomes embedded in healthcare practice in Scotland. A drinks reception rounded off the event.



Living in a right-handed world

We live in a world that's designed for right-handers, even though a tenth of the global population is left-handed. That's around 750 million people all struggling every time they want to use something as simple as a pair of scissors. A campaign to highlight the issues faced by left-handers has prompted much response

"When you design for everyone, you design for no-one" – a bold statement from the CIEHF's communications champion, Dr Ella-Mae Hubbard, as the CIEHF kicked off its social media campaign ahead of Left-Handers Day this August. Created to highlight the different talents and needs of left-handers, the campaign generated a plethora of contributions across Twitter and Facebook from the human factors community, helping to raise awareness of an issue affecting millions worldwide.

Three left-handed human factors professionals discuss their personal experiences of right-handed design.

Clumsy people

In **Frances Brown's** home town in Ireland, a left-handed person is known as a 'ciotóg', meaning 'clumsy person'. She said that growing up, she was expected to fit in to the right-handed world, but on the positive side, this has given her early insight into the extent to which design choices become 'hidden'. As a user researcher, her job is to get product owners, developers and designers to think more widely, to realise that while they might find things easy and intuitive, many other people might not. "It's a surprisingly difficult task" she said. "Often, it's only when they actually see people struggling with their design that they realise how many factors feed in to a person's ability to engage with technology and how many of those factors they hadn't even considered."

Frances, CEO of Fowlam Ltd, added: "I never assume another person has the same abilities as me and I realise how ingenious people can be in coping with bad design. The fact that people can use a product doesn't mean they can use it comfortably or easily. I get great pleasure from coming up with often very simple solutions that suddenly clarify the situation for designers and make a product more pleasing and usable. These are the solutions that convince the 'clumsy person' and the 'technophobe' that perhaps they're not the problem after all."

Everyday design

Vicky Banks, a Research Fellow in Aviation Human Factors at the University of Southampton, said that as a left hander there are a host of everyday products that lack basic human factors considerations, including knives, scissors, can openers, tape measures, mugs, shop pens on chains and signature pads. "Left hander-friendly products do exist" she said, "but as a consumer you really have to look hard for them. Accessibility and availability of such products remain an issue. Further, most are available at an inflated price which acts as a barrier to sale. This means that many of us have learned to adapt to the right-handed world with varying success."

"My experience of working in human factors has shown that we need to do more to ensure that all users of our products and services are considered. Most research tends to focus on balancing factors such as age and gender, but to get a true understanding of our users, we should consider handedness, especially when exploring product usability."

People can be ingenious in coping with bad design

Safety first

As products have more features designed for right-handers, greater problems arise for left-handers in relation to safety according to **James Bucknall**, a Director at Control 6 Ltd. He highlights that initially, tools tended to be ambidextrous and could be used equally comfortably, or even uncomfortably, by both left and right-handers. Yet increasingly tools are becoming awkward, uncomfortable and, in some cases, extremely dangerous for left-hand use. He cites power tools used by DIYers as a concern. "Easy availability of power tools, together with a lack of training is an issue, and one that's compounded by design for right-handed use," he said. "There's a market and a need for left-handed products by design. Driven less by economics and more by morality, safer products should be designed for all users, alleviating many of the issues currently found in the workplace and at home. With increasing knowledge, the now standard use of computer aided design and the advent of 3D printing, the cost of bringing a left-handed product to market is considerably reduced."

CHIEF EXECUTIVE'S PERSPECTIVE

A tale of two services

I had two very different personal experiences recently in interacting with two very different service providers, the first of which was private, the second public. One was uplifting, the other salutary. One was a paid service, the other free at the point of use. Both brought home to me how human factors has the credentials and capability to lift the ordinary to the level of the extraordinary and send someone away with a spring in their step. Although, by coincidence their names are adjacent to each other in the alphabet, these two services could not have been more different. Both were delivered in bright, well-designed buildings but that, believe me, was where the similarity ended.

I ordered the first service without talking to a person but by using a large, legible touchscreen, about a metre by half a metre, very well designed and at a great height for a variety of people. It needed just the right amount of touch and interaction to take me through a very logical ordering sequence. At the end of my order – and it felt very personal - I paid in full by a fast, contactless method and then input a 3-digit number from a location identifier hanging in front of me. I took the identifier and sat down. Within 5 minutes, and sooner than I had genuinely expected, my service was delivered with a friendly smile to exactly where I sat. The product was excellent, exceeding my expectations, and was exactly as I had ordered. I left thinking how good the experience had been and that I would gladly return for more, recommending this to others. Altogether, excellent.

The second service I applied for would actually result in a transfer of service from one provider to another. I applied online about ten weeks before, as it turned out and I didn't know at the time, I really needed it to be set up and ready for use. Nothing appeared to happen following my application until I eventually acted (indeed I now needed to). I entered a bright, seemingly well-designed building that was remarkably poorly waymarked and I was informed face-to-face by a person in a rather perfunctory way that my application for service must have been lost and needed to be resubmitted. This I did, in person and in ink, by hand, on paper, there and then. By good fortune through a last-minute cancellation, I was immediately able to see a very professional service representative who recommended, via a necessary temporary ID to ensure I was matched to the service I was receiving, that an immediate referral be made. This referral depended on my new handwritten service application, the professional's handwritten notes and my temporary ID all being matched up by someone, presumably using a written down procedure to avoid things going wrong.

Nothing happened for a while, and there was no indication that anything was happening. On going back to the same building and enquiring face-to-face, I was told that the professional's notes had been returned to my previous service provider, someone that was supposed to have been replaced by my application to this new provider, and to which I now had no access. So once again, I saw the same very professional service representative that I'd seen before who went over the same ground and came to the same conclusion, albeit with a month now lost. They printed out and handed me two pages of information and advice that I had to use to book my own appointment online from home. Diligently following the advice, I discovered that the first available appointment was not for another 100 days. Was this the reality of 'immediate referral'?

One of these service providers is a national fast food chain beginning with 'M' and the other is a national healthcare provider with a three-letter, well-recognised abbreviation, beginning with 'N'. Although the services that each deliver are of course palpably different, the number of interactions with individual customers over the course of a year is probably rather similar. The way in which one provider, irrespective of its output, puts individuals at the very centre of its thinking is admirable, simple, clever, progressive and is about learning and being better. The adoption of human factors approaches has patently improved one of these providers; we know that human factors could, should and must help visibly improve the other. A start had been made, and I hope our newly-published Health and Social Care White Paper represents tangible encouragement to push forward.

One provider puts individuals at the very centre of its thinking

Steve Barraclough
Chief Executive of the CIEHF
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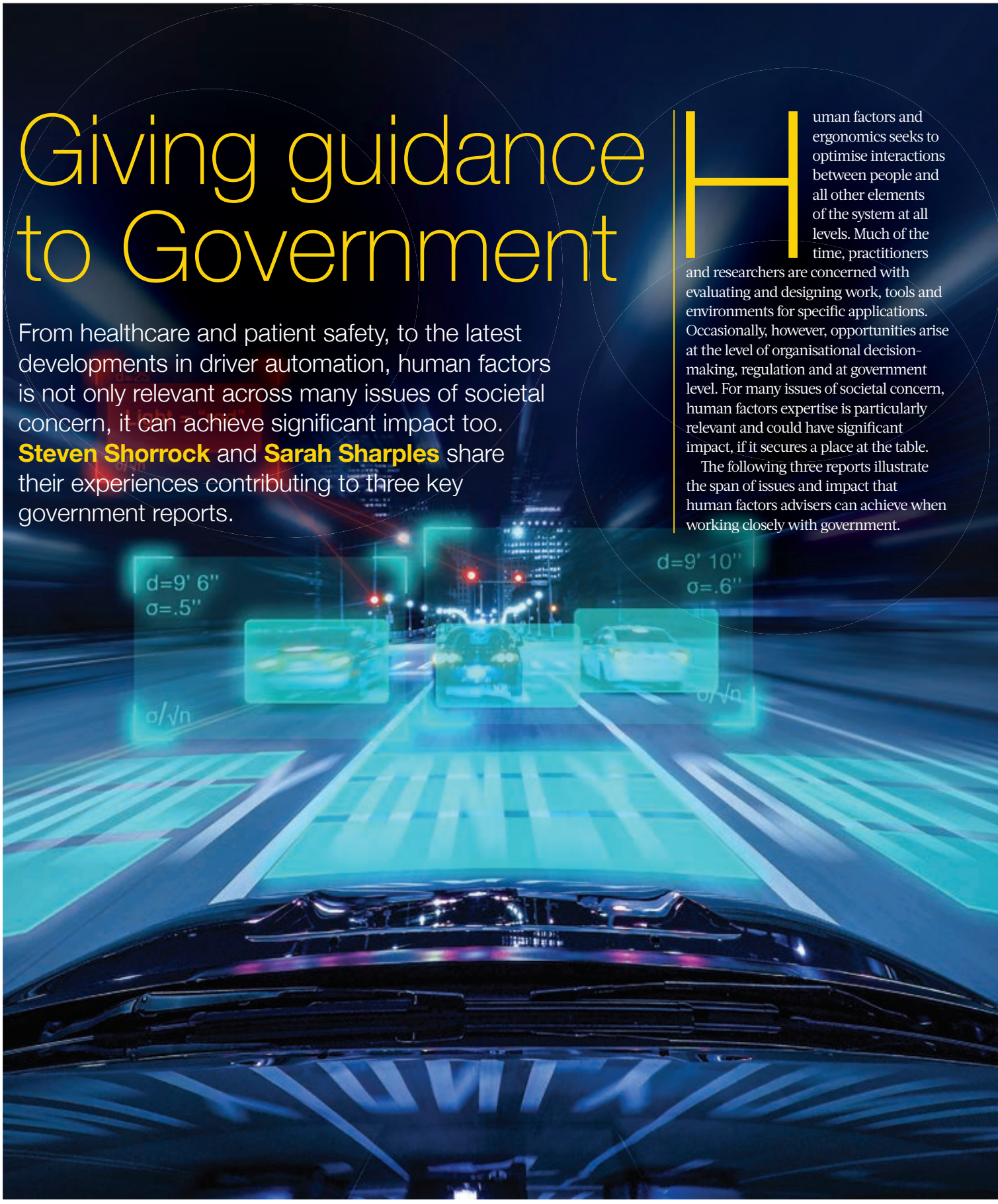
IMAGE: SHUTTERSTOCK

Giving guidance to Government

From healthcare and patient safety, to the latest developments in driver automation, human factors is not only relevant across many issues of societal concern, it can achieve significant impact too. **Steven Shorrock** and **Sarah Sharples** share their experiences contributing to three key government reports.

Human factors and ergonomics seeks to optimise interactions between people and all other elements of the system at all levels. Much of the time, practitioners and researchers are concerned with evaluating and designing work, tools and environments for specific applications. Occasionally, however, opportunities arise at the level of organisational decision-making, regulation and at government level. For many issues of societal concern, human factors expertise is particularly relevant and could have significant impact, if it secures a place at the table.

The following three reports illustrate the span of issues and impact that human factors advisers can achieve when working closely with government.



Learning in the NHS

Steven Shorrock gave oral evidence, with Scott Morrish, father of the late Sam Morrish and Member of the Healthcare Safety Investigation Branch (HSIB) Expert Advisory Group, on Tuesday 8 November 2016 in a meeting Chaired by Bernard Jenkin MP in the Houses of Parliament.

This report focused on the issues arising from the Parliamentary and Health Service Ombudsman's (PHSO) July 2016 report, 'Learning from Mistakes: An investigation report by the Parliamentary and Health Service Ombudsman (PHSO) into how the NHS in England failed to properly investigate the death of a three-year old child'.

'Learning from Mistakes' was the PHSO's second report on the tragic death of a three-year old child, Sam Morrish, on 23 December 2010. It set out four key findings:

1. A defensive culture in the NHS.
2. A lack of competence and sufficient independence in the conduct of NHS investigations into potentially avoidable harm and death.
3. Poor coordination and cooperation between NHS organisations involved in investigations, and failure to collectively identify and act on lessons.
4. Insufficient involvement of families and staff in NHS investigations.

The report made conclusions and recommendations regarding:

- The Investigative Landscape in the NHS in England.
- HSIB and the learning culture.
- Learning and accountability: implementation of the 'safe space'.
- System-wide 'just culture'.
- Improving local competence.
- Measuring improvement.

In response to discussion surrounding a 'just culture' taskforce, Steven said that from his experience in aviation, there must be consensus on the need for a just and fair culture that is about learning as a whole. He said that if you don't have that consensus from a range of stakeholders, you'll always have something in your system that is pushing against it. "An inclusive taskforce where people are trying to understand each other's worlds is really the only way to go about it," he said. "We have certainly learned that that is the only way to get people to understand the need for a just culture, and also to understand each other's worlds, that the world of the judiciary is very different to the world of practitioners, and both of those worlds do need to co-exist," he added.

Be comfortable with yourself as an expert

Responding to Scott Morrish's comments around blame culture, Steven said he felt there that healthcare needed to start looking more at similarities between the ways that things work in different parts of the system. "Fundamentally, most adverse events in healthcare do have at their heart a certain level of pressure, which is one of the system vulnerabilities," he said.

"Understanding that the system as imagined and system as found are two different things, is vital," he said. "The system that we imagine is a very different one to the system that really exists, where resources are often inadequate, the constraints affect the work in a way that is counterproductive, and pressure makes everyone's job, especially practitioners, much more difficult." Steven went on to say that healthcare managers must focus on the system as they find it; the work as it's actually done, and not the one that they imagine. "That means we need to involve an awful lot of people to understand how the system really works if we want to understand and improve it."

Picture right: Driverless car evaluating upcoming traffic,and below: a pile of reports

Autonomous vehicles

Oral evidence was provided by Professor Sarah Sharples on Tuesday 22 November 2017 in Committee Room 4A at the Palace of Westminster.

The House of Lords Science and Technology Committee heard evidence from the Department for Transport, the Department for Business, Energy and Industrial Strategy as well as leading academics. The Committee explored with Government Ministers how driverless vehicles fit into wider transport strategy and policy and what the Government is doing to ensure knowledge gained in their development benefits all sectors. The Committee also examined with the academics the socio-economic aspects of the deployment of self-driving cars such as how much is really understood about human interaction with the technology.

The four main findings of the report into connected and autonomous vehicles (CAV) were:

- The Government is too focused on highly-automated private road vehicles ('driverless cars'), when the early benefits are likely to appear in other sectors, such as maritime and agriculture.
- The development of CAV across different sectors needs coordination and the Government, working with key stakeholders, must get a grip on this chiefly by establishing a Robotics and Autonomous Systems (RAS) Leadership Council as soon as possible to play a key role in developing a strategy for CAV.
- There is a clear need for further Government-commissioned social and economic research to weigh the potential human and financial implications of CAV.
- This is a fast-moving area of technology and the Government has much to do, alongside industry and other partners, to position the UK so that it can take full advantage of the opportunities that CAV offer in different sectors.

IMAGES: GETTY/ISTOCK

Asked for her view on full-scale trials and live testing, Sarah recommended a mixed-methods approach. Referencing early data from a Transport Systems Catapult demonstration, she said public attitude towards the vehicles was very positive. "It's only when the public see those vehicles deployed in a real situation that we can start to understand what people might think when they see these new technologies implemented in the context they are so familiar with," she said.

"Humans are fallible, but humans are also brilliant," said Sarah in response to the notion that people could be the biggest barrier to autonomous vehicle success. "We know that humans are great at adapting to new situations and changing the way they work with new technologies, but we need to be aware of their capabilities and limitations when we design those technologies."

Commenting on the potential loss of skills and the responsibility of the driver, Sarah highlighted the control task of the vehicle and the need to maintain both the skills and understanding, and that people gain an appropriate level of competence through a driving test. "Even with fully automated vehicles we need to build in contingency for when the driver will need to take control," she said.

She went on to suggest that within the conventional driving test, an understanding of the capabilities of those different types of vehicles could be introduced.

Gross negligence manslaughter

Oral evidence was provided by Steven Shorrock at De Vere Grand Connaught Rooms, London, on 6 April 2018.

The Williams Review was a rapid policy review into gross negligence manslaughter in healthcare and was chaired by Professor Sir Norman Williams. The review was set up to make recommendations to support a more just and learning culture in the healthcare system. It covered:

- The process for investigating gross negligence manslaughter.
- Reflective practice of healthcare professionals.
- The regulation of healthcare professionals.

Healthcare professionals discussing patient care

The review heard evidence from a variety of organisations and individuals. It was set up to look at the wider patient safety impact of concerns among healthcare professionals that simple errors could result in prosecution for gross negligence manslaughter, even if they happen in the context of broader organisation and system failings.

Providing Evidence

Based on Steven and Sarah's experience of providing evidence, they offer nine pieces of advice:

1. Ask for a list of topics or likely questions. You can then consider the kinds of things that you want to discuss. Prepare, but don't rehearse answers to the questions.
2. Get advice from people who have done it before. There are likely to be CIEHF members who have participated in similar kinds of committees or reviews.
3. Maintain good contact with the clerks. They'll help you to understand what is expected and when.
4. Find out whether the evidence will be recorded, and how. Evidence may be televised, or transcribed, or not. If the evidence is not recorded, then you may wish to take notes on the themes of your answers during and after the session, in case the notes don't reflect your answers.
5. Be comfortable with yourself as an expert. You are expected to base your views on the state of the art, but your opinions are also respected.
6. Don't campaign. You need to be objective and evidence-based where possible, and not political. Your answers may be professional opinion or fact, but this must be clearly distinguished.
7. Follow up with resources and information. There will be things that you won't mention during oral evidence, or that were not recorded, that you think are pertinent and it's fine to send these to the clerk after you have given evidence.
8. Check what extra input will be required and when. You may be sent information to fact check, with very little notice, maybe 24 hours.
9. Be mindful that your evidence may be used selectively. On publication, you may find that your evidence is used very partially or not in a way that you expect. This may relate to the terms of reference of the review or committee. ●

Steven Shorrock is a Chartered Psychologist and Chartered Ergonomist & Human Factors Specialist with experience in various safety-critical industries, including aviation, rail, chemical manufacturing and healthcare.

A former CIEHF President, **Sarah Sharples** is Faculty Pro-Vice-Chancellor for Equality, Diversity and Inclusion, and Professor of Human Factors at the Faculty of Engineering at the University of Nottingham. She is also Non-Executive Director of the Transport Systems Catapult.

Further reading

Learning from Mistakes: Oral evidence was given, recorded and broadcast at https://goo.gl/XJyXNB. The evidence transcription is at https://bit.ly/2NnltlY. The report is available at https://bit.ly/2wJ1DbD

Autonomous vehicles: The evidence transcription is at https://bit.ly/2wZKTOi. Supplementary written evidence is at https://bit.ly/2MfuBWv. The report is available at https://bit.ly/2NBbon2

The Williams Review report is available at https://bit.ly/2sN7ADw

Texting threatens pedestrian safety

The University of Iowa's human factors experts have been considering ways to harness technology to prevent fatalities among pedestrians who are struck by vehicles while texting. In their latest study, 'Harnessing Vehicle-to-Pedestrian (V2P) Communication Technology: Sending Traffic Warnings to Texting Pedestrians', they simulated a busy roadway to determine whether sending loud warning sounds to mobile phones when pedestrians attempted to cross an unsafe gap while texting would result in safer crossing behaviour.

The researchers concluded that the warnings were somewhat effective in distracting people from texting. The group of texting pedestrians who received the warnings were more cautious overall relative to their counterparts who did not receive the warnings.

"Real-time information about when roads are safe or dangerous to cross could aid pedestrians in making good crossing decisions," the authors note. "However, there are significant challenges in the development of sensor technology to reliably and accurately measure traffic conditions and movement initiation in time to prevent collisions."

New sensing and communications technologies offer tremendous possibilities for improving road safety for pedestrians and bicyclists. However, additional research is needed to determine how and when roadway information can most effectively be given to vulnerable road users. For more, see **http://bit.ly/2K21ViC**

Care of young people under scrutiny

The Healthcare Safety Investigation Branch (HSIB) has published its second full investigation report to support a new learning culture around mistakes in the NHS. The investigation reviewed the transition of care from child and adolescent to adult mental health services to understand how variations in the transition impacts the safe and effective care of young people. Several recommendations have now been made to national NHS organisations to make the transition smoother and safer for young people.

HSIB's Chief Investigator, Keith Conradi, whose experience includes six years as the chief investigator of the Air Accident Investigation Branch, said: "Young people's mental health has received considerable national interest in recent years, with particular attention paid to how young people are supported in transition to adult services. Experts have documented the elements of a safe and effective transition for many years however, many young people still do not have a positive experience and, as a result, disengage from services. Find out more at **www.hsib.org.uk**

IMAGES: GETTY/ALAMY/SHUTTERSTOCK

Falling asleep at the wheel

Did you know that a shocking 37% of people admit to falling asleep behind the wheel? And according to the AAA Foundation for Traffic Safety, the percentage of crashes involving drowsiness is nearly eight times higher than estimates might indicate.

To help spread awareness about the dangerous effects that fatigue can have on drivers, Maureen Short, a human factors expert for Chevrolet, is travelling to a few US cities this summer conducting drowsy driving simulations. During the simulation, participants don a 23-pound suit and goggles that replicate how your body feels when you are driving in a drowsy state, including delayed blinking patterns, sluggishness and extreme tiredness.

Talking to NBC News BETTER, Maureen said: "We want people to understand how dangerous it is to drive drowsy, especially during the summer when kids are out of school and people are more likely to take long road trips. Drowsy driving causes you to have a delayed reaction, and it's critical when you're driving to be able to respond if you have an unexpected event. It also means your decision-making is impaired.

Fatalities in the waste industry

A new report published by the Health & Safety Executive (HSE) investigates the common human factors underlying worker fatalities in the waste and recycling industry. While accounting for an estimated 0.4% of employees in UK, the waste and recycling industry has a fatal injury rate 15 times greater than the average across all other industries.

To improve performance, the report prioritises two areas for further discussion between HSE and the industry: selection, design, use and maintenance of equipment; and safety management systems, with awareness raising and the sharing of good practice being part of the solution. Download the report at **http://bit.ly/RR1128**

Systems must be designed so that machines supplement human capability

A magnetic resonance imaging machine (MRI)

Finding the best fit

Comparing the skills and capacities of people and machines, Fitts' List, published in 1951, is a theoretical framework that remains a widely-used tool even now, due to its simplicity and broad applicability. But considering today's technological advances, **Tim Phillips** questions its relevance when designing for a new paradigm of healthcare

Deciding which functions of a system should be allocated to humans and which to machines is a core activity within human factors. In simple products and systems, function allocation is a relatively logical and intuitive exercise. However, as complexity increases, consideration of how roles are distributed between people and machines becomes more poignant.

Paul Fitts' research was intended as an approach to function allocation problems without being overly-specific or prescriptive. He argued that in some instances, humans appeared to surpass machines, primarily in their ability to reason and exercise judgement. However, in other instances, machines appeared to surpass humans, particularly with regard to deductive reasoning and their quick response to control signals.

Humans appear to surpass machines in:	Machines appear to surpass humans in:
Detecting a small amount of visual or acoustic energy.	Responding quickly to control signals.
Perceiving patterns in light or sound.	Applying great force smoothly and precisely.
Improvisation and use of flexible procedures.	Handling highly complex operations (doing several things at once).
Storing very large amounts of information for long periods and recalling relevant facts at the appropriate time.	Performing repetitive, routine tasks.
Inductive reasoning.	Storing information briefly and then erasing it completely.
Exercising judgement.	Deductive reasoning, including computational abilities.

Since Fitts' research was written up, computers have made gains, partly due to the monumental increase in processing capability, but also due to novel machine learning techniques, which allow them to encroach on the skills where humans were once dominant. Practically, machine learning and Artificial Intelligence (AI) will have a profound impact on the delivery of healthcare within the next decade, with the immediate need being decision support systems.

How does this apply to healthcare?

Machines are allowing us to do more than ever before within healthcare, often faster and with much higher accuracy than their human counterparts. In comparison to computers, human sight is now relatively poor for identifying fine details. Conventionally, detection and diagnosis of malignant tumours is a time-consuming process. In some instances pathologists must review multiple slides of tissue, and in computer terms this constitutes billions of pixels of data. Success is dependent upon clinician experience, with agreement rates as low as 48% between different pathologists. Google is investigating how these issues can be addressed in a manner which compliments the pathology workflow. Their optimised system has been shown to exceed the performance of humans in a fraction of the time, however it's only optimised for certain tumour types so lacks the breadth of knowledge of an experienced clinician who might identify a wider range of abnormalities.

Similarly, carefully marking features and tissues on an MRI scan is a critical process before radiotherapy to ensure only cancerous tumours are irradiated but requires several hours of a consultant's time to perform. Microsoft's 'InnerEye' system builds a 3D model from the patient's scan and accurately identifies key regions in minutes, meaning treatment can be performed using same-day scans for greatest accuracy.

As Fitts identified, humans excel at identifying patterns in data but making tough call diagnoses can require careful correlation of many disparate signals – often beyond human capacity. Sepsis is the 11th leading cause of death globally but doctors rarely concur on a diagnosis as signs appear subtle and confusing before becoming too severe to treat. Machine learning enables computers to consider every physiological signal in the context of every other signal, to retrospectively learn the parameters which make up a correct diagnosis. Researchers from Johns Hopkins developed a system to accurately identify sepsis from test results and qualitative data within electronic health records.

Fitts also asserted that humans are superior with inductive reasoning – using multiple premises to arrive a conclusion. Today, Deep Learning enables real-time monitoring and predicting of epidemic outbreaks across the world. A group at the Centre for Development of Advanced Computing in India developed software to predict malaria outbreaks from temperature, rainfall, recorded cases and other sources. An experienced team of people may be able to arrive at the same conclusions from the data, but in this time-critical field their response would be slower.

IMAGE: ISTOCK

A revised perspective

Modern computing advancements afford far broader applications than when Fitts' research was carried out and the List drawn up. As such, it may be appropriate to revise the list to reflect modern capabilities. A potential solution focuses on the relative cognitive capabilities of people and machines.

Humans appear to surpass present day machines in:	Present day machines appear to surpass humans in:
Abstractive reasoning.	Deductive reasoning.
Exercising judgement and sanity checking.	Performing repetitive, routine tasks.
Recalling relevant information in an ad-hoc manner.	Detecting and responding quickly to small nuances in signals.
Invoking morality in decision-making.	Storing data and recalling accurately and immediately.
Extracting meaning from qualitative information.	Identifying trends in quantitative data.
Transferring learned knowledge and skills to new tasks through adaptation and flexibility in working methods.	Handling multiple operations simultaneously.

What is clear is that machines are excelling in verticals, not horizontals; they may be superior when developed for very specific tasks but lack the flexibility to be applied more generally. For this reason, humans are key to the successful implementation of technology; our improvisation, abstractive reasoning and ability to make moral judgements are paramount for robust systems.

When considering new technologies for healthcare, societal implications must also be considered. How will patients perceive the use of technology for their care, to what extent might it de-skill the healthcare professionals who interface with it and could over-reliance on technology leave the system vulnerable to failure? As such, AI systems are increasingly referred to as 'Augmented Human Intelligence' to clarify their role as supportive rather than substitutive healthcare technologies.

Critics have argued that Fitts' indices over-simplify the decision-making process for function allocation; just because functions can be automated doesn't mean they should be. Moreover, the List seemingly pitches humans and machines as competing entities, providing unwarranted justification for replacing humans for the predictability of automation. Arguably, these criticisms disregard the caveats given in Fitts' research; principally, the responsibility for safety and effectiveness must be appropriately shared between people and machines, with risks weighed and mitigated. Systems must be designed such that machines are implemented to supplement our capabilities, rather than simply to eliminate the uncertainty of a human element. ●

Tim Phillips is a Senior Human Factors Engineer at Cambridge Consultants, with a background in design engineering. He has a particular interest in the evaluation and integration of cutting-edge technologies in medical devices.

Flight times

From offshore lighting on a helideck to the 'switchology' of flight controls, a career in military aviation is far more varied than many of us can imagine. Experienced human factors engineer **Vicki Wall** provides some fascinating insights into a sector that understandably keeps it head well below the parapet

I worked in aviation for 15 years, before moving from looking at things in the air to things in the sea. My time working in aviation started when I joined the Flight Management and Control department at the Defence Evaluation and Research Agency (DERA) at Bedford. The department had a range of flight simulators and my work was conducted mainly in an old Boeing 747 procedures trainer that had been modified so it had reconfigurable glass or 'electronic' cockpit displays, allowing it to be used to test new system or display concepts.

One assessment was conducted as part of a collaborative European Union Air Traffic Management programme, which tested, amongst other things, the idea of a head down moving map display and Head Up Display (HUD) symbology in the civil aircraft cockpit, to facilitate airport ground movements. In the HUD, this included 3–2–1 markers of distance to their taxiway exit off the runway, like the exit markers used on motorways. The work aimed to provide operational benefits through improving the pilots' Situation Awareness and reducing their workload. One concept trialled was the use of datalink for Air Traffic Control clearances, including the taxi route, which would be shown on the aircraft moving map display.

IMAGES: GETTY

Simulator trials were conducted with operational pilots, and situation awareness and workload assessed, which was then followed by real world trials at operational airports in Hamburg and Prague. In terms of economics, there's a drive to get a high and predictable airport runway throughput. Pilots, being human after all, are typically unpredictable in the time taken to land and vacate the runway and speed typically reduced in low visibility conditions or when they were unfamiliar with the airport or the taxi route. The display concepts aimed to make the human performance more reliable and predictable, improving operational efficiency.

On another occasion, we turned the same civil aircraft cockpit simulator into a military Air to Air Refuelling (AAR) aircraft, complete with an electronic emulation of the Air Engineer workstation in the rear. This was back when bids were being solicited for the Future Strategic Tanker Aircraft (FSTA), which is now in-service with the RAF as 'Voyager'. We were tasked to undertake a detailed task and workload analysis of current, and then the potential future, tanker aircraft operational workload. We undertook task analyses based on two different concepts of operation and developed a stressing but credible operational scenario with RAF AAR Subject Matter Experts that would put the crew through their paces. We flew the operational sortie in our test simulator with RAF crew from Brize Norton and assessed their workload through use of subjective rating scales plus objective performance measures such as time and any errors made. Two different concepts of operation for the FSTA were trialled, and the results fed back to our MoD customer to directly inform the procurement decisions being made.

DERA Bedford also had a strong background in visual landing aids and I provided human factors input and was the Flight Test Observer (FTO) on a number of flight trials conducted to assess the performance of potential visual landing aids that could be quickly and easily deployed to unprepared landing sites to facilitate safe landing and take-off. These included LED (visible and Infra-Red) and retro-reflective markers.

We were also tasked by the Civil Aviation Authority (CAA) Safety Regulation Group to look at improving the lighting and marking on the helidecks on offshore oil rigs, to enhance the safety of offshore operations. The aim was to provide visual cues to the pilot to identify the location of the offshore platform and of the helideck, to provide closure rate and alignment information, and to eliminate glare. I provided the human factors input, developing in-flight rating scales and briefing and debriefing material and was the FTO on board during flight trials of on-shore and offshore trial installations of different lighting configurations. As I flew offshore I had to go into 'the dunker', more formally known as Helicopter Underwater Escape Training. Lighting that was developed and validated through these trials conducted over a number of years is now included in the specification for offshore lighting and marking contained in the CAA standards, so a real contribution to flight safety was made through this work.

As I flew offshore I had to go into 'the dunker' also known as Helicopter Underwater Escape Training

After a change in company name from DERA to QinetiQ, I spent another 11 years working solely in military aviation, mostly at the QinetiQ Aircraft Test and Evaluation Centre at Boscombe Down airfield in Wiltshire, plus a short stint at the helicopter manufacturer AgustaWestland in Yeovil. I worked mainly on Rotary Wing aircraft (helicopters) - the Chinook, Puma, Lynx, Merlin, Seaking and Apache - but with forays into Fast Jets, working on the Hawk Advanced Jet Trainer and heavy aircraft, on Nimrod and VC-10.

At Boscombe Down, we assessed anything from a small modification to an existing in-service aircraft, say a new radio or indicator light, to a whole new avionics fit and new cockpit display system. This could be part of a capability sustainment or life extension programme of an existing aircraft such as with the Merlin or Puma helicopters, or a new build aircraft, like the Future Lynx, now in-service as 'Wildcat'. On these larger programmes, I would support Human Machine Interface Working Groups, which developed human factors aspects of the aircraft design including cockpit layout. Within this forum we →

A member of the RAF returns to base after flying a Chinook helicopter at RAF Odiham, England

Air to air refuelling

also developed the system's Human Computer Interface, taking into account the operational context of use and the ability of the interface to support the task and information requirements of the crew.

Many of the smaller modifications to existing aircraft that were assessed were driven by the need to deliver new capability to the front line, as required in the aircraft's current theatre of operations. These were termed Urgent Operational Requirements. As implied by the name, these required assessment and reporting in short timescales to get the equipment cleared for use on the aircraft and out in the field.

Over the years I spent many hours in semi-darkness in the Night Vision Systems Test House facility, assessing the suitability of the cockpit lighting and Night Vision Goggle performance in different aircraft cockpits. Lighting needed to be assessed to ensure that everything was balanced across the cockpit, it had a suitable range for bright day and night operations, did not introduce reflections, or cause issues when operating on Night Vision Goggles.

I spent many hours in semi-darkness assessing Night Vision Goggles

I also routinely clambered on and off aircraft in the hangar at Boscombe and at many RAF, Royal Navy and Army Air Corps bases, looking at all human factors aspects. Firstly, just getting in and out of the cockpit and cabin, and accommodation in these spaces, by a range of crew sizes, dressed in different aircrew clothing assemblies, or passengers when you had troops on board. In the cockpit and cabin, aspects such as the presentation of information, readability, and ease of use of the flight and mission displays needed to be evaluated. The ability to identify, the suitability of type used, and reach to controls was also assessed.

Other things assessed included field of view through the aircraft transparencies; the ability to have unrestricted flight control movement; the 'switchology' on the flight controls; the suitability of warnings, cautions and advisory indications; weight limits on crashworthy seats; the ability to escape from the aircraft in an emergency; and the use of any equipment on board including mobile devices. Assessment was carried out through on-aircraft ground and flight trials, flight simulator, or rig assessment, or any combination of these, dependent on what was being assessed. Any issues with operation of the equipment were identified that would affect the safe or effective use of the aircraft in any flight or mission condition.

Human factors personnel work as an integrated part of a multi-disciplinary team, and what the team deliver is airworthiness, safety and operational advice in the form of 'Release to Service' recommendations delivered to the MoD. Recommendations could be made for operational limitations, modifications, advice for operators, or training advice, required to mitigate any safety or operational effectiveness concerns identified.

This human factors work undertaken at QinetiQ Boscombe Down is an essential part of ensuring that the aircraft and the equipment within it, is safe to operate and fit for purpose to be delivered to those using it on the front line. It made me feel proud to see the helicopters that I worked on for many years, the Chinooks and the Pumas, leading the way in the RAF 100 fly past over Buckingham Palace in July and to know that the work that I and all of my colleagues did, had helped to get them up there.

Vicki Wall is a Chartered Fellow of the CIEHF with 20 years' experience of applied human factors, primarily in the defence sector. She's currently working as a Principal Human Factors Engineer at BAE Systems in Barrow-in-Furness. Vicki says she wrote this article in response to a challenge in a recent edition of *The Ergonomist* where the Chief Executive threw down the gauntlet to those who have conducted human factors work in aviation to share their experiences.

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Maintaining skills and knowledge at work

Balancing training needs versus budget is a challenge for every industry. Wherever skills or knowledge fade, there will be consequences and especially in high risk occupations, the stakes can be high. But research lessons for skills maintenance in one sector can be tailored to others, explains **Bob Webb** and **Harry Angel**

Every organisation must match the training it provides to a budget and a schedule. Mismatches risk loss of capability, money, even injury or death. Yet too much training is a waste and balancing these aspects is a constant challenge for managers. Traditionally, people think of gaining skill or knowledge as the primary goal for any training. But over time, knowledge and skills fade or change. For high risk industries, refresher training for critical tasks may be mandatory, yet best practices about the refresher training intervals are based largely on tradition rather than the characteristics of the task and its context.

The same training management challenges apply to military units as any other organisation. For example, an infantry battalion of 600 soldiers might receive six months' notice to train for Afghanistan and then stay there for six months. Such army units have multiple interdependent teams needing diverse skills: cognitive, social, physical, cultural. These teams must multitask. There are uncertain expectations and high risk, and demanding and fatiguing environments.

To prepare, military units must manage their access to training facilities, often with competition from other units facing similar challenges. Once deployed, individuals and teams must preserve knowledge and skills for weeks or months as well as learning as they go. Consequently, the military in more than one country studies retention of military skills for both individuals and teams. Over the past decade, for different clients, Human*Systems*® reviewed this research into the causes of skill fading for military and first responder tasks.

Managers need to know accurately, who is required to refresh their skills or knowledge, when and for which tasks. They also need to track training outcomes to know if the training, refresher or initial, has worked. Training teams or individuals to reach, and then stay at peak performance needs management of multiple issues over the long-term. Skills can fade rapidly within three to six months after training, but rates of decline vary with the frequency of task performance.

Task frequency after completion of training can vary widely, sometimes being years apart. The risk of error rises as the frequency of task performance drops. Within teams, the effect of turnover among members varies with the task whether cognitive or physical. Yet there are few long-term empirical studies of skill retention that apply this research knowledge to actual working environments.

With over 20,000 employees, Pacific Gas and Electric (PG&E) is a leading US utility serving Northern California. The PG&E Learning Academy manages

many thousands of training days on-the-job and at training centres. An Academy team reviewing refresher training for critical electrical transmission and distribution tasks found that the available skill retention research was not directly transferable to tasks at PG&E. To provide evidence-based recommendations for change, PG&E needed its own skills retention research.

PG&E tasked the Human*Systems*® project team with helping PG&E decision makers and practitioners at all levels to:

- Identify knowledge and skill retention rate requirements and methods.
- Define best practices and benchmarks relevant to PG&E's current practices.
- Identify gaps in current business processes and methodologies.
- Review systems information that enables retention methods.
- Improve awareness of need for reassessment and maintenance of workforce capability.
- Improve decision making to manage risk.

Working closely with the PG&E team, the Human*Systems*® project team updated its knowledge of recent advances in skill retention modelling and best practices, as well as conducting site visits and interviews with transmission line workers and managers.

Skills can fade rapidly within three to six months after training

The team then modelled line worker skill retention using Difficulty, Importance, Frequency and User Decision Aid skill retention models, and compared the models to PG&E training results spanning four years. The predictions from both models came close to actual skill loss for the two tasks examined and we adjusted the models to match actual performance. Further adjustment will be possible as additional data is gathered over the coming years.

The team drew several conclusions. Just a few skill errors (unsafe behaviours) accounted for many of the evaluation failures during reassessment, for example, minimum working distance or correct grounding contact. We found the same safety-critical errors in the field as during evaluations. These and other findings allowed us to provide recommendations to PG&E to improve their best practices.

Despite fighting massive wildfires in California, PG&E is continuing work on skills fading. For example:

- To focus training content and refresher intervals on critical errors in further tasks.
- To add factors to the skill retention models, for instance, task frequency data.
- To expand the range of tasks modelled for their skill retention profile.
- To expand data collection and validation as tasks, conditions and training technologies change.
- To capture data in the field and during reassessment to identify the most frequent errors.
- To explore correlations between knowledge test results and performance skills at work.
- To explore new technologies, such as e-learning, to refresh infrequent tasks.
- To gather data on risks related to complacency and tasks rarely performed.

PG&E can now collect a well-researched, robust skills retention dataset. Continuing to track and analyse the data gathered should lead to better models and better predictions. The range of data capture can be expanded to more tasks for a wider range of operations. But a bigger point to make here is that tailoring, and application of human factors research knowledge would benefit many organisations, not just electrical utilities and training.

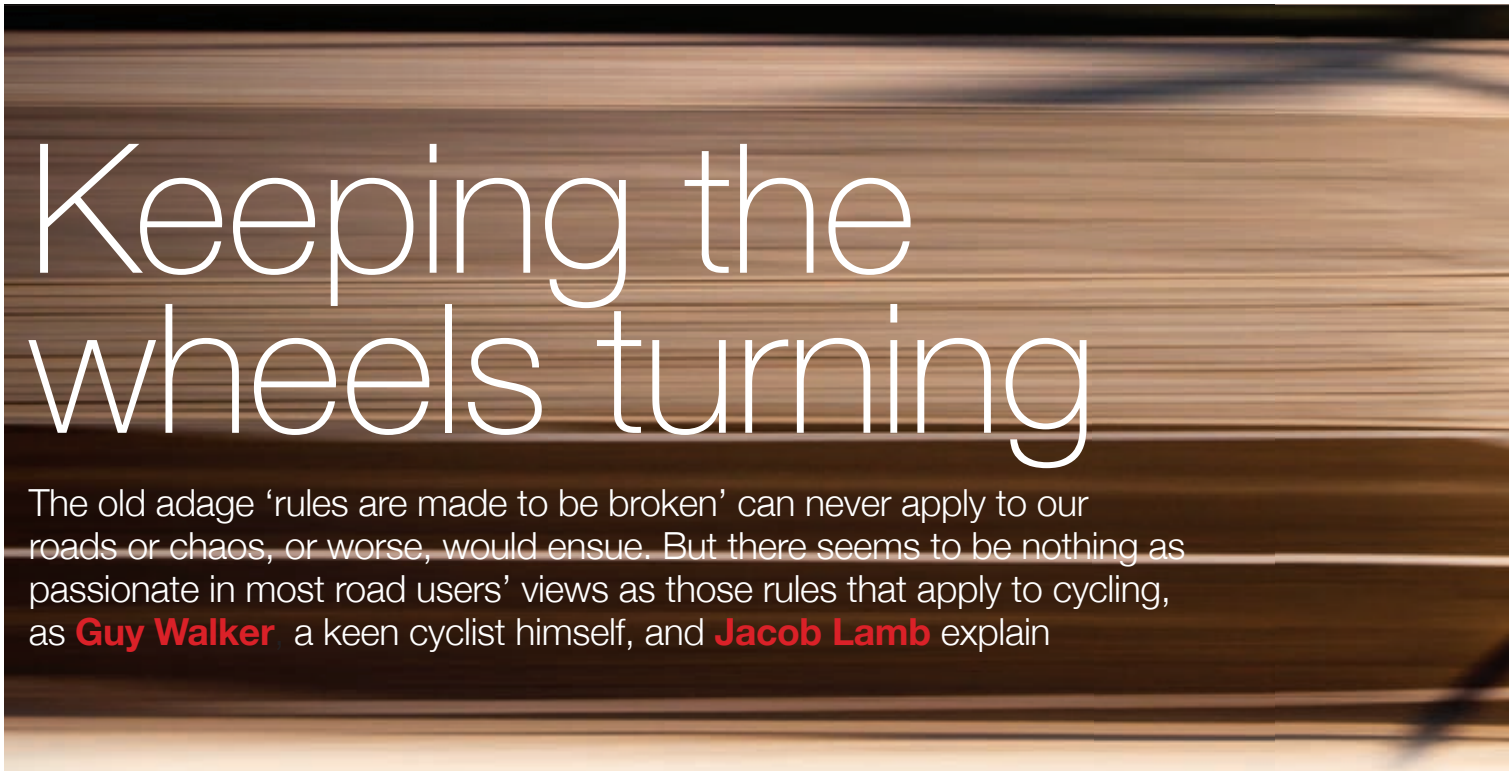
Many human capabilities are well-researched, for example training, body size and shape, attention, decision-making and endurance; the list is probably endless. Yet, I expect we all have stories to share about how well researched knowledge can be thoughtfully and successfully applied in one sector yet fail to migrate to other sectors. That's something to put right.

As practitioners we must communicate better with less jargon and use relevant real work examples that reveal the underlying human factors that apply to any industry. If we can do that, we're more likely to engage with those having both the vision to recognise the benefit and be in a position to make it happen. Our clients at PG&E had the vision and the means, Human*Systems*® was just the messenger. We believe that people are the most important and complex part of any system and that human error and its risks, as often as not, are something one can predict.

Bob Webb is President of Human*Systems*®. After his research degree at UCL as part of a team led by Otto Edholm and Ralph Hopkinson, he emigrated to Canada in 1978 but has kept in touch and valued his long-distance membership of the Institute, largely through this publication. His faculty position at the University of Guelph in Ontario led to the creation in 1982 of a consulting firm called Human*Systems*® which then became his full-time job in 1987. Now 15-strong, the company works mostly in high risk applications in Canada and the US in defence, healthcare, industry and the emergency services. See www.humansys.com.

Harry Angel is a Principal Consultant and has been with Human*Systems*® since 1996. Harry led our project team working at PG&E and has an MSc in Ergonomics from Loughborough.

IMAGE: ISTOCK



Keeping the wheels turning

The old adage 'rules are made to be broken' can never apply to our roads or chaos, or worse, would ensue. But there seems to be nothing as passionate in most road users' views as those rules that apply to cycling, as **Guy Walker** a keen cyclist himself, and **Jacob Lamb** explain

In my 20 years of ergonomics practice and research one topic has excited more debate than any other. It wasn't the high-profile military project we conducted at the height of the Gulf War and neither was it a paper on nuclear decommissioning. These were benign compared to the vexed issue of cycling safety. On this topic, I've been stopped midway through a public engagement lecture and told to correct an innocuous figure of speech. I've also had to calm tempers when research impact workshops took on an almost literal meaning. And I'm not alone. Policy collaborators I work with have received death threats at public consultations about new cycling infrastructure, and a £60k cycle lane in a nearby town was ripped up amid applause from local residents.

I nervously expect this balanced, impartial and evidence-based article to require an uplift in my personal security detail as we proceed once more to inadvertently offend both motorists and cyclists in equal measure. Take cover, for we are about to deal with the topic of... minimum passing distances for cyclists.

It's simple. If people followed the rules, then cyclists wouldn't get killed or seriously injured. Neither would motorists be inconvenienced or find themselves in stressful situations around vulnerable road users. This theme comes through strongly in numerous workshops we've held over the years with road users. But like so many ergonomics problems, this common sense view starts to make less sense and become more uncommon the closer it's examined. If we step back and look at the issue of minimum passing distance rules dispassionately, what we see is a 'compliance-based' approach. One we know works in many instances. Speeding, for example, is based on rules. There's an objective, measurable and publicly observable value which defines the boundaries of acceptable driving behaviour. So it is with a minimum passing distance rule.

If it becomes a legal requirement to pass a cyclist at a given distance then that distance could conceivably be measured, subjectivity is minimised, and the purpose of the law upheld. Of course, not all laws are compliance-based in this way. Many of the most serious motoring offences are actually 'performance-based'. There's no one measure for defining all cases of dangerous or careless driving, for example; it relies on a range of measures, some objective, some subjective. Cyclists and drivers must both satisfy certain legal safety objectives but there's a degree of flexibility in how they achieve this aim and how they will be judged by police officers when called into question. So which way to go? Compliance-based or performance-based enforcement of cyclist safety? The arc is currently curving towards compliance-based Minimum Passing Distance Laws (MPDL).

Eight countries currently have minimum passing distance laws. The first of these appears to have been enacted in 1973 but the vast majority are much more recent. Ireland only passed its MPDL in early 2018 after a significant amount of political pressure from cycling advocate groups, who cited a similar initiative in Queensland, Australia. Queensland introduced its minimum passing distance law in 2014 and is relatively unique in being one of the few territories to have conducted an evaluation study. The findings were encouraging if not conclusive. On the positive side, surveyed riders reported a beneficial change in driver behaviour and overall levels of compliance. On the negative side it seems the law is difficult for the police to enforce and sometimes difficult for drivers to interpret.

In Queensland the minimum passing distance is one metre within a 60km/h speed limit zone, and 1.5 metres elsewhere. This is similar to France, Spain, Germany, Belgium and Portugal. The least generous passing distance, meanwhile, is to be found in North Carolina in the US, with a minimum passing distance of 61cm. Clearly there is no consensus on the minimum passing distance to be set. A distance of 1.5 metres could certainly feel safe, subjectively, to the cyclists being passed. A distance of less

Footage from the on-board 'bike cam' showing an unsafe passing manoeuvre in Ayrshire, Scotland.

Footage from the on-board 'bike cam' showing a safe passing manoeuvre in Queensland, Australia

IMAGE: ISTOCK

than 61cm, on the other hand, is very obviously a close pass that's easier for police officers to enforce. The question which we set out to answer was where, exactly, to draw that line, and whether a line needs to be drawn in the first place. The other option, of course, is to take a performance-based approach and let the police use their discretion.

An instrumented bike covered over 500 miles both in Scotland (no MPDL) and Queensland (where there is a MPDL) to help us investigate further. It collected video of thousands of real passing manoeuvres, from large vehicles close-passing at high speeds to small vehicles passing wide at low speeds, and all points in between, including punctures and an unfortunate incident when the rider just fell off. Selected clips were then shown to 60 participants and the subjectively-rated risk level allowed the clips to be ranked from most to least risky.

If people followed the rules, then cyclists wouldn't get killed or seriously injured

We were delighted to work with Police Scotland and to have the opportunity to show the same clips to ten serving traffic officers. But this time two different questions were asked. The first question was to estimate the passing distance, as a police officer would be required to do in real life, and the second question was "would you pull this driver over for advice and/or enforcement?". With these ingredients a classic signal detection theory approach could be used to tell us three things. A so-called 'receiver operating characteristic' curve could be plotted to show the relationship between taking enforcement action on a driver whose passing manoeuvre was actually considered safe by cyclists (a false alarm in the terminology of signal detection theory) and taking enforcement action on a driver whose passing manoeuvre was considered unsafe by cyclists (a signal detection 'hit'). The theoretical ideal, of course, being a case of maximum signal detection 'hits'. Secondly, it could tell us lots about discretion and how sensitive police officers were in judging legal or illegal passing manoeuvres. Thirdly, we could look at whether officers had an innate tendency to respond one way or the other; were they too lenient or too harsh.

A somewhat complex method delivered a simple, useful answer to a real-world problem. The current performance-based method relying on police officer discretion and judgement outperformed all current minimum passing distance laws. The officers were better at identifying unsafe passing manoeuvres because risk, including subjective perceptions of risk, is about more than just passing distance. In this analysis, discretion didn't mean an overly harsh interpretation of the law either; quite the reverse. Discretion erred on the side of caution and gave the benefit of the doubt while also achieving the highest number of correct enforcements for close passing.

Back to the common sense logic of rules and where you draw the line. Yes, MPDLs do have effects on who gets penalised for a close-pass, some of them beneficial. The evidence, however, suggests a performance rather than compliance-based approach, or simple officer discretion, is better than all of them. We modelled police officers' decision-making under uncertainty using signal detection theory and found it to be good. Enforcement decisions based on them would benefit both cyclists and drivers more than any of the current MPDLs. Please don't shoot the messenger.

Guy Walker is a professor in human factors at Heriot-Watt University in Edinburgh.
Jacob Lamb is a PhD candidate at University of Calgary in Canada.

Despite
90%
of midwives reporting symptoms of musculoskeletal disorders, only 30% take sick leave to recover

Managing midwife wellbeing

A 25% boost in midwifery training is part of the Government's ambitious plans to make the NHS "the safest place in the world to give birth". Following her research, **Kubra Okuyucu** explains the physical demands placed on midwives as they deliver the UK's 775,000 babies each year

IMAGE: SHUTTERSTOCK

The UK is currently facing a midwife shortage, with an estimated deficit of 3500 professionals according to The Royal College of Midwives (RCM). While Health and Social Care Secretary Jeremy Hunt has announced the "largest ever" increase in the NHS with the creation of more than 3000 places on midwifery training courses over the next four years, the health and wellbeing of our existing workforce is under threat.

A recent RCM survey revealed that 62% of midwives were absent from work most commonly due to stress and musculoskeletal disorders (MSDs). Our research has gone on to discover that of the 600 midwives in our study, 90% have suffered from MSDs in the past 12 months alone.

MSDs are defined as any injury, pain, discomfort and damage to muscles, tendons, ligaments and other musculoskeletal tissue. It's well known that these kinds of symptoms are experienced by people within a variety of occupational groups, resulting in sickness absenteeism and considerable financial cost. This obviously has a negative impact on quality of life and productivity at work.

MSDs are likely to occur when physical job demands exceed the capacity of an individual. Therefore, physical exposures at work have been commonly acknowledged as the biggest contributory factor for developing MSDs.

Healthcare workers report occurrences of MSDs arising mostly because of the need for them to help move and handle people whilst adopting awkward postures. And whilst health organisations report the highest sickness absence days compared to other sectors, UK midwifery has not been extensively explored in relation to MSDs, their impact and the contributory risk factors.

Midwifery tasks and working conditions are physically and psychologically demanding and can increase the risk of developing MSDs. These physical demands could likely be the result of the mother-centred birth process, whereby the mother is encouraged to choose the most comfortable position for her. As a result, the midwife must accommodate according to the mother's needs, jeopardising their own physical comfort. The reality is that to provide optimal care, midwives are frequently required to work in awkward and physically challenging positions. Another contributory factor is that a midwife is the carer for two patients simultaneously, both mother and baby. So strategies need to be developed to prevent or reduce MSDs to enhance the health and wellbeing of midwives, whilst still providing high quality care to both patients.

Exploring the issues

Development of risk management strategies to reduce MSDs and their detrimental impacts are initiated by establishing the magnitude of the problem and exploring the contributory factors. To achieve this in our research, we investigated the scope of MSDs and conducted an online survey. Questions were asked about sickness absence, working schedules and functional limitations due to MSDs. Following the survey, interviews were carried out to explore the contributory factors due to working conditions and the burden perceived by midwives.

Lower back pain followed by pain in the neck and shoulders were the most commonly reported symptoms identified by our study, with most midwives reporting resulting limitations in their normal activities at work or leisure. Moreover, 45% of midwives reported changing jobs or duties and 30% said they took sick leave because of musculoskeletal symptoms. Considering the number of symptoms reported, the low levels of sick leave suggested many remained at work despite their symptoms. This 'sickness presenteeism' has potential detrimental effects on workers through the cumulative effect of loading on the musculoskeletal system, consequently increasing the risk of injury.

Our participants generally attributed MSDs to work-related activities or thought they were aggravated by working tasks. For example, symptoms in the back were thought to be due to twisting and being in an awkward position during assisted breast feeding, or through delivering in birthing pools with regular bending and stretching over the pool.

Increased workload was considered to be another contributing factor, with longer shifts and fewer staff being a major issue. Interviews also revealed an increased concern about complaints from patients. Such complaints led to midwives working very defensively and overcompensating by physically doing much more than required.

Initiating management strategies

Exploring underlying issues through research such as this, followed by a comprehensive risk assessment will lead the way in developing better management strategies to reduce MSDs and improve patient safety and staff wellbeing. Intervention studies based on risk assessment programmes can be most effective in reducing work-related MSDs. A useful approach is that of participatory ergonomics, facilitated by human factors professionals, whereby workers are actively involved in providing feedback about problems and identifying potential solutions.

Creating more places to train midwives is undoubtedly good news in helping to solve the midwife staffing crisis but we need to ensure we don't overlook the health and wellbeing of those delivering the service too.

Kubra Okuyucu is a postgraduate research student at Loughborough University. Her research was presented at the IEA2018 Congress in Florence, for which she successfully applied for funding from the John Wilson Student Travel Bursary.

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For questions on these opportunities and working with BAE Systems Submarines Human Factors Department, please contact Anna Welch: anna.welch@baesystems.com.

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JOURNAL EXTRACTS

From journals available to members as part of their benefits package

Self-managing health

1 During Breast Cancer Awareness Month every October, millions of people join together to raise awareness of the UK's most common form of cancer. Whilst one person is diagnosed with the condition every 10 minutes, survival rates have doubled in the last 40 years in the UK. Human factors is playing its part as researchers have been uncovering the 'invisible patient work system' through a case study of breast cancer self-management.

As patients transition from passive recipients to actors in their health management, researchers say that there is an opportunity to enhance theoretical frameworks describing the patient work system. Patient work can be defined as personal health management performed by patients and is a crucial component of health maintenance and recovery. In the past, frameworks have depicted how patients manage health outside the institutional healthcare system, though none formally integrate the concept of invisible work: self-management practices undervalued or unseen by healthcare providers.

Researchers interviewed 30 breast cancer survivors about their experiences post diagnosis. The researchers say the results show that all participants had invisible work system components, and future research and design conducted to support self-management practices should explicitly address the invisible characteristics of the patient work systems. ●

R Gorman, C Wellbeloved-Stone & R Valdez (2018) Uncovering the Invisible Patient Work System through a Case Study of Breast Cancer Self-Management, Ergonomics, DOI: 10.1080/00140139.2018.1503339

Water cooler moments

2 The BBC drama *Bodyguard* recently attracted record-breaking audience numbers but many non-English language dramas, such as *The Bridge* and *Follow the Money* have proved very popular in Britain too. It seems we can't get enough good TV dramas and now programme makers such as Amazon and Netflix have joined the more traditional channels in producing popular series and box sets, the competition for viewers is fiercer than ever.

Researchers are now challenging self-reports as the only source of data in viewer evaluations of television drama series. Based on two viewer evaluation studies of one-hour dramas, both conducted in an applied research setting, the research outlines pros and cons of electroencephalography and skin conductance measurements tested in combination with in-depth interviews and written self-reports.

Viewer evaluations consisting only of self-reports will continue to be a popular and necessary method in television studies because they are cheap and quick to gather but the researchers suggest programme makers enhance written self-reports with skin conductance measurements to get a truer understanding of whether or not viewers enjoy their programmes. ●

L Heiselberg & T Bjørner (2018) How to evaluate emotional experiences in television drama series: improving viewer evaluations using a combination of psychophysiological measurements and self-reports, Behaviour & Information Technology, 37:9, 884-893, DOI: 10.1080/0144929X.2018.1505953

Learning from success

3 With our 'Human Factors in Aviation Safety' event just around the corner, it's timely that new research highlights normal performance in near misses.

Learning from successful safety outcomes, or what went right, is an important emerging component of maintaining safe systems. Accordingly, there are increasing calls to study normal performance in near misses as a part of safety management activities. Despite this, there is limited guidance on how to accomplish this in practice.

Sixteen serious incidents from the aviation domain were analysed using a risk management framework. The findings show that a network of protective factors prevents accidents with factors identified across the sociotechnical system. These protective networks share many properties with those identified in accidents.

The research demonstrates that it's possible to identify these networks of protective factors from incident investigation reports. The analysis of near misses is an important part of safety management activities and safety practitioners can use the framework described to discover and support the system-wide networks of protective factors. ●

B Thoroman, N Goode, P Salmon & M Wooley (2018) What went right? An analysis of the protective factors in aviation near misses, Ergonomics, DOI: 10.1080/00140139.2018. 1472804

IMAGES: ISTOCK

Following her initial PhD research, **Saydia Razak** shares her background and experience with Lou Boulden in exploring the complex systems brought about by Chemical, Biological, Radiological, and Nuclear events. Her focus has been on hospital Emergency Departments and the response by first receivers in dealing with these major emergencies

Responding to attack

What led you to your PhD?

I have an interest in research, methodology and human behaviour so my early ventures were into psychology and sociology. I also have an interest in healthcare so I combined these interests and began to train as an Operating Department Practitioner.

Once qualified, I took up a post in orthopaedic theatres and continued my academic studies in psychology to enhance my research capabilities. My time in theatres taught me how vital team communication was in providing safe and high-quality care to patients; this is covered in the introductory part of the World Health Organisation Surgical Safety Checklist.

Seeking a new challenge, I went on to expand my skillset and became an Emergency Department (ED) Practitioner. The role forms part of the ED team, providing clinical care to critically ill or injured patients in the resuscitation room. The ED is a complex, dynamic, safety and time-critical environment that's susceptible to errors and mishaps due to demanding workload, pressure to perform, and the uncertainty of what will 'walk through the door' next. It was just the challenge and adrenaline rush I needed.

Wanting to combine my interest in human behaviour and interactions in a complex system with my acquired research skills, I applied for a PhD at Loughborough University. The PhD is part of a multi-disciplinary European project working with the National Ambulance Resilience Unit to better understand the front-line Chemical, Biological, Radiological and Nuclear (CBRN) response. I'm concentrating on using my ED knowledge to focus on the ED response to CBRN events.

What does a CBRN response involve?

A CBRN event is a multi-faceted phenomenon that requires a prompt response, which is a challenge in itself in an under-resourced, high-pressure environment, such as is usually the case in EDs. Guidance on how to respond to CBRN events has been published by both government and independent bodies such as the NHS Health Protection Agency, NHS England and most recently, Public Health England. The guidance emphasises the responsibilities proposed by the 'Emergency Preparedness, Resilience and Response' initiative. It also sets out the actions needed by the Initial Operational Response in recognising that a CBRN event is occurring and then implementing the required decontamination procedure.

What demands do CBRN events place on the ED?

An ED is a highly complex system in which numerous interactions between staff, patients, relatives and technologies occur simultaneously. This complexity is further amplified by the multifaceted demands of a CBRN event which places three types of demands on the ED. Firstly, that of unfamiliarity in terms of the CBRN presentation in patients because CBRN exposure often mimics the symptomology of other ailments. Secondly, CBRN events have organisational demands which effect flow in the ED, the hospital, and the Trust in terms of surge capacity. Thirdly, CBRN events can jeopardise the safety of first receivers and patients already in the ED through contamination. In addition, CBRN events are, thankfully, rare occurrences, but this means that first receivers (ED staff) are often unfamiliar with the actions required during a CBRN event.

What interested you most about this project?

Mandatory training days are common practice in EDs and include CBRN event training sessions. Although the sessions are meant to be informative, interactive and realistic, they rarely go to plan either because the training days are cancelled due to short staffing or due to limited time. I was interested in being part of a project that aimed to understand the CBRN response and provide realistic future recommendations for front line practice in EDs.

This research is important because CBRN events, which could potentially harm large numbers of people, are becoming more frequent in the UK. Examples include the use of Polonium P-10 resulting in the death of Alexander Litvinenko in 2006, the 'mysterious mist' which appeared over an East Sussex beach during the summer of 2017 and the use of the Novichok nerve agent this year.

So what's the aim of your PhD?

The aim is to understand which actions are most important when responding to a CBRN event using human factors methods and theory. This approach provides principles and data to enhance human wellbeing and system performance, and as a clinician it's within my duty of care to enhance human wellbeing of both staff and patients, so this fits well.

My research aims to understand the similarities and differences in 'work as imagined' as compared to 'work as done'

Three challenging phases exist in CBRN response: detection, de-contamination and diagnosis

to provide top-down and bottom-up evidence to inform future recommendations for ED CBRN planning.

How did you get to your first findings?

ED response to a CBRN event should be well practised and be based on a set CBRN plan detailing what should happen during a CBRN incident, as devised by CBRN leads, managers or consultants. What actually happens during a real CBRN event may be different to the plan. So in order to interpret the ED response to CBRN events, I compared work as imagined and work as done.

Hierarchical Task Analysis (HTA) was used to explore the CBRN response and actions as it provides a simple and systematic way of analysing and visually representing complex tasks. It was a particularly useful method because it requires clearly defined objectives and consistent approaches to visually display and compare work as imagined and work as done. This work led to one of the first findings of my research which was that three challenging phases exist in the ED CBRN response: detection, de-contamination and diagnosis.

What are the next steps?

A further aim of my PhD is to demonstrate the relevance and practical applicability of human factors in the ED, for example, by applying human factors methods to a complex system to unpack multi-faceted CBRN events. The next step is to compare the ED response between different hospital Trusts in terms of work as imagined and work as done to formulate the recommendations.

Where else could this approach be used?

There are safety-critical and time-critical responses to situations such as cardiac arrests, sepsis and trauma alerts which could be enhanced by implementing HTA and forming pathways so that policies and guidance (work as imagined) is written to reflect and better inform what actually happens (work as done).

This approach could be replicated to unpack the transfer of critically-ill patients across hospitals, operating theatres, High Dependency Units and Intensive Care Units. Transfer protocols could be analysed using HTA with critical care clinicians interviewed to inform the HTAs. The comparisons of work as imagined with work as done and the resulting recommendations can enhance performance in healthcare.

Saydia Razak is studying for her PhD at Loughborough University under Professor Sue Hignett. Her research was presented at the IEA2018 Congress in Florence, for which she successfully applied for funding from the John Wilson Student Travel Bursary. She will complete her research in 2019.

Further reading

Razak, S, Hignett, S and Barnes J, 2017. *Human factors in the Emergency Department CBRNe response: How is technology used?* Presented at CIEHF's Ergonomics & Human Factors 2017 conference in Daventry. See https://bit.ly/2PJ8HNh

IMAGES: ISTOCK

Q&A

As the first Briton to scoop a prestigious Distinguished Service Award for 30 years, CIEHF Fellow and Past President **Roger Haslam** talks to Lou Boulden, giving an insight into his vibrant career as both an esteemed contributor to the discipline and a mentor to many

Recognition for outstanding service

Presented just once every three years, the International Ergonomics Association (IEA) Distinguished Service Award honours individuals for outstanding contributions to the promotion, development and advancement of the IEA. This year, Roger Haslam received the accolade which recognised, over 30 years, his leadership and support of ergonomics with his research, writing, and editorial work, as well as his activism on behalf of the IEA.

What does this award mean to you?

I have a longstanding respect for the IEA and its work. Since the early 1960s, the IEA has provided international representation and coordination for our discipline and profession, benefitting from the leadership of major international figures in the field of ergonomics and human factors. Today, the IEA is a federation of around 50 national societies, representing approximately 30,000 members around the world. The CIEHF has always supported the IEA's mission and activities, both financially and through the input of individuals. My own involvement has been as a UK delegate to the IEA Council and participation in each of its triennial congresses since 1994. It really is an honour to receive the IEA Distinguished Service Award. To be honest, when I look at the roll call of previous recipients, I'm surprised to find myself in such august company. The last to receive the award from the UK were Peter Davis and Tom Singleton in 1988.

What are you currently working on?

It's still a work in progress, but the research I've been pursuing with my colleague Alistair Gibb, Professor of Construction Engineering Management at Loughborough University, seems to have generated interest. Over the past 20 years, we've looked at health and safety in the construction industry from various perspectives. Currently, we are carrying out a long-term study following the health and safety initiatives on the Tideway project in London. Due to complete in 2023, Tideway is a £4.2billion infrastructure project, building a 25km tunnel along the Thames to intercept the raw sewage that overflows into the river when it rains. We're looking at how leadership, policy and practice play out over time in protecting workers and the lessons that can be learnt from this, in the context of a complex sociotechnical system.

Support for Roger's award

"Roger has been one of the most passionate advocates for ergonomics. He's one of the strongest British supporters of the IEA and its ideals. Be it nurturing thousands of future ergonomists, ensuring the quality of prominent ergonomics journals, creating and disseminating knowledge through publishing or being an activist for ergonomics, Roger's contribution is well worth nomination for distinguished service."
Nick Gkikas, Treasurer, CIEHF

"Roger has always demonstrated strong leadership and determination. As a health and safety regulator with the Health & Safety Executive, I was aware of Roger's research work on underfoot incidents, on musculoskeletal disorders, manual handling, ageing and construction work. I was a recipient and user of the reports and know how they have been applied and influenced national health and safety policy. Roger's research profile is excellent; it's practically orientated, excellent quality and very relevant in the UK and internationally."
Dr Claire Dickinson, Principal HM Inspector of Railways

Roger Haslam (right) receiving the award from IEA President Yushi Fujita

How is research improving the discipline?

I welcome the research efforts to improve the evidence base for ergonomics practice. In many instances, we don't have robust evidence to underpin our advice and actions. Taking just an example from my close experience, I'm co-author of a recent Cochrane Review, which looked at interventions to prevent injuries in construction workers. This found weak evidence for the effectiveness of most current safety practices. Workplace falls amount to over a third of reported occupational injuries but when it comes to prevention, we're unable to say with confidence which prevention measures work and which ones don't.

What part has the CIEHF played in your career?

The Institute has taken up a good deal of my time! Since being coaxed reluctantly into becoming involved with the Membership Committee in the mid-90s, I've gone on to hold most of the different officer positions. This has been a great privilege and, although there have been challenges along the way, I've learnt a good deal both personally and professionally. I do feel I've gained as much as I've given. It's been a pleasure to work with so many good colleagues promoting ergonomics and our profession. The highlight of my involvement, of course, was being President when the Institute was granted its Royal Charter.

What careers advice would you give?

It is difficult to avoid the clichés. In my own case I've certainly benefitted from some lucky breaks, so I'd say, without being pushy, strive to make your own luck. Increase your chances of being in the right place at the right time by working on your professional connections and by saying yes to opportunities to learn and do new things, whenever you can. Finally, keep your glass half full; people seem to stay around longer when you smile.

Roger Haslam is Professor of Ergonomics at Loughborough University and Editor-in-Chief of the international journal *Ergonomics*.

Further reading

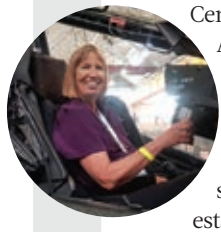
'Building London's super sewer', *The Ergonomist*, issue 565, May-Jun 2018, p30.

"Roger is a leading ergonomics researcher who has served the IEA community over a long time, both on the front line on the IEA Council, as well as behind the scenes. As editor of Ergonomics, his publication and dissemination of the IEA 'Future of Ergonomics' document enabled the IEA Council and community to discuss the proposed strategy at the IEA triennial conference in Brazil. This publication has become one of the most read and cited papers in Ergonomics."
Jan Dul, Professor of Technology and Human Factors, Burgemeester Oudlaan

REGIONAL NEWS

SOUTHERN

Army aviation explored



Southern Regional Group organiser Jo Davies in one of the cockpits

The Museum of Army Flying was the venue for a Southern Regional Group visit to the Army Aviation Centre (AAC) at Middle Wallop in September. The AAC originated as an RAF training school at the beginning of WWII. At the end of the war it was transferred to the Royal Navy for a year before the RAF moved back with a squadron of Spitfires. The Army Air Observation Post training unit joined shortly after. In the 1950s the Army Air Corps established the Joint Experimental Helicopter Unit and when Army Aviation became independent of the RAF, the School of Army Aviation was established there. The AAC was formally set up in 2009 and now provides training for all Army Air Corps pilots and ground crew (excluding engineering). This history is very well captured at the Museum.

The afternoon began with a visit to the Historic Army Aircraft Flight Trust where we were shown the Scout, Sioux, Skeeter helicopters and Chipmunk, Auster and Beaver aircraft used by the Army Air Corps in the 1950s and 60s. They're maintained for use at air shows by volunteers led by ex-Army Aircraft Engineer Dave Gillespie (see http://historicarmyaircraft.co.uk). It was fascinating to look at the older generation technology and to appreciate the amount of effort required to maintain airworthiness.

We were then brought up to the present day with access to the sophisticated Apache helicopter. Two Apache Instructors gave us a comprehensive overview of the weapon systems, defensive aids suites and cockpit displays and controls. The weapon aiming is largely controlled by the helmet-mounted monocular sight, and teamwork between the two pilots is essential to achieve effective combat in very hostile and alien environments. Egress is not very easy, particularly if the helicopter crashes in the sea. The escape hatches need to be pushed out prior to immersing in water as flotation devices are not currently available. There were →

Pilot getting into an AH-64 Apache attack helicopter.

IMAGE: ISTOCK

examples of good ergonomic designs with controls identifiable by touch and feel - particularly important for night sorties.

We completed our visit with access to the Engineering Flight Safety Department who allowed us entry to the crashed helicopter hangar. The accident investigation reports were available to help us appreciate the causal factors.

Overall a fascinating, technical and educational visit providing us with an insight into the demanding role of training and maintaining skills for Army Aviation operational readiness. Thanks to SSgt Stuart Owen, 667 Sqn, Middle Wallop and WO2 Kevin Hayes, RAF Odiham, for organising and hosting the event.

MIDLANDS

Flight simulator experience

A limited number of one-day places are available at the largest flight simulator centre in Europe for you to explore the day-to-day operations performed by aircrew, the equipment they use, the human factors incorporated in what they do, and to get a real-life experience of how this all comes together, including when things don't quite go according to plan.

The event, on Thursday 1 November in Coventry, starts with an insight into how pilots work in a multi-crew environment and the use of Crew Resource Management to deal with issues as they arise. There follows a session on how pilots brief before and during a flight, using preparation and footage of an actual flight. An incident will then be considered where American Captain Sullenberger made an emergency landing of his aircraft on the Hudson River. Simulators will be used to allow everyone to follow the Sullenberger routing and experience, offering a unique opportunity to understand the human factors issues first-hand.

Find out more at events.ergonomics.org.uk

Eligible for CPD Lifelong Learning

CIEHF events at a glance

For more details of all CIEHF events, see our website at **events.ergonomics.org.uk**

EVENT	WHEN & WHERE	DETAILS
Flight simulator experience	1 November 2018, Coventry	A day of insight, briefings and simulations of real-life incidents illustrating the work and challenges of piloting commercial aircraft.
Human Factors in Aviation Safety	12-13 November 2018, Gatwick	Presentations, discussion and debate on human performance issues in military and commercial aviation.
Ergonomics & Human Factors Careers Day	27 February 2019, Birmingham	The very best of careers guidance, options and opportunities, featuring talks about work in different sectors and a lively Jobs Fair.
Doctoral Consortium	29 April 2019, Stratford-upon-Avon	A day for PhD students to present their ongoing research to their peers and to learn from each other, and from a PhD Masterclass
Ergonomics & Human Factors 2019	29 April – 1 May 2019, Stratford-upon-Avon	Celebrating our 70th anniversary with a line-up including Masterclasses, keynotes, presentations, posters, discussions, drinks, BBQ, annual dinner, entertainment and more.

Please note that some events details may be subject to change after publication. Please check the events website for up-to-date information.

70 YEARS OF ERGONOMICS 1949-2019

Twenty nineteen is a milestone year for the CIEHF, as it marks 70 years since the term 'ergonomics' was coined and the formation of our organisation. Whilst the Institute is formulating ideas for more significant celebrations for the 75th anniversary, we've got plenty of exciting activities planned for 2019, as **Mark Young** explains.

Marking time

Several activities are planned throughout 2019, many of which are designed to benefit and engage our members, and you'll hear more about these as time progresses. As a teaser, there will be a strong 70th theme at our annual Ergonomics & Human Factors conference in April, while next September will also be a key month as it marks the 'birthday' of the Ergonomics Research Society. For now, though, we would like to highlight two plans for wider public engagement, and to call for help with contributions to make this happen.

That's ergonomics!

If you had to do a two-minute elevator pitch for ergonomics and human factors, what would you say? What examples would you give to help someone understand how far-reaching ergonomics is and how its application can make the world a better place?

We're looking for 70 short videos, which could be filmed on your smartphone, illustrating ergonomics and human factors in the world around us. These will be posted on our YouTube channel throughout the year, and then linked from our website, on social media and in other ways. There's a wide remit here, so you can cover anything from a simple interface on a consumer product or website (pointing out how easy or effective it is to use and how this relates to ergonomics) to a complex system like air traffic control (saying in simple terms how the current system has benefitted from human factors considerations).

Bearing in mind the aim is to raise public awareness, the message needs to be simple to understand, clear and preferably focused on one recognisable thing. If appropriate, you could illustrate your message with a bad design but counter it with a good design to show how ergonomics principles have a positive impact.

It doesn't matter if you don't know whether or not ergonomics research and methods were used in your chosen example, and it doesn't have to show the result of a detailed ergonomics design process; the point is simply to demonstrate a principle or a good example of ergonomics and human factors in practice, especially in areas that people might not otherwise have associated with our discipline.

Although there will be some vetting of submissions, primarily to ensure diversity of examples, don't feel you have to have any great video skills; this is meant to show the real world, so just get out your smartphone and record something. You don't have to play a starring role either, you or a colleague could just add a commentary to explain the ergonomics point you're making. It just needs to be informative, engaging and ideally entertaining – and a maximum of two minutes long. We'll supply simple graphics for the start and end of your video, so it will be ready for use without the need for us to add these later.

For more details, go to www.ergonomics.org.uk > About us > 70th anniversary.

Making an impact

The second project aims to produce a glossy publication (working title: 'Impact!'), documenting examples of where ergonomics has had a significant impact on the world in each of the seven decades from the 1950s until the present day. These could be traditional case studies, scientific advances or paradigm shifts – whatever you think merits inclusion.

Again, the audience is the wider public, so we're not looking for technical details, methods or complicated explanations. The example should focus on where ergonomics and human factors has made life safer, better or simply more enjoyable through good application and design that was a significant step forward at the time.

Ultimately, we'll be looking for a submission of around 500 words and of course, you'll be fully credited as the author. There'll be an element of selection, again to ensure a spread of examples as much as quality, so in the first instance we're merely asking for a brief one paragraph outline of your idea by 30 November 2018. Make your submission at **http://bit.ly/EHFImpact.**

With the New Year on the horizon, please inundate us with examples and help us make it a memorable year for the CIEHF!

Mark Young is currently a member of CIEHF's Council and is the lead for its 70th Anniversary Working Group.

akt

Senior Business Leaders Safety Forum

30th October 2018

PIPER ALPHA

On the 6th of July 1988, an inferno swept through the Piper Alpha platform in the North Sea, taking the lives of 167 men.

The AKT Piper Alpha safety workshop draws on the influential Cullen report and personal testimonies in the Scottish and National Archives.

Our dramatisation highlights the lack of proper oversight of production operations in the North Sea. We explore how disastrous decisions and a failure of leadership at many levels contributed to the disaster. Not only was the Piper Alpha disaster entirely avoidable, it had been predicted, by on-shore and offshore personnel.

If you would like to attend, please reply to **denise.powrie@aktproductions.co.uk**.

If you cannot attend the event but would like more information about AKT or the programmes we create please write to **kate.dooley@aktproductions.co.uk**.

Date:	Tuesday 30th October 2018
Time:	Registration will be at 1:00pm for a 2.00 start. Tea and coffee will be available. We invite you to stay for drinks with us afterwards from 4.30pm to 5.30pm.
Venue:	Lilian Baylis Studio, Sadler's Wells, Rosebery Avenue, London EC1R 4TN

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