

# CONNECTIONS

Volume 1 | Issue 1 | May 2021

## Human Factors & Ergonomics and Global Risks

**Sociotechnical Systems  
Modelling for COVID-19**

**Human Factors and  
Ergonomics in Healthcare**

 **USC**  
Centre for Human Factors  
and Sociotechnical  
Systems

# Centre for Human Factors and Sociotechnical Systems

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Defence, Security, & Resilience, *Prof Paul Salmon (Theme Leader)*

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Emeritus Professor Neville Stanton,  
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## A word from the Director

Welcome to the inaugural edition of Connections, a new quarterly newsletter from the Centre for Human Factors and Sociotechnical Systems.

For those of you who don't know us, we are a research centre at the University of the Sunshine Coast in Queensland, Australia who apply Human Factors and Ergonomics (HFE) to understand and optimise behaviour in areas such as transport, defence, sport and outdoor recreation, healthcare, urban design, cybersecurity and workplace safety.

The aim of Connections is to share our latest research with the HFE and wider community and provide news and useful information such as upcoming conferences, new publications, journal special issues, available PhD scholarships, and job vacancies. We are also keen for the reader to get to know the team and so each issue will include a meet the team section detailing centre members current work, inspirations, and pathways into HFE.

The theme of the first issue is Human Factors and Ergonomics and Global Risks, which reflects recent world events and the notion that HFE has a key role to play in understanding and responding to global risks. Adjunct centre member Dr Jason Thompson tells us all about his recent work modelling the spread of COVID-19 and I was asked to write a commentary on the role of HFE in managing global risks. Dr Satyan Chari features in our Practitioner Connections section, and our Meet the Team section includes Dr Adam Hulme and one of our recently submitted PhD students, Rachael Wynne.

I would like to take this opportunity to thank the Connections editorial team for all of their efforts in putting together what is a stellar first issue. It is extremely exciting to see the concept come to fruition and I hope you enjoy what the team has put together.

Enjoy!

Paul

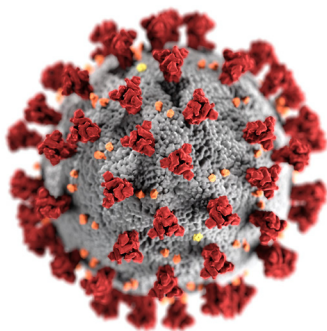


**Prof Paul Salmon**

Director

 @DrPaulSalmon

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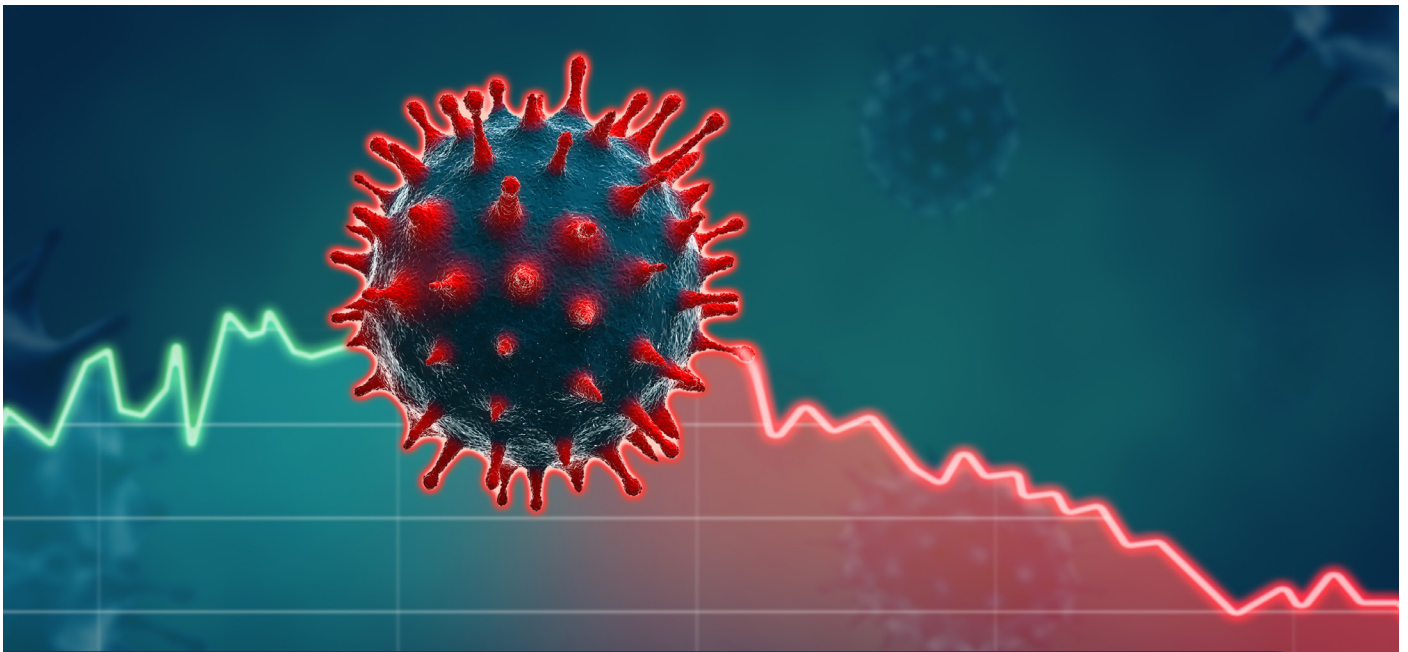
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## When life and models get real

**Dr Jason Thompson, University of Melbourne**

*Jason is a CHFSTS adjunct fellow and a Chief Investigator on Prof Paul Salmon's Australian Research Council Discovery Project 'Managing the risks posed by Artificial General Intelligence'*

Well, here we are in 2021 and thank goodness 2020 is behind us. If you are a Victorian, like me, there wasn't a lot to get excited about. But, if there was an academic silver lining, I have to say it was that the power of sociotechnical systems modeling really came to the fore.

In early 2020 when rumours of the new COVID-19 virus and its devastating effects were circulating in the northern hemisphere, we were at the time hosting a colleague from the World Health Organisation, Dr Thiago Herick de Sa, who had come to work with us at the Transport, Health, and Urban Design (THUD) Research Laboratory in Melbourne. On March 17th, after jumping straight off a flight from Geneva (i.e., no quarantine at all) he delivered a lecture to an anaemic public audience, made up of the handful of people in our Faculty who were still only at work because of either politeness, habit, bravery, or because they hadn't yet worked out how to use Zoom. Most others had seen the writing on the wall and were already prepping at home - toilet-paper and all.

Immediately following the lecture, the University announced that on-campus activities would cease. Having no-where else to go, Dr de Sa

travelled back with me to my house in country Victoria where over the course of the following week, airlines, flights, and opportunities to escape first to Sydney and then back to his family in Brazil collapsed behind him as he went. We travelled increasingly empty roads as I toured him around the countryside and up to the Murray River. We watched last-gasp wedding parties posing for group photos on 150 year-old paddle-steamers, wondering how long this was going to continue. We talked together at a restaurant as the last and only patrons they would probably see for months. Throughout, we discussed what policies government might enact to protect health, the economy, and ultimately welfare.

"We toyed with creating an agent-based model that could describe the dynamics of viral spread through a community, and the sorts of policies that might halt its progression"

Dr Jason Thompson

Importantly, we also toyed with creating an agent-based model that could describe the dynamics of viral spread through a community, and the sorts of policies that might halt its progression. It would be a model of a sociotechnical system.

One that not only included the relatively static biological properties of the SARS-CoV-2 virus, but the more dynamic behaviour of people, communities, economy and movement. It would include the most important biological, behavioural, and spatial aspects of the pandemic.

Ultimately, that model came to be useful. In August, the Victorian Government asked our research group to assist in planning their Roadmap out of the devastating second wave of infections. The aim was to help guide when and how to open up schools again, universities, workplaces, and broader society so that COVID-19 infections got low, stayed low, and minimised the risk of a significant third wave. By this time the model was pretty sophisticated. It could handle policy inputs imagined by Government, combine these with an understanding of how people might respond in-turn, and play thousands of these scenarios out in an artificial society that existed only inside the 'mind' of a computer. Results could then be analysed to see which policy combinations achieved the best outcomes for health and the economy.

Ultimately, this model of the sociotechnical system was successful. We predicted that, despite opening up schools and some workplaces, Victoria would reach less than five new cases per day on October 26th, 2020, enabling us to achieve a 'COVID-normal' summer and beyond. Despite immense scrutiny and pressure, it achieved something that none of the existing epidemiological models available to Government could do - it appreciated not just the virus, but how people and societies might dynamically interact with government policies and social restrictions over time.

Reducing community transmission to zero from over 700 cases per day is something no other country or jurisdiction in the world has achieved. In the words of Victoria's Chief Health Officer, Brett Sutton, the modelling was "extraordinarily helpful" in assisting Government chart Victoria's course to safety.

"We backed the modelling ....and that's what it told us [getting to less than five cases per day was possible] ..... and we are very pleased that it has been validated and vindicated.... If there's a lesson for anyone, it's that science-based disciplines use empirical data and other inputs to try to make the best decisions... it's not perfect, nothing is perfect, but it has been extraordinarily helpful to get us here" – Professor Brett Sutton.

Last week, I went back into the office for the first time since the day of Thiago's lecture, March 17th, 2020. Like a time capsule, the pinned-up signs on the walls advertising the event, now just a little dusty and faded, were still there hanging in the office. For a moment, it made me feel like nothing much had happened last year - that the world had somehow stopped or time had been deleted. However, it has been quite the opposite. Last year showed the importance of sociotechnical systems modelling - of representing and appreciating the dynamic relationship between biological, behavioural, and spatial factors - has never been more recognised.

"The dynamic relationship between biological, behavioural, and spatial factors - has never been more recognised." Dr Jason Thompson



**Dr Jason Thompson**

Research Fellow  
Transport, Health & Urban Design  
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## Practitioner Connections

### Dr Satyan Chari

Program Director

Clinical Excellence Queensland Bridge Labs, Queensland Health

*The Bridge Labs Program is an initiative of the healthcare improvement unit at Clinical Excellence Queensland. CHFSTS is collaborating with the Bridge Labs Program via the Healthcare Human Factors Learning and Innovation Lab.*

#### What is your role in Queensland Health?

I am Program Director for the Clinical Excellence Queensland Bridge Labs, an initiative that fosters linkages with Queensland academic groups in safety, Human Factors and Ergonomics (HFE) and design. One of these labs is HF-NET, which seeks to increase translation of HFE approaches into healthcare. I am also a senior faculty member on the healthcare improvement fellowship program which takes clinicians through a year-long immersion in contemporary quality, safety and improvement approaches. Finally, I sit on a board level committee for clinical quality and care governance with Uniting Care Queensland.

#### What does a typical workday look like for you?

A big part of my work involves facilitating, educating, and supporting clinical improvement fellows on their individual learning journeys. With the Bridge Labs, I focus on strategy and innovation, and develop relationships, priorities and projects that advance the goals of each linkage and the Bridge Labs. I am periodically called upon to bring a HFE perspective on priority projects within the department. COVID-19 has created opportunities to demonstrate the value of HFE in addressing system challenges (large and small). I will often apply HFE tools to map systems, identify high leverage opportunities and design user-centred solutions.

#### What HFE theories / methods do you use, if any?

I use complex systems thinking as my primary lens and this seeps into all of my work. On well-defined macro-, meso- projects, I will draw on formal systems frameworks like Rasmussen's Dynamic Risk Management Framework, normal accident theory and resilience engineering. When working with focused technical questions, I use a variety of tools including AcciMap, STAMP, FRAM, cognitive walkthroughs, and a multitude of physical ergonomics and manual task risk assessments.

#### How does HFE add value to your organisation?

We are on the cusp of something transformative at Queensland Health. Despite small pockets of HFE-led innovation within the system and in cognitive HFE research, the growing influence of Safety II concepts are generating interest in the frontline to understand normal performance in complex systems. We now see surging interest in HFE, patient safety practitioners

“We are on the cusp of something transformative at Queensland Health”

Dr Satyan Chari

seeking to look beyond human error in patient safety incident investigations, digital

teams seeking expert input in the redesign of electronic documentation systems, active consideration of systems HFE issues when conceptualising large scale service deployment programs.

#### What do you consider are the main barriers and facilitators to the use of HFE in practice?

While misconceptions around HFE exist in healthcare, these are slowly resolving. The challenge now is that demand for HFE support outstrips the meager capacity of specialised practitioners in the workforce. While there are no easy solutions, we are trying to address this gap creatively, by extending our capacity by partnering with academia, and working on scalable strategies to build capability into the healthcare workforce.

#### Is HFE valued by practitioners?

While healthcare can be resistant to new thinking, a few fingers do point back at the discipline itself. Specifically, we have not presented a coherent, non-technical and practical narrative around HFE in a way that would appeal to clinical improvement and safety practitioners. Therefore, HFE can be viewed by the workforce as something esoteric, out of reach, or even worse – primarily academic. If anything, our recent collaborations with the Centre for Human Factors and Sociotechnical systems demonstrate that sharing examples of practical applications of HFE principles and methods can generate enormous interest amongst clinicians, senior leaders, improvement and safety practitioners.

# Meet the CHFSTS Team

## What is your current research?

I am working on the theoretical development, reliability and validity testing, and further refinement of next generation, systems-based risk assessment (Net-HARMS), incident analysis (AcciNet), and intervention analysis (SafetyNet) methods.

## How did you arrive into the world of HFE?

My background includes Sport and Exercise Science (BSc HONS), Public Health/Health Promotion (MA), and Epidemiology and Systems Ergonomics (PhD). My PhD supervisor introduced me to Prof. Paul Salmon. From there, I have been blown away by the potential of Systems HFE to address complex issues.

## What do you enjoy most about your job / research?

Intellectual curiosity drives me. I want to know and learn more about systems HFE and the problems that it can be applied to. I love that my work offers diverse projects, with many problems to solve, and supporting students on their HFE journey.

## What book or paper has inspired your HFE journey?

Dr Richard Holden's article in the journal Professional Safety titled "People or systems? To blame is human. The fix is to engineer" Dr Holden recognised that person-centred approaches to safety (e.g., human error and blame) is still prevail in practice, and that greater emphasis needs to be given to systems-centred theories and approaches.

## What's your favourite quote?

"Let yourself be silently drawn by the strange pull of what you truly love. It will not lead you astray." - Rumi



**Dr Adam Hulme**

Research Fellow

 @system\_complex

## What is your PhD research?

My research involves the investigation and comparison of how researchers measure driving related behaviours (both on-road and in alternative environments). Using eye tracking software, I also investigated Learner Drivers' attention and the changes that occur as they gain driving experience.

## How did you arrive into the world of HFE?

My background includes a Bachelor of Psychological Science (Honours). I accidentally came across HFE whilst teaching Psychology, during which, Prof. Paul Salmon and Dr. Natassia Goode presented a guest lecture on accident analysis. A few years later, I decided to commence a PhD with the Centre for Human Factors and Sociotechnical Systems.

## What do you enjoy most about your job / research?

I enjoy trying to solve problems through research, especially analysing the data and figuring out what the data means. I also enjoy sharing the findings of my research with others.

## What book or paper most inspired you on your HFE journey?

The 'hidden' gorilla study has had an influence on my journey in research. It fascinates me that something so obvious (in theory) could be missed: Simons, D. J., & Chabris, C. F. (1999). Gorillas in our midst: Sustained inattentive blindness for dynamic events. *Perception*, 28(9), 1059-1074.

## What's your favourite quote?

"These aren't the droids you're looking for" - Star Wars



**Rachael Wynne**

PhD Student

 @rachaelawynne



## Human Factors and Ergonomics to the rescue? Saving the world with global HFE

Professor Paul Salmon, Centre for Human Factors and Sociotechnical Systems

Society faces an increasing number of complex global risks and existential threats for which we are ill prepared. With an air of foreboding, the World Economic Forum recently outlined the top global risks by likelihood and impact: climate action failure, weapons of mass destruction, extreme weather, biodiversity loss, water crises, information infrastructure breakdown, natural disasters, cyber-attacks, human made environmental disasters, infectious diseases, global governance failure, asset bubble, data fraud and theft, and natural disasters.

The COVID-19 pandemic provides a sobering example of the massive personal, social, and economic costs that arise when the response to global risks is inadequate. At the time of writing, COVID-19 has killed over 2.5 million people with an estimated cost in the region of \$28 trillion dollars (International Monetary Fund, 2020).

Many of the World Economic Forum's global risks are subject to multi-and trans-disciplinary research programs aiming to help prevent them or better manage their impacts. Experts from many disciplines are involved in this work; however, there is little evidence that Human Factors and Ergonomics (HFE) researchers and practitioners are involved, or that the science of

HFE is being considered (Salmon et al., 2019; Thatcher et al., 2018; 2020). As the discipline concerned with understanding and optimising behaviour and human health and wellbeing, this is both surprising and alarming.

At the Centre for Human Factors and Sociotechnical Systems, we believe that HFE has a critical role to play in understanding and responding to global risks. A key feature of most global risks is that they are highly complex but human-centred, and effective management of them requires widespread changes in human, system, and societal behaviour. Optimising behaviour is of course HFE's *raison d'être*, yet we seem to have no seat at the global risk management table.

**"HFE has a critical role to play in understanding and responding to global risks"**

Prof Paul Salmon

Thankfully there are movements within HFE to begin applying our methods to help understand and respond to global risks (Salmon et al., 2019; Thatcher et al., 2018; 2020). Our own research has demonstrated that systems HFE in particular provides a suite of methods that are suited to analysing such complex and large-



scale issues. This is based on the capacity for systems HFE methods to model the structure and behaviour of complex systems and identify 'leverage points' where interventions can have significant effects on behaviour (Meadows, 2008).

Our recent pilot work involved the use of Work Domain Analysis (WDA) to develop a model of the world to support analysis of complex global risks (Salmon et al., 2019). The model demonstrated the interrelatedness of many global risks, suggesting that there were leverage points where interventions could have widespread impacts. For example, optimising land use can support health and wellbeing and environmental protection whilst at the same time minimising pollution and resource depletion. Improving the way in which we use land can have widespread benefits and help prevent or mitigate various global risks.

**“Given the variety and magnitude of current and forthcoming global risks, it is not far-fetched to suggest that humanity may not survive the current century. It is our view that the survival of humanity could depend on systems HFE”**

Prof Paul Salmon

We also recently applied WDA to develop a model of a COVID-19 return from lockdown restrictions system (Salmon et al., 2021). We used the model to identify critical vulnerabilities, conflicting functions and purposes, and leverage points which could be used to optimise future return from lockdown processes. The analysis demonstrated how well intentioned goals and functions (e.g. increase economic activity and prevent virus transmission) can often conflict and prevent systems from working effectively.

Building on this work, we have proposed the use of a many model systems HFE framework to help understand and respond to global risks (Salmon & Read, 2019). This involves the use of systems HFE methods such as AcciMap, STAMP, CWA, EAST, the Sociotechnical Systems Design Toolkit, and System Dynamics in an integrated manner to analyse in-depth global issues and design, model and refine interventions. By applying multiple systems HFE methods together, it is possible to develop in-depth analyses of the systems in which the

risks reside and the personal, organisational, societal and global factors which interact to create global risks. Over the next few years we will be applying this approach to respond to global risks and existential threats in a range of projects.

It is clear that the World Economic Forum's global risks are not going away anytime soon. By 2050 we will also likely face an onslaught of emergent risks related to artificial intelligence, automation replacing human workers, an ageing population, and otherworld settling. Humanity has therefore reached a critical juncture. Should we continue to live as we do whilst at the same time responding sub-optimally to global risks, a dystopian future awaits us.

Global risks are complex, difficult to understand, and even more difficult to manage. This is why systems HFE can and should play an active role in efforts to remove or mitigate global risks. It is hoped that this short piece acts as a rallying cry for HFE researchers and practitioners to engage in work around global risks.



**Prof Paul Salmon**

Director  
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## HFE Conferences

So that you don't miss out on the latest in HFE, here is a list of some upcoming conferences and journal special issues.

13 - 18 June 2021	<b>IEA Congress</b> <i>Vancouver, Canada</i>	14 July 2021	<b>Human Factors and Emerging Risks Symposium</b> <i>Online (details on back cover)</i>
21 - 24 June 2021	<b>Naturalistic Decision Making (NDM) and Resilience Engineering Association (REA) Symposium</b> <i>Toulouse, France</i>	4 - 8 October 2021	<b>65th International Annual Meeting of the Human Factors and Ergonomics Society</b> <i>Baltimore, USA</i>
25 - 29 July 2021	<b>12th International Conference on Applied Human Factors and Ergonomics</b> <i>New York, USA</i>	17 - 20 October 2021	<b>Human Factors and Ergonomics Society of Australia 2021 Conference</b> <i>Online</i>

## Journal Special Issues

Special Issue Title	Journal	Submission Deadline
Applications of Advanced Technologies in Transportation Safety Studies	Accident Analysis & Prevention	30 July, 2021
Safety Science in the New Age of Work	Safety Science	1 September, 2021
Sustainability, Business Responsibility and Occupational Health, Safety and Wellbeing	Safety Science	30 September, 2021
In the Face of Crisis: Human Factors in Organizational and Operational Research	Central European Journal of Operations Research	1 October, 2021
Safety, Health, and Ergonomics in Cleaning Occupations	Applied Ergonomics	30 November, 2021



Interested in applying HFE in:

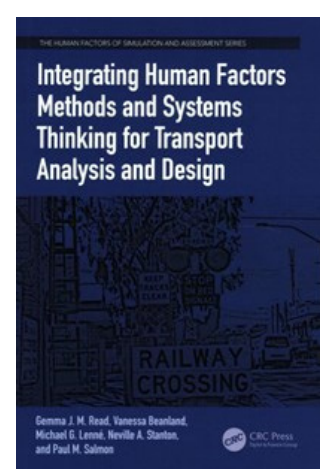
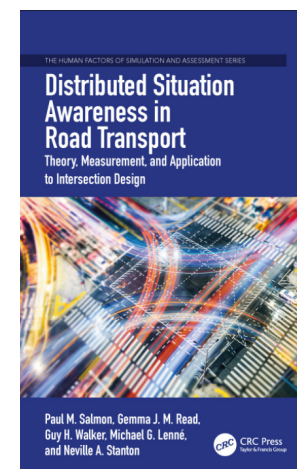
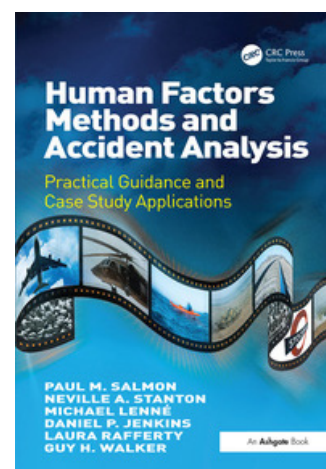
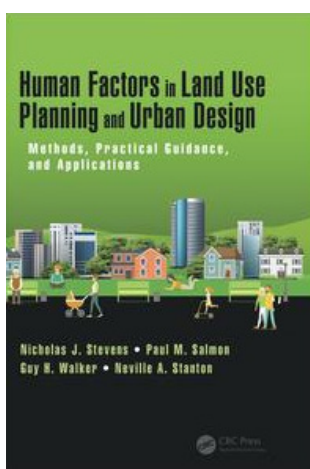
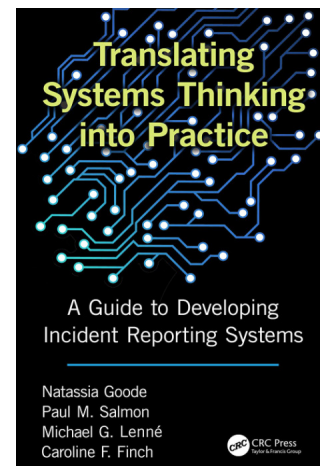
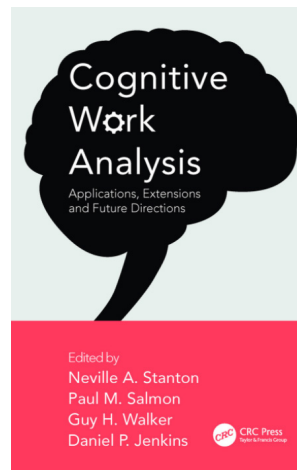
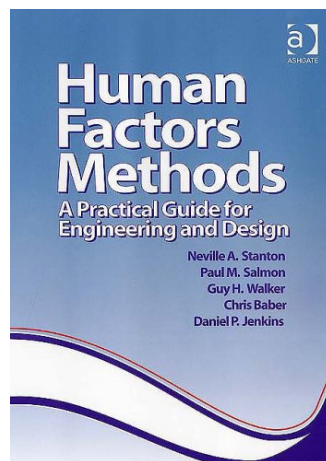
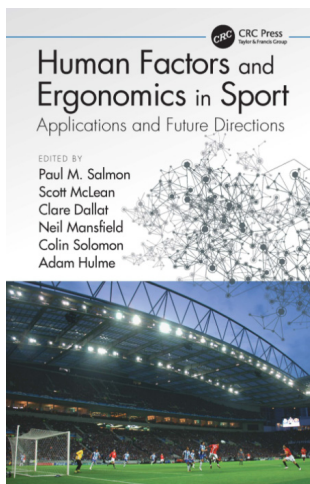
- Transport & Infrastructure
- Defence, Security, & Resilience
- Sport & Outdoor Recreation
- Organisation Safety, or
- Land Use & Urban Planning

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## Books



## Recent Publications

- Hulme, A., McLean, S., Dallat, C., Walker, G. H., Waterson, P., Stanton, N. A., & Salmon, P. M. (2021). Systems thinking-based risk assessment methods applied to sports performance: A comparison of STPA, EAST-BL, and Net-HARMS in the context of elite women's road cycling. *Applied Ergonomics*, 91, 103297. <https://doi.org/10.1016/j.apergo.2020.103297>
- Koorts, H., Cassar, S., Salmon, J. et al. (2021). Mechanisms of scaling up: Combining a realist perspective and systems analysis to understand successfully scaled interventions. *International Journal of Behavioral Nutrition & Physical Activity* 18, 42. <https://doi.org/10.1186/s12966-021-01103-0> (Open Access)
- McLean, S., Finch, C. F., Goode, N., Clacy, A., Coventon, L. J., & Salmon, P. M. (2021). Applying a systems thinking lens to injury causation in the outdoors: Evidence collected during 3 years of the Understanding and Preventing Led Outdoor Accidents Data System. *Injury prevention*, 27(1), 48-54. <http://dx.doi.org/10.1136/injuryprev-2019-043424>
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# Human Factors and Emerging Risks Symposium

*A Centre for Human Factors and Sociotechnical Systems Event*

**When:** Wednesday, 14th July 2021, 6:30pm to 8.30pm (AEST)  
**Where:** Online, via a Zoom Webinar  
**Cost:** Free  
**Register:** Click [here](#) to register or via QR code



## Presenters

Neville Stanton	The quest for the ring: Redesigning the layout for all control rooms of the future
Paul Salmon	Endgame: Human Factors and the management of existential threats
Gemma Read	Beyond human-vehicle interaction: Identifying the system-wide risks to the safe introduction of autonomous vehicles
Nick Stevens	Frequent and fatal: Managing the risk of natural hazards in our urban environments
Lauren Coventon	UPLOADS: A unified industry approach to incident report and learning for risk management
Adam Hulme	A strong signal or lots of noise? A review of evidence to determine whether our risk management methods work in practice
Scott McLean	Controlling the uncontrollable: Managing the risks associated with artificial general intelligence
Clare Dallat	Leading at the front: Applying Human Factors and Ergonomics in practice in international education during COVID-19

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