



**Joint CIB W099 & W123 International Conference 2021:**  
**Changes and innovations for improved wellbeing in construction**  
9<sup>th</sup>-10<sup>th</sup> September 2021



University for the Common Good

# **Joint CIB W099 & W123 Annual International Conference 2021**

**Changes & innovations for improved wellbeing  
in construction**

**9<sup>th</sup>-10<sup>th</sup> September 2021**

## **PROGRAMME & ABSTRACTS**





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## Foreword

Welcome from the Chair of the Joint CIB W099 & W123 International Conference 2021  
Professor Billy Hare, Glasgow Caledonian University.

We would like to extend a warm ‘virtual’ welcome to the construction safety and wellbeing community. Whilst we hoped this year’s Glasgow conference would have been face-to-face, we had to make the difficult decision to once again host the event online. However, this year promises to be bigger and better than last year, doubling in length to two days, and packed full of trailblazers and scholars sharing their research and industry knowledge. We chose to give this year’s conference the forward-looking themes of change and innovation for improved wellbeing, as we see the construction industry meet the challenges of the last eighteen months. The global changes over this period are reflected in the content of the research papers received, and our keynote speakers are likewise bursting with new and exciting ideas for taking our industry into the brave new post-pandemic world. I am sure this year’s conference will be one to remember for all the right reasons and we look forward to seeing old friends and new in our virtual rooms.

## W099 & W123 Committee for 2021

Professor Billy Hare	Glasgow Caledonian University, UK
Professor Fidelis Emuze	Central University of Technology, SA
Professor John Smallwood	Nelson Mandela University, SA
Professor Fred Sherratt	Anglian Ruskin University, UK
Dr Kenneth Lawani	Glasgow Caledonian University
Dr Philip McAleenan	Expert Ease International, UK
Dr Ciaran McAleenan	Ulster University, UK
Dr Patrick Manu	University of Manchester, UK
Dr Emmanuel Aboagye-Nimo	University of Brighton, UK
Mrs Tres Hendry	Glasgow Caledonian University, UK



## Scientific Committee

The success of this Joint CIB W099 & W123 Conference depends on the voluntary efforts of our Scientific Committee. We are indebted to these members who provided constructive feedback in the peer-review process.

Emmanuel Aboagye Nimo	University of Brighton
Aka Adefemi	Federal University of Technology
Wael Alruqi	Al Jouf University
Omar Amoudi	Oxford Brookes University
Bankole Awuzie	Central University of Technology
Paul Bowen	University of Cape Town
Siddharth Bhandari	Western Michigan University
Clara Cheung	University of Manchester
Alex Copping	University of Bath
Marcello Costella	Federal University of Rio Grande do Sul
Fidelis Emuze	Central University of Technology
John Gambatese	Oregon State University
Alistair Gibb	Loughborough University
Matthew Hallowell	University of Colorado
Billy Hare	Caledonian University
Theo Haupt	Mangosuthu University of Technology
Marcus Jeffries	University of Newcastle
Andrea Jia	University of Melbourne
Richard Jimoh	Federal University of Technology
Wendy Jones	Loughborough University, UK
Ali Karakhan	Oregon State University
Elvira Lantelme	Federal University of Rio Grande do Sul
Kenneth Lawani	Caledonian University
Helen Lingard	RMIT University
Patrick Manu	University of Manchester
Thomas Mills	Oklahoma State University
Ciaran McAleenan	Ulster University
Patrick McAleenan	Expert Ease International
Innocent Musonda	University of Johannesburg
Chioma Okoro	University of Johannesburg
Manikam Pillay	University of Newcastle
Payam Pirzadeh	RMIT University
Sally Rajendran	Central Washington University
Tarcisco Saurin	Federal University of Rio Grande do Sul
Fred Sherratt	Anglia Ruskin University
John Smallwood	Nelson Mandela University
Simon Smith	University of Edinburgh
Heldley Smyth	University College London
Michelle Turner	RMIT University
Tariq Umar	Kingston University
Ned Umeokafor	Liverpool John Moores University
Rita Zhang	RMIT University



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## Programme

### Thursday 9<sup>th</sup> September

09.00	Opening: Housekeeping & Welcome Speech Billy Hare, Glasgow Caledonian University Andrea Nelson, PVC, Glasgow Caledonian University
09.15	Keynote: Gordon Crick, Health & Safety Executive
09.45	Keynote: Mike Webster, Construction & Structural Safety, Risk and CDM Specialist
10.15	Keynote: Alfredo Soeiro, ISHCCO Philip Baker, ISHCCO
10.45	Morning break
11.00	<b>Parallel Sessions</b>
	Digital Innovation & Technology      Healthy Mind: Mental Health
12.00	Lunch break
13.00	Keynote: Richard Atkins, Compound Surveys Ltd Martin Lacey, WestGlen Consult Ltd
13.30	<b>Parallel Sessions</b>
	Human Factors & Behaviour      Culture & Leadership
14.30	Afternoon break
14:45	Workshop: 'where to go from here?'

### Friday 10<sup>th</sup> September

09.00	Welcome
09.30	Keynote : Billy Hare, Glasgow Caledonian University
10.00	Keynote: Ciarán McAleenan, ICE
10.30	Morning break
10.45	<b>Parallel Sessions</b>
	Flying Innovation & Technology      Home & Work      Management
12.00	Lunch break
13.00	Keynote: Alistair Gibb, University of Loughborough
13.30	Afternoon break
14.00	<b>Parallel Sessions</b>
	Healthy Mind: Stress & COVID      Healthy Body
15.00	Prize Giving Presentations
16.00	Close & Flag Ceremony
16.30	Management Meeting



## Keynote Speakers

### **Gordon Crick**

#### **HM Inspector of Health & Safety, Chair BIM4 Health & Safety Working Group Health & Safety Executive**

As a Health & Safety Inspector within UK construction, Gordon leads the liaison with industry to promote improved management of health and safety risks through BIM. He also Chairs the BIM4H&S Working Group, which is an independent group promoting good practice in using BIM and digital technology throughout the construction industry. Having previously owned his own construction company, Gordon brings a vast amount of experience from both perspectives.



### **Dr Mike Webster**

#### **Director, MPW R&R Ltd**

Mike, a chartered engineer with over 30 years' experience, runs his own business and provides consulting, forensic and expert witness services focussing on construction and structural Safety, CDM, risk, and health and safety regulations.

He has undertaken detailed reviews of the CDM Regulations and provided consultancy to HSE and duty holders on CDM and construction safety since 2001. He led the independent evaluations of CDM 1994 and CDM 2007, the review of the implementation of CDM 2007 in the construction of London 2012 and, earlier this year, was appointed by HSE to lead a review of the CDM 2015 Principal Designer role which will be published as a HSE Research Report in the future.

Mike has published around 50 publications (<http://mpwrandr.co.uk/publications/>) and 25 articles (<http://mpwrandr.co.uk/blog/>) on a range of risk, regulatory, CDM, construction safety and structural safety issues.

Mike has been instructed as an expert witness by both prosecution and defence teams in cases involving allegations of gross negligence manslaughter and breaches of the Health and Safety at Work Act, the CDM Regulations (1994, 2007 and 2015) and the Work at Height Regulations during construction projects. These cases have involved a range of collapses and hazardous situations on construction sites.

He is a member of the Temporary Works Forum, the Institution of Structural Engineers Health and Safety Panel, Structural-Safety and CROSS, the Panel for Confidential Reporting on Structural Safety.



### **Alfredo Soeiro,**

#### **Vice-President, ISHCCO**

Degrees in Civil Engineering (UPorto, 76) and (UFlorida, Ph.D., 89), Pro-Rector of U. Porto (98/03), president of IACEE (01/04), president of AUPEC (01/05), president of SEFI (03/05), secretary general of AECEF (17/...), vice-president of ISHCCO ([www.ishcco.org](http://www.ishcco.org) 19/...), member of ANECA EUR-ACE committee (14/...) and coordinator and partner of several EU projects in e-learning and author of several papers in e-learning, e-assessment, construction safety, construction management, quality of lifelong learning and use of digital tools in construction.





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**Philip Baker**  
**Chair, ISHCCO**

After an initial career predominantly in design, Philip Baker has spent 25 years working as a Safety and Health Construction Co-ordinator in the UK mainly in the preparation stage on both new build and refurbishment projects. Philip is Chair of the ISHCCO IQF Working Group which developed the ISHCCO Qualification Framework (IQF) that is promoted as the basis for establishing practitioner proficiencies for safety and health construction coordination.



**Richard Atkins**  
**Compound Surveys Ltd**

Richard has nearly 40 years experience in the construction industry, qualifying as a Chartered Architect in 1991. In 2017 Richard completed a PhD in the Assessment of Social, Financial and Environmental Sustainability in the Existing Built Environment at Glasgow Caledonian University. Richard has been responsible for a number of exemplar sustainable buildings, as well as providing consultancy advice to Communities Scotland, Historic Environment Scotland, The City of Edinburgh Council, SUST, WWF, HEEPI etc. Richard's work includes the authorship of a design guide for sustainable tourist infrastructure for the Yemeni island of Soqatra, High Performance Buildings for higher and further education and The Responsible Transfer of Assets from the Public Sector for SUST. Richard Co-authored Historic Environment Scotland *Technical Paper No 8* which looked at energy modelling, 'Sustainability: RIBA Plan of Work 2013 Guide' published in 2016 and jointly edited the Scottish Ecological Design Association's (SEDA) *100 Scottish Sustainable Buildings Book* in 2017. Richard has presented at academic and industry conferences, has taught part time at the University of Edinburgh, lectures at Glasgow Caledonian University and acted as the RIAS lead assessor for the 2002 Sustainable Urban Design Competition.



Richard co-founded [www.RIAS-regs.co.uk](http://www.RIAS-regs.co.uk) a scheme to approve Certifiers of Design (Section 6 - Energy)

**Dr Ciarán McAleenan CEng MICE**  
**ICE Health & Wellbeing Leadership Group**

Ciaran has wandered this earth for many years now, planning for many more, of course, and in his various capacities he has promoted humanity, ethically aligned decision making, and ecological survival. A 'tree hugger' by nature (you should try it) Ciaran's work has always been about workers' care and wellbeing, right from his early life as a lifeguard, his 43 years in civil engineering to his current adventures as a mountain endurance athlete and coach. As the last Chair of Institution of Civil Engineer's Expert H&S Panel and first of its newly directed Safety, Health and Wellbeing Leadership Group Ciaran will deliver a keynote address aligning the linkages between education, research and the civil engineering profession.





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**Martin Lacey**

**WestGlen Consult Ltd**

Martin has over 20 years of experience in international engineering and project management with a focus on the hydropower sector. In addition to his consulting responsibilities, for the last four years he has also been leading a research and development team focused on remote inspection, collaboration and monitoring systems to help improve the delivery of international construction projects and the subsequent management of those assets using remotely located technical expertise.



**Alistair Gibb**

**Emeritus Professor of Construction Engineering Management**  
**Loughborough University**

Alistair has led a research team in construction health and safety, and innovation for more than 28 years. They have completed projects commissioned by UK Government, HSE, research councils, professional bodies, charities and industry. Prior to joining Loughborough in 1993 he had a successful career as an engineer and construction manager on major projects. He retired in 2021 but retains an active involvement in a number of H&S initiatives.



**Billy Hare**

**Glasgow Caledonian University**

Billy is a Professor of Construction Management within the School of Computing Engineering & Built Environment at GCU. He is Research Theme Lead for Built Environments, Deputy Director of the School's Research Centre for 'Built Environment & Asset Management' (BEAM) and former chair of the School Ethics Committee. Billy has a PhD in Construction Management (H&S Thesis); BSc (Hons) in Construction Management & Engineering and a BA in Occupational Health and Safety. He joined GCU in 2002, after a career in construction contracting. Since then, he has delivered research on several HSE, IOSH, EPSRC, CITB and industry funded projects totalling £900k, 50+ peer-reviewed publications and a REF Impact Case Study for REF2014. His research portfolio is exclusively focused on improving occupational health and safety within the construction industry, including studies that have improved worker engagement, migrant worker H&S, and safety in design. These contribute directly to UN Sustainable Development Goals for 'Good Health and Wellbeing', and 'Decent Work'. Billy's industry engagement is a key factor in his research success, with several studies leading to industry guidance for HSE and CITB. He has developed several CPD courses on the subject of construction health and safety, and is currently International Coordinator of the 'International Council for Research and Innovation in Building and Construction' Health and Safety Working Group, and chair of several other industry working groups. His expert commentary is often sought by the media, including coverage of the Glasgow School of Art Mackintosh fire in June 2018, which was covered by the BBC World Service and published in 151 news reports worldwide. Billy has also been appointed as 'Senior Advisor – Buildings and Construction' for the Independent Review of the Queen Elizabeth University Hospital Infections of 2018/19.





## Abstracts

### Digital Innovation & Technology

Digitalisation for Occupational Health and Safety in Construction: A Path to High Reliability Organising? *Jing Xu, Meri Duryan, Hedley Smyth*

LEARNING FROM ACCIDENTS: MACHINE LEARNING PROTOTYPE DEVELOPMENT BASED ON THE CRISP-DM BUSINESS UNDERSTANDING. *May Shayboun, Christian Koch, Dimosthenis Kifokeris*

Barriers to Technology Integration in Construction Health and Safety (H&S) Management in Zimbabwe. *Benviolent Chigara, John Smallwood*

A BIM for safety Framework Involving Automated Rule Checking, Visualization and Training  
*Adeeb Sidani, Joao Pocas Martins, Alfredo Soeiro*

### Human Factors & Behaviour

A Safety leading indicator approach: an exploratory study of the Nigeria construction sector. *Isimemen Ejohwomu, David Oloke, Lovelin Obi, Olugbenga Oladimirin*

Causal Analysis of Crane Accidents Based on Human factors Analysis and Classification System  
*Linqi Zhou, Zhipeng Zhou*

Addressing factors contributing to human errors on construction sites. *Lesiba George Mollo, Fidelis Emuze, John Smallwood*

Work Ethic and Cognitive Models of Work: Contractors and Workers Perspectives on Elevated Injury and Fatality among Latino Workers in Small-Scale Residential Construction. *Shannon Montgomery, Joseph Grzywacz, Michael Merten, Thomas Mills, Antonio Marin and Elsa Nunez Reyes*

### Healthy Mind : Mental Health

Building a 'Sense of Place' to support mental health in construction: A conceptual model. *Michelle Turner, Helen Lingard, James Harley*

Developing an Assessment Tool for Evaluating the Mentally Healthy Levels of Construction Project Organizations in Australia. *Xiaohua Jin, Robert Osei-Kyei, Srinath Perera, Bashir Tijani*

JOB QUALITY AND CONSTRUCTION WORKERS' MENTAL HEALTH: A LIFE SPAN DEVELOPMENTAL PERSPECTIVE. *Helen Lingard, Payam Pirzadeh, Michelle Turner and Rita Zhang*

Improving Mental Health and Safety in the Construction Industry: A Study in Australia.  
*Carol Hon*

### Culture & Leadership

Application of the Worker Engagement Maturity Model to an Industrial Service Organisation  
*Dick Robinson, Billy Hare, Kenneth Lawani, Iain Cameron*

Cultivating a 'just' culture in construction industry to improve Occupational Health and Safety management systems. *Meri Duryan, Jing Xu, Hedley Smyth*

Elevated Injury among Latino Workers in Small-Scale Residential Construction: Contractor and Worker Perspectives. *Joseph Grzywacz, Shannon Montgomery, Michael Merten, Thomas Mills, Antonio Marin and Elsa Nunez Reyes*

Leading safety culture from the top: A typology for top leadership safety commitment. *Siphiwe Gogo, Innocent Musonda*





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### Flying' Innovation & Technology

Safety Implications of Using UAVs in Construction: An Ethical Perspective. *Mostafa Namian, Mohammad Khalid, Michael Behm*

Creating game-based drone for improving construction site safety. *Kenneth Lawani, Billy Hare, Iain Cameron, Hamid Homatash, Julie Campbell*

The Community Logic as a Springboard for Innovation. *Andrea Yunyan Jia*

Ascending Drones' Safety Risks in Construction. *Mostafa Namian, Mohammad Khalid, George Wang, Sharareh Kermanshachi*

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A review of the Costs of Accident in GCC Construction. *Tariq Umar, Nnedinma Umeokafor*

Factors Contributing to Contractors' Health and Safety Non-Compliance on Transnet Projects. *Siyabonga Shezi, John Smallwood*

Occupational health and safety factors influencing absenteeism among construction workers in Johannesburg, South Africa. *Livington Moyo, Shingirirai Feresu, Martha Chadyiwa and John Smallwood*

Protecting the Image - PPE or branded workwear? *Alistair Gibb*

DETERMINING THE ROOT CAUSES OF ABANDONED COMPLETED COMMUNITY-BASED HEALTH PLANNING AND SERVICE IN GHANA. *Edward Nana-Addy, Innocent Musonda*

### Home & Work

FAMILY ROLE BLURRING AND CONFLICT: THE CASE OF SOUTH AFRICAN CONSTRUCTION PROFESSIONALS. *Paul Bowen, Rita Zhang*

Data Driven Analysis of the Impact of Occupants' Tolerance on Building Performance in Classroom Spaces. *Ayca Duran, Ipek Gursel Dino*

The Home as a Work-life Hub: A Policy (and Design) Blackspot. *Kirsten Day, Andrew Martel*

Family members' perspective regarding safety behaviors and responsibility of Latino construction workers. *Michael Merten, Joseph Grzywacz, Shannon Montgomery, Thomas Mills, Elsa Nunez Reyes and Antonio Marin*

### Healthy Mind : Stress & COVID

Occupational Stress and site workers' wellbeing: A case study of Ghana. *Emmanuel Aboagye-Nimo, Francisca Nai, Samuel Osei-Nimo, Sam Mamphey*

Rethinking Construction Health and Safety Legislation Compliance: Lessons Learnt from COVID-19 – Pilot Study. *Mohlomi Raliile, Theodore Haupt*

Perspectives on Mental Health Among Asian Americans During the COVID-19 Pandemic. *Hongyue Wu, Biao Kuang, Yunfeng Chen*

Exploring Acculturation Stressors of Ethnic Minority Workers in the Construction Industry. *Mei-Yung Leung, Khursheed Ahmed*



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## Healthy Body

A study of ergonomic injury exposures from moving heavy objects on construction sites in Johannesburg, South Africa. *Fidelis Emuze*

Risk myopia among UK construction workers: Refining the Prescription for our Safety Glasses  
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An evaluation of manual handling training for non-lumbar musculoskeletal injury prevention  
*Oliver Hewitt and Alexander Copping*



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# Digital Innovation & Technology

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## **Digitalisation for Occupational Health and Safety in Construction: A Path to High Reliability Organising?**

**Jing Xu, Meri Duryan, Hedley Smyth**

University College London, UK

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The occupational health and safety (OHS) performance has plateaued in the UK construction industry and the fatality remains three times the all-industry rate. Digitalisation of the construction industry offers increased productivity and new opportunities to reduce some OHS risks or better manage them. However, there is little in-depth knowledge on their processes and outcomes in terms of driving continuous improvement. This study deals with this gap by using high reliability organising (HRO) as a lens for obtaining insights into digitalisation for OHS management in construction. The aim is to investigate whether and how the implementation of digital technologies can help achieve high reliability of construction OHS. 21 semi-structured interviews were carried out, discussing how the process of digitalisation for OHS applied the five principles of HRO. The findings demonstrate that construction tends towards a 'quick fix' adoption process for technology, which falls short to sustain high reliability performance. Two complementary ways for enhancing digitalisation for OHS, based on HRO, were discussed: (1) integrating soft and hard systems to facilitate learning and interactions between hierarchies, at the firm-project interface and across organisations, and (2) empowering the workforce in OHS management through digital tools supported by appropriate systems at firm and project levels. More importantly, to achieve HRO requires the digitalising process generating collective mindfulness and a sense of caring rather than socially intruding among office and site workers.

**Keywords:** Digitalisation, high reliability organising, mindfulness, occupational health and safety.



## **LEARNING FROM ACCIDENTS: MACHINE LEARNING PROTOTYPE DEVELOPMENT BASED ON THE CRISP-DM BUSINESS UNDERSTANDING**

**May Shayboun, Christian Koch, Dimosthenis Kifokeris**

Chalmers University of Technology, Sweden

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Occupational accidents continue to be an unresolved problem in the Swedish construction industry, despite a whole range of routines, campaigns, education, management appraisals, authorities' enforcement, networks, and research in place. While registered accidents *are* less frequent, there is a widespread willingness to strive for better performance. A potential solution is to apply more robust data analytics to the large company occupational accident registers, complementing existing regular analysis. Machine learning (ML) can provide a promising solution for strengthening data analysis, and international prototypes of such systems are emerging. However, there is a need to appreciate local and corporate concerns, and the ML development method "Cross Industry Standard Process Development Method" (CRISP-DM) appears to offer just that. This paper aims to analyse experiences and challenges in using the first phase of CRISP-DM, i.e., "business understanding". The sociomaterial approach serves as the framework of understanding and is supplemented with accident research and ML development concepts. Methodologically, the paper draws on an ongoing research project to develop a ML prototype for occupational accident analysis. It quickly surfaced that CRISP-DM's "business understanding", while asking relevant questions in the company context (such as the goal for the model and the relative application), was too general to provide developmental guidelines. We, therefore, shifted from a top-down to a bottom-up approach, where knowledge on accident registration procedures and registered accidents became the starting point for iterative prototype development. Also, early challenges were to understand the registered data extracted from standard software with limited transparency, and tackle register entries of different quality. Apart from CRISP-DM's slightly idealistic approach to a company context, it is important to appreciate the classical decoupling between top management and (bottom) project levels in Swedish contractor companies.

Keywords: accidents, machine learning, Sweden, CRISP-DM, construction, accident register



## **BARRIERS TO INDUSTRY 4.0 TECHNOLOGY INTEGRATION IN CONSTRUCTION HEALTH AND SAFETY (H&S) MANAGEMENT IN ZIMBABWE**

**Benviolent Chigara, John Smallwood**

Nelson Mandela University, South Africa

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The integration of Industry 4.0 enabled technologies in construction health and safety (H&S) management is of paramount importance to improve workers' health, safety, and wellbeing. The COVID-19 pandemic expanded the need for Industry 4.0 technology integration in H&S management. Despite this, the findings of previous studies and anecdotal evidence indicate that the construction sector lags other sectors in terms of technology adoption. This study aims to identify the level of Industry 4.0 technology integration in construction H&S, and the factors affecting the integration of Industry 4.0 technologies in construction H&S management. A quantitative survey design was adopted which entailed the distribution of questionnaires to architects, construction managers, engineers, and quantity surveyors, in construction and consultant firms in Harare. The data analysis consisted of computing frequencies and a measure of central tendency in the form of mean scores (MSs) to facilitate ranking of the factors. The results of the study indicate that Industry 4.0 technologies integration in H&S management is sub-optimal. The high investment cost, lack of knowledge of emerging technologies, lack of client support, lack of awareness relative to technologies necessary for H&S, and lack of top management support are the leading factors limiting the integration of technology in H&S management. The study results highlight the significance of policies and strategies that aim to reduce the cost, and raise awareness of H&S technologies in terms of promoting an Industry 4.0 technology-led H&S performance improvement drive. Although the study was exploratory, the findings are useful to inform construction stakeholders with regards to areas that require interventions to enhance technology integration in construction H&S management.

Keywords: construction, health and safety, Industry 4.0, Zimbabwe.

**[Link to this presentation will be made available via the conference website  
www.W099&W1232021.com](http://www.W099&W1232021.com)**



## **A BIM for safety Framework Involving Automated Rule Checking, Visualization and Training**

**Adeeb Sidani, João Poças Martins, Alfredo Soeiro**

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The construction industry bears a lot of casualties and accidents more than other high-risk industries annually. Thus, to have a practical site inspection, monitoring, and training, the AECO (Architecture, Engineering, Construction, and operation) is gradually integrating new digital technologies such as building information modelling (BIM), automatic rule checking, Augmented and Virtual Reality (AR/VR).

The current research objective is to provide a general framework of a BIM-based safety system to improve the safety status in the construction field. The system aims to offer Safety planning, Visualization, safety management, training, automated rule checking, monitoring and inspection. A BIM for Safety verification system is proposed, based on a fully automated approach, adopting Automated rule checking, and a manual approach adopting Virtual and Augmented Reality (AR/VR). These two systems will be a part of a BIM for Safety General Framework, which covers the construction project lifecycle with all the involved stakeholders and international standards.

The BIM-based technologies can help with safety prevention, inspection, monitoring, and training from the design stage to the operation and management. The integration of these tools in a standardised manner could ease the adoption of the tools, following EN ISO 19650-1 and PAS 1192-6:2018, giving the owner better awareness and control over the safety aspects of the project, identifying specific tasks for each stakeholder, and involving health and safety measures from the beginning of the project. Some limitations are found in implementing new tools since every tool represents a standalone, each tool covers a specific field only, the digital tools are not involved in the standards and regulations, workers and safety professionals lack the experience of using such tools, low demand from the owners, incompatibility of software and data format exchange, especially between different appointed parties, and the time spent preparing the BIM model.

**Keywords.** Building Information Modelling, Automated Rule Checking, Augmented Reality, Virtual Reality, Construction, Occupational Health and Safety.



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# Healthy Mind: Mental Health

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## **BUILDING A 'SENSE OF PLACE' TO SUPPORT MENTAL HEALTH IN CONSTRUCTION: A CONCEPTUAL MODEL**

**Michelle Turner, Helen Lingard, James Harley**

RMIT University, Australia

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Sense of Place (SoP) centres on community, belonging, and identity and is associated with psychological wellbeing. The SoP concept is underscored by a positive psychology approach which focuses on conditions and processes in the workplace that contribute to flourishing or optimal functioning. It is proposed that in construction, creating SoP in the workplace will yield benefits for workers' psychological wellbeing. In the construction industry SoP is a relatively understudied area. The conditions and processes which contribute to SoP are not well understood, and this presents as a gap in the literature. The aim of the research was to respond to this gap by identifying a set of protective workplace factors which contribute to SoP in construction, are mutually exclusive, and are measurable. An integrative literature review was undertaken and six components associated with SoP were identified: community, respect, life balance, support, resilience, and engagement. Each of the six components is defined, their relation to mental health is identified, and a set of scales is outlined. A limitation of the study is the lack of empirical evidence for the SoP components and associated scales. It is recommended that future research empirically evaluate the six components of SoP in a construction workforce setting. We acknowledge that developing SoP in construction projects is likely to be challenging due to the temporary nature of work and a transient workforce. However, given the high levels of mental ill-health in the construction industry, it is imperative that strategies seeking to promote mental health are encouraged and supported.

Keywords: construction, mental health, positive psychology, sense of place, wellbeing.



## **Developing an Assessment Tool for Evaluating the Mental Health Levels of Construction Project Organizations in Australia**

**Xiaohua Jin, Robert Osei-Kyei, Srinath Perera, Bashir Tijani**

Western Sydney University, Australia

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Construction project organization is a stressful working environment that exposes project management practitioners (PMPs) to poor mental health, which is a significant social and economic problem in Australia. The New South Wales (NSW) government, Australia government launched training on how businesses can attain mentally healthy workplaces through indicators for mental healthiness evaluation of project organization, where construction projects are executed. While acknowledging the significance of NSW initiative in promoting mentally healthy construction p environments, indicator assessment tool to assist construction businesses in NSW in evaluating mental healthiness of construction project environments is lacking. The paucity of an assessment tool for mentally healthy construction project environment prevented detection of unprecedented risk inimical to the mental health of project management practitioners in NSW, Australia. In this regard, this paper aims to develop an indicator assessment tool in the form of a data spreadsheet, using mental health indicators. Mental health assessment tool would assist project managers and stakeholders to accurately and reliably evaluate the mental healthiness of their construction project organisations in NSW, Australia. More importantly, with the mental health assessment tool, project managers can compare the mental health status of different project organisations on the same basis. The paper adopted systematic literature review to identify indicators for mentally healthy environments from various sectors to build a user-friendly indicators assessment tool for evaluating mental health level of construction project organizations.

Keywords: Construction project organization; Indicators; Mental health ; Assesment tool



## **JOB QUALITY AND CONSTRUCTION WORKERS' MENTAL HEALTH: A LIFE SPAN DEVELOPMENTAL PERSPECTIVE**

**Helen Lingard, Payam Pirzadeh, Rita Zhang, Michelle Turner**

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The research aimed to examine whether the factors that impact manual/nonmanagerial construction workers' mental health change with age. Specifically the research sought to identify, compare and contrast the characteristics of job quality that are related to mental health in three groups of construction workers in varying age brackets (young, middle-aged and older). Data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey was analysed to explore the relationship between job quality and health in Australian manual/non-managerial construction workers. Drawing on a life span developmental perspective, participants were divided into groups according to their age. Longitudinal statistical analysis was conducted to examine the association between four identifiable aspects of job quality and participants' self-reported mental health. The relationships varied by age groups, suggesting that psychosocial risk factors shape construction workers' health differently as they transition from an exploration phase (young workers), through an establishment phase (middle-aged workers) to a maintenance phase (older workers). The findings highlight the need to develop targeted approaches to protecting and promoting the mental health of construction workers in different age groups.

Keywords: mental health, wellbeing, construction



## Improving Mental Health and Safety in the Construction Industry: A Study in Australia

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Many construction workers have poor mental health conditions. In Australia, construction workers died by suicide six times more than they were killed by accidents in construction sites. While there are many factors leading to suicide, a prolonged exposure to psychosocial hazards and their risks in the workplace adversely affects mental health of the construction workforce. Research on psychosocial risks in the construction industry has been very limited. Many existing studies are qualitative and overlook the interdependencies of psychosocial risks and their impacts on mental health of the construction workforce. This lack of information means that mental health intervention strategies may not be as effective as they could be. To fill this gap, the author is undertaking a research project to improve mental health and safety of the Australian construction industry using a Bayesian network and agent-based modelling approach. This paper aims to outline the research framework and share the latest progress and preliminary findings of the research project. Prevalent psychosocial hazards in the construction industry were identified through interviews. Strategies to manage psychosocial hazards and improve mental health of construction practitioners were proposed. While the research described in this paper is being conducted in Australia, comparative research can be done in other countries where the construction workforce is exposed to similar psychosocial hazards with poor mental health. This paper would provide insights to researchers who are interested in mental health and safety in the construction industry.

Keywords: Mental health and wellbeing, health and safety, construction



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# Human Factors & Behaviour

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## **A Safety leading indicator approach: an exploratory study of the Nigeria construction sector**

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The construction industry assembles the construction space needed for economic activities. However, the construction industry's reactive approach to safety has a negative impact on the image of the sector. The current study seeks to determine the extent to which proactive tools, such as safety leading indicators (SLIs), are utilized in the construction sector. The study adopted the use of qualitative research methods, and data was collected using interviews and web scraping. The analysis of the collected data showed that the construction industry adopts the use of a reactive approach to safety management. In addition, the construction segment of the oil and gas industry utilizes a different approach to safety management when compared with other segments of the construction industry. The adoption of proactive measures, such as SLIs, could help to address the poor safety performance in the construction industry.

Keywords: Construction, Health and Safety, Nigeria, Safety Leading Indicators, Sentiment Analysis and Topic Modeling

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## **Causal Analysis of Crane Accidents Based on Human factors Analysis and Classification System**

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In order to systematically analyse human factors that lead to crane accidents, traditional HFACS model has been modified to a four-layer Crane-related HFACS model to investigate human related crane accident causes. The study collected 141 crane accident investigation reports during 2011 to 2020 to establish a database, each report was coded to identify human related causal factors according to Crane-Related HFACS. Struck by load was found to be the most significant crane accident type to which the modified framework was applied to build an accident pathway network through which we could get the most frequent human-factor-chain. The research traced back to the organizational influences from unsafe acts of crane accidents, and accordingly created an accident causal network of the most representing accident type. It provides a theoretical support and reference for reducing crane accidents and improving engineering efficiency and quality.

Keywords: Crane accidents, Causal analysis, HFACS, Human factors, Struck by load



## **OBSERVED FACTORS CONTRIBUTING TO HUMAN ERROR ON CONSTRUCTION SITES**

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Accidents in the construction industry are connected to a chain of events that are caused by human errors. The purpose of this study was to assess factors causing human error on construction sites. The quantitative data were collected from multiple case study projects using non-participant observation protocols in Bloemfontein, South Africa. Gaps in communication, knowledge, safe work procedure (SWP), and skills were observed as error contributing factors in the study. The statistical data suggests that these factors are significant contributors to error manifestation. The results thus provide a reason to extend the study to better understand the dynamics of errors on site. The statistical data further outlines that the construction leaders do not mitigate the observed factors (including fatigue and distractions) contributing to human error. The identification of human error factors would help site management to reduce accidents on construction sites. Being error-wise is becoming a competence that site management must evolve in construction.

Keywords: Accidents, construction sites, human error, workers

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**Work Ethic and Cognitive Models of Work: Contractors and Workers  
Perspectives on Elevated Injury and Fatality among Latino Workers in Small-Scale Residential Construction**

**Shannon Montgomery<sup>1</sup>, Antonio Marin<sup>1</sup>, Elsa Nunez Reyes<sup>1</sup>, Thomas Mills<sup>2</sup>, Michael Merten<sup>3</sup>, Hector Nolasco<sup>4</sup>, Joseph Grzywacz<sup>1</sup>**

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**Purpose.** Small-scale residential construction contractors are of great interest to the field of construction safety because young Latino workers in this subsector have among the highest rates of injury and fatality. This study sought to determine how contractors and workers employed by small contractors think about the nature of their work and their work ethic. **Design.** Qualitative semi-structured interviews were undertaken with n=4 Latino contractors and n=8 Latino workers in the framing and roofing trades of small-scale residential construction. Interviews were recorded, transcribed verbatim, and analyzed for dominant themes and patterns. **Findings.** Contractors and workers held a comparable work ethic. Contractors' and workers' status in the U.S. as an "immigrant" shaped how they thought about the nature of their work and contributed greatly to their work ethic. Because of their immigrant status, both contractors and workers believed they had to "work harder" and "faster" than their American counterparts to demonstrate their value. However, "working hard" and "fast" impeded safety. Workers were often willing to forgo safety precautions and discounted injury risk believing it is at odds with making money needed to support themselves here and family in Mexico. Additionally, traditional Latino cultural norms shaped their belief systems about safety risks, for example, through superstitious beliefs and a "stubborn" nature. **Limitations.** The generalizability of study findings is unknown because the data are from a small, regional sample of contractors and workers in two trades of small-residential construction. **Implications.** Safety interventions in framing and roofing trades of small-scale residential construction must acknowledge the immediate survival demand (i.e., the need to support two families) that underlies worker behavior in the industry. The possibility of potential injury is an important, but comparatively distal threat relative to the short-term financial loss.

**Keywords:** small-scale residential construction, immigrant Latino workers, worker safety, injury inequalitier



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# Culture & Leadership

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## **APPLICATION OF THE WORKER ENGAGEMENT MATURITY MODEL TO AN INDUSTRIAL SERVICE ORGANISATION**

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The aim of the research described in this paper is to validate an existing Worker Engagement Maturity Model (WEMM) that was designed to evaluate WE in health and safety (H&S) in the construction industry and also determine if the WEMM could be applied to evaluate WE in the Industrial Services (IS) sector. This qualitative research used a literature review to validate the five psychological constructs (Meaningful Discussion, Motivation, Trust, Commitment and Empowerment) from an existing WEMM. Further validation was obtained via an expert panel. The methods employed 12 semi-structured interviews with workers at three locations. Thematic coding analysis was undertaken to fully understand workers' perceptions of engagement in H&S. The research found that the WEMM is a valid and reliable tool for evaluating WE in H&S in the Industrial Services sector. An amended WEMM was developed and this would benefit from further testing in other public and private sector organisations. The study was bound by the limitations of time and resources of a Professional Doctorate, which limited the sample size. This study has contributed to the existing body of knowledge on Worker Engagement in H&S by validating an existing evaluation tool in another industrial sector. The research has also further developed the maturity levels designed to evaluate WE in H&S.

**Keywords:** meaningful discussion; motivation; trust; commitment; empowerment.



## **Cultivating a 'just' culture in construction industry to improve Health and Safety management systems**

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Within the last decades, safety statistics in the UK construction industry have reached a plateau and cultural changes are required for further improvement of occupational health and safety (H&S) management systems. The aim of this research is to understand how the UK construction industry can improve H&S reporting to learn from failures and near misses based on experience of aviation and aerospace industries that made a successful shift from a 'blame' to a 'just' culture. The reason is that H&S culture remains undeveloped within the industry. Cultivation of a culture that can facilitate bottom-up reporting and learning from failures and near misses is difficult due to fragmented nature and the complexity of construction programme and project operations. The industry that is criticised for being inward looking and slow in learning could benefit from safety practices of other safety-critical industries, rather than take a position of its uniqueness. An interpretative methodology is applied in this research. Thematic analysis is supported by cognitive mapping technique. The findings revealed that H&S practices in the construction industry are affected by the lack of consistency across construction sites due to fragmented supply chain, 'silo' project culture and a tendency to blame individuals for human error. The levels of engagement with bottom-up reporting are quite low and the most frequently mentioned reasons are transactional approach to H&S by the management, figure-pointing behaviours, lack of robust follow-up processes and lack of trust. H&S regulations, norms and guidelines do not include all possible safety issues specific to unique project environments. Cultivation of a 'just' culture could help the industry to go beyond H&S legal compliance and change attitude to safety reporting. Despite the differences, construction organisations can learn from aviation and aerospace industries' accountability for the systems they design and from their proactive approaches to dealing with human error and encouraging and facilitating self-reporting.

Keywords: Health and Safety, Construction, Culture, Management System, Organisational Learning.



## **Elevated Injury among Latino Workers in Small-Scale Residential Construction: Contractor and Worker Perspectives**

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The desired outcome of this study was actionable information that could be converted into intervention strategies that could be deployed with immigrant Latino construction workers in small-scale residential construction and the constructors who employ them to reduce construction-related injuries.

Qualitative data obtained from semi-structured in-depth interviews with n=7 immigrant Latino construction workers in small-scale residential construction and n=5 immigrant Latino contractors in small-scale residential construction were coded and analyzed.

There was substantial overlap between workers and contractors in the causes of common injuries in small-scale residential construction. There is a general lack of concern with safety attributed to human nature (i.e., That's Just the Way We Are; We're Careless). Safety's relative priority is further diminished by a desire for workers and contractors to make as much money as possible in the shortest amount of time.

These data were obtained from workers and contractors in a single urban setting in the southern, midwestern region of the United States. Although the data comport with beliefs reported by immigrant Latinos in other sectors of the economy, the generalizability of the results in the construction industry is unknown.

*Implications.* These data indicate that small-scale residential construction contractors, like their workers, place a premium on finishing jobs quickly as a matter of keeping their business going. The data also demonstrate an undeniable need to include both workers and small contractors in strategies to improve safety in small-scale residential construction.

**Keywords:** Accident; Behaviour; Immigrant Latino Workers; Qualitative Research; Safety Education



## Leading safety culture from the top: A typology for top leadership safety commitment

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The debate on leadership commitment in the organisational health and safety (H&S) effort has been on the agenda of many scholars and industry participants; however, this is directed chiefly to middle managers and supervisors. The conceptualisation of how leaders can achieve this commitment has been viewed within the leadership styles framework, most of which are based on traits and behaviour. Recent literature establishes further dimensions of this conceptualisation to point to a balanced matrix of hard and soft skills whilst anchored on the type of leadership style as a driver. The reliance on leadership type limits the effects of environmental elements on the top leaders and how these leaders apply their effort in H&S. This paper reflects on the limitations of literature on leadership commitment in the transformation of H&S culture and is directed to the construction industry in South Africa, where its main contribution is exploring the top leadership commitment aspects within the national setting. In this context, the study establishes that conceptualising the top leader's commitment incorporates cognitive and social intelligence and contextual H&S knowledge and discipline/science knowledge. It is found that these aspects are shaped by the national context and development approach on top leadership competency, specific to H&S. The associated H&S leadership development and audit framework are explored consistently with the national context and leadership echelon. We propose a typology that recognises the effect of national context in the commitment required to make a sizeable impact in the transformation of H&S culture by the upper echelon leaders. The balanced-mix typology of hard and soft skills is developed from a literature synthesis through a systematic literature review focused on the top leadership commitment in the H&S context grounded on the contextual setting.

**Keywords :** Construction industry, organisational health and safety, safety culture, transformation, top leadership



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# 'Flying' Innovation & Technology

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## **Safety Implications of Using UAVs in Construction: An Ethical Perspective**

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The applications of Unmanned Aerial Vehicles (UAVs), also known as drones, in construction have been rapidly escalating due to their prevalent advantages in accessibility, cost, and efficiency. As a result, over the last decade, many construction companies have utilized drones in their projects by curbing manual labor into technology-based automation in construction surveying, remote monitoring, progress tracking, surveillance, and inspection. Aside from the astonishing opportunities of UAVs, they can pose significant safety and privacy risks to workers. Construction is reported as one of the most hazard-prone and fatal industries. The predominant integration of drone operations brings in a wider spectrum of unwarranted risks and hazards. The safety implications of drones in construction have recently received much attention from researchers and practitioners. However, there is an evident scarcity pertaining to the underlying ethical challenges impacting the safety and wellbeing of the construction workforce. This research aims to review the existing scientific literature and government regulations in place to address the undesirable aspects of using drones in construction job sites from an ethical perspective. These ethical concerns pertaining to the utilization of drones can impede a worker's safety performance and jeopardize the physical and mental health of construction workers and expose them to vulnerable status. This eventually leads to compromised safety performance and hazardous situations. The findings of this study would help the construction professionals and practitioners who aim to safely utilize drones in their projects with the intention of keeping the workers' mental and physical health intact.

Keywords: UAV, Drone, Construction Safety, Ethics, Risk.





## **Creating game-based drone for improving construction site safety**

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Technological advances in the construction sector promises faster and more streamlined working practices. Forward-thinking contractors are investing in digitizing their operations and the use of drones with the capability of providing real-time site information is already a reality. Deploying drones for site inspections can help construction and safety managers avoid placing workers in precarious situations and the ability to quickly gather site aerial data can be invaluable. This study focuses on creating a drone flying game for inspecting construction sites and identifying potential safety hazards. The single-player, user-focused game comprises of fun flying mechanics to control the drone and this is an integral part of enabling users to gain the experience of simulated flying of a real drone. The game platform is the WebGL for rendering interactive 3D graphics within any compatible web browser without the use of plug-ins. The target audience for user experience and usability testing are construction and safety managers, construction professionals and students working in the industry. Preliminary findings revealed that the drone game was fun to play; the game was intuitive and easy to pilot the drone; the hazards in the simulated construction environment looked real; and the game satisfies the main aim of the playtest. The skills acquired from playing the educational drone game for site inspection and monitoring can successfully be applied when flying a real drone in a construction site. The significance of using drones for site inspection during Covid-19 pandemic where workers need to be physically distanced is timely and relevant.

Keywords: Drone, Site inspection, Simulation, Game-based, Site safety, Web Graphics Library

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## **The Community Logic as a Springing Board of Innovation in Major Projects and the Role of OHS in Fostering It**

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Occupational health and safety (OHS) management in major construction project organisations has been practiced in two distinctive institutional logics: one is a protection logic upheld by the regulator and the union focusing on risk avoidance, another is a production logic upheld by construction people focusing on efficient delivery of the project. These two logics compete for resources and attentions in the project process, leading to suboptimal outcome in safety and productivity. This paper discusses the concept of a third logic that helps reconcile the two conflicting logics, the community logic, and its function as a springboard for innovation, as well as the role of OHS practices in fostering it. The research took a grounded theory approach. Three cases from on-site ethnographic fieldwork are illustrated to initiate a journey of theoretical development. This is followed by an iterative literature review between empirical and theoretical references. The results suggest that the community logic generates innovation by allowing the holistic person to function and take initiative, bringing in diversity, self-initiative, social capital and peripheral communication into the major project field. It focuses on building trust and partnership among the stakeholders to effect a secure environment that nurtures a supportive network in which actors can engage in open exchange of ideas for identifying needs and framing problems, from which innovation emerges. Extended OHS or CSR activities help foster a community logic by engaging diverse actors and giving lay users opportunities of participation in the project process. A path model is synthesized from the findings and illustrated as a recommendation.

**Keywords:** Institutional logics, community logic, employee-driven innovation, health and safety, peripheral communication



## **Ascending Drones' Safety Risks in Construction**

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Drones or Unmanned Aerial Vehicles (UAVs) have established rapid technological dominance due to their remarkable efficiency and diverse applications. Drones are capable of being equipped with the latest cutting-edge technologies to execute tasks that seemed merely impossible by using traditional methods until now. Contrarily, UAVs can expose construction workers to a new array of safety risks. Construction is among high injury-prone industries, while the safety risk levels can potentially be heightened even more by UAVs. The industry lacks an adequate understanding given the scarce research of drone-associated safety hazards. This study aims to comprehensively identify and investigate drone-related hazards and the associated safety risks in construction and find the relative impact of identified hazards. An online questionnaire survey was developed and distributed among construction experts. The analysis of collected data from an extensive literature review and surveying 54 construction experts revealed a wide range of safety risks, including 'unauthorized trespassing' ranked first followed by 'system malfunction,' and 'distraction.' The research findings can help practitioners and professionals to mitigate safety risks of using drones in their projects and incorporate counterpart preventive measures into their safety management programs.

Keywords: construction, drones, safety risk, UAS, UAV.



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## Home & Work

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## FAMILY ROLE BLURRING AND CONFLICT: THE CASE OF SOUTH AFRICAN CONSTRUCTION PROFESSIONALS

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Many construction professionals play a role in both the work- and family-domains, frequently engage in role transitions and role blurring, and often juggle between work and family demands. The proliferation of communication technologies makes the boundaries between work and family more blurred and permeable than ever. Using data collected via an online survey, the relationships between work demands, role blurring, work-to-family conflict (WFC), and health and wellbeing consequences among South African construction professionals were explored using structural equation modelling (SEM). Work pressure was found to be a pivotal antecedent to all role blurring activities i.e., after-hours work contact, pre-occupation with work, and multi-tasking between job tasks and family tasks whilst at home. Work contact is directly predicted by work hours, but work hours indirectly affect pre-occupation and multi-tasking via the mediating role of work contact. All role blurring activities are positively associated with construction professionals' experience of work-to-family conflict, subsequently leading to depression and sleep impairment. The results also indicate that depression affects the quality of sleep and that construction professionals are likely to consume use alcohol to cope with sleep problems. Depression was found to be negatively associated with alcohol consumption, which calls for a more fine-grained analysis of the complex inter-relationship. This study provides evidence that excessive work demands can interfere with the family domain through the boundary permeating mechanism of role blurring, ultimately affecting construction professionals' health and wellbeing. This study highlights the importance of appropriate work design with manageable workloads and reasonable work hours. It also points to the promotion of boundary tactics for reducing work-family role blurring and conflict experienced by construction professionals, providing valuable pointers for organisations in the construction industry.

Keywords: Role blurring, work-family conflict, health and wellbeing, alcohol consumption, construction professionals.



## **Data-driven Analysis of the Impact of Occupants' Preference on Building Performance in Classroom Spaces**

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Occupant behavior is a prominent factor affecting occupants' well-being indoors. Occupants' thermal satisfaction is subjective, as the sensation of comfort is subjective and depends on physiological factors. Variations in the occupants' thermal preferences have a significant impact on building performance and occupant's comfort. However, occupants' behavior and preferences are standardized in building simulations with generalized assumptions on comfort conditions. For this reason, their influence on the building performance and occupants' desired comfort conditions are neglected. Particularly, educational buildings should provide their occupants' satisfactory indoor environments as indoor conditions play a determinant role in the performance, productivity, attendance, and health of both students and teachers. Classrooms generally operate at full capacity, leading to high internal gains, severe indoor overheating, and increased carbon dioxide concentration levels if not adequately ventilated. This study presents a data-driven methodology to analyze the impact of occupants' preferences on their comfort in classroom spaces and its environmental impact. Based on the simulation outputs, three prediction models with different decision tree (DT) algorithms (Classification and Regression Trees, Random Forest, and Extreme Gradient Boosting) are build and compared. In order to understand relationships between input features and outputs, in other words, occupant-controlled building parameters' effect on well-being in classrooms and the environmental impact, DT feature importance's are calculated. There is a tradeoff between resource consumption and occupant comfort and well-being should be maintained in school buildings, especially in classrooms. In this study, occupant well-being in classroom spaces is related to thermal comfort and indoor air quality. A naturally ventilated classroom space facing south in Ankara, Turkey, is selected as a case study.

**Keywords:** Building energy performance, data-driven model, educational building, occupant behavior.



## **The Home as a Work-life Hub: A Policy (and Design) Blackspot**

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There is a complex relationship between home and work for people with a disability that is not reflected in the many policies and legislative frameworks that apply to housing in Australia. These include Commonwealth housing policy (largely financial in nature), the Building Code of Australia, and Home Modification Schemes run through the National Disability Insurance Scheme. Much current policy settings assume housing as a passive economic generator – a financial asset that appreciates and gains value over time.

However, for many people with disability, the home is a place of active economic activity, both by the person with disability (working from home) and for them, as external workers come into the home to provide services that support their activities of daily life. This complicates the spaces within dwellings, particularly in terms of public and private space, which effects personal and professional places. The policy and legislative disconnect is reflected in housing design which manifests in a structural inequality – homes are not accessible, and a social inequality – homes do not support work or socializing.

This paper reviews the policy and legislation used to support appropriate design recognising the role of the home as a location that blends elements of privacy, work, and socialising, while also providing the physical support so people can work and socialize in the community as full citizens. The aim of the ongoing research is to show how change and innovation to the legislative frameworks and the role that AECM consultants can play in improving the wellbeing of people who live with disability.

Keywords: building codes, disability, policy, legislative frameworks, housing



## Family members' perspective regarding safety behaviors and responsibility of Latino construction workers

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Family is a major agent for change, regardless of whether the focus is on disease management, educational success, or safety in the workplace. The current study aims to examine beliefs about worker safety from the perspective of family members of small-scale Latino construction workers and provide insight into issues of promoting safety in the workplace and beliefs about responsibility as it relates to accidents and injuries that occur on the job.

Qualitative semi-structured interviews were conducted with 18 family members of small-scale Latino construction workers in the framing and roofing trades. The 60-90 minute interviews were audio-recorded, transcribed verbatim, and analyzed for dominant themes.

Preliminary data finds that family members are aware of the dangers that the Latino construction workers face. Interviews suggest that family members (largely spouses) acknowledge that family members are to varying degrees familiar with unsafe behaviors exhibited on the worksite. In regards to family members' involvement in encouraging worker safety, family members communicate messaging about safety to workers in both passive ways and methods that involve "thinking about family."

The generalizability of study findings is unknown because the data are from a small, regional sample of contractors and workers in two trades of small-residential construction.

Understanding the perspectives of family members of small-scale Latino construction workers regarding safety behavior and responsibility is a novel approach to creating worker education programs that have the potential to be more effective than traditional worker/contractor only programs.

An opportunity exists for family members to become more actively involved in promoting safety practices of the worker. The inclusion of family members in small-scale residential construction safety programming may significantly reduce serious injury in the workplace.

Keywords: accident, family members, immigrant Latino workers, qualitative research, safety, small-scale residential construction.





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## **A REVIEW OF THE COSTS OF ACCIDENT IN GCC CONSTRUCTION**

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Construction industry in the Gulf Cooperation Council (GCC) member countries is at peak as the region is in the stage of developing its major infrastructures. The development projects in the GCC have made the region as a major jobs hub for both local and international workforce but at the same time these projects have also resulted into several issues including poor safety performance. This article attempts to estimate the costs of workplace accident in construction using qualitative research approach and considering different parameters. The data from three countries Qatar, Oman and Saudi Arabia was used to estimate the cost of accident in GCC region. The parameters used in these estimates include the i) values of the current projects in the selected countries, ii) average cost of accident in United States of America (USA) and United Kingdom (UK) and iii) compensation cost. The average cost of an accident in USA, UK, Australia (ASU) and South Africa (SA) was used for comparison of the costs of accidents in Qatar, Oman, and Saudi Arabia. The total costs of an accident in Oman are estimated at US\$ 415,620 with an economic burden of US\$ 205.73 Million/year on Omani economy. In Saudi Arabia, the costs of an accident are estimated at US\$ 91,940, while the economic burden of the Saudi economy is estimated at US\$ 261.11 Million/year. The findings of this research will be useful to understand the cost implication of accidents in construction, and thus will be helpful to motivate the construction organizations to invest in safety related issues and avoid accidents. One of the main limitations of this research is that the direct costs are calculated from the indirect costs of accidents due to the lack of available data. Further research is needed to estimate the direct costs of accident in the region.

**Keywords:** accidents, construction, costs of accidents, economic burden, GCC region.



## **Factors Contributing to Contractors' Health and Safety Non-Compliance on Transnet Projects**

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The construction industry is well known as being a dangerous and risky industry compared to other industries and Transnet construction sites are not immune to these revelations. Unsafe acts and unsafe working conditions are major contributors to work related incidents, injuries, and fatalities. In South Africa, the Occupational Health and Safety Act (OH&SA) and Construction Regulations 2014 are the primary legislation that govern health and safety (H&S) in construction. However, the South African construction industry exhibits high levels of non-compliance with H&S legislation, especially the Construction Regulations.

The aim of the study is to evolve a strategy to promote contractor compliance with H&S legislation and regulations by contractors undertaking Transnet projects. In general, most contractors working on Transnet construction sites are not complying with the applicable H&S legislation and safe working procedures (SWPs).

The quantitative research methodology was adopted for this study. The study was confined to ten Transnet construction sites countrywide, and a questionnaire was circulated to Transnet projects' staff, contractors' management, and built environment professionals (BEPs) such as construction project managers (CPMs), designers, and construction H&S practitioners (CHSPs).

The study established that failing to adhere to the H&S regulations and working procedures lead to contractors' workers undertaking unsafe acts (behaviours) on construction sites. Furthermore, most contractors are failing to appoint competent personnel, either due to budget constraints, and / or unavailability or lack of competent persons in the industry.

The study concluded that a good H&S management system that defines leadership, management involvement, safe work procedures (SWP), management commitment, communication, and competence, impacts positively on project H&S performance.

Recommendations include that all project and construction personnel should share the responsibility for H&S on construction sites and key responsibilities at various stages of the project should be given to personnel with the necessary H&S competencies and capacity to control project hazards and risks.

Keywords: Competencies, Construction, Health and Safety, Transnet

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## Occupational health and safety factors influencing absenteeism among construction workers in Johannesburg, South Africa

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Absenteeism among construction workers is a cause for concern in this industry. Unearthing occupational factors linked to non-attendance in this labour-intensive industry was prioritised, hence determining the relationship between occupational health and safety factors and absenteeism among these workers was imperative.

The study assessed if there was a statistically significant association between absenteeism and reported workplace exposures and health ailments among construction workers, to influence the effective implementation of safety management systems among small and medium construction firms.

A cross-sectional design was used to assess the prevalence of exposure and health outcomes for comparative analysis. A simple random sampling technique was used to select research participants. The sample size of 500 participants was determined using Epi Info™ 7.2 statistical software for epidemiology. Data was analysed using the IBM SPSS™ Statistics version 26. Data visualisation tools, frequency distributions, cross tabulations and logistic regressions were used to present and analyse data.

Research results reflected an association between absenteeism and occupational health and safety factors. There was a probability of a small construction employee being absent from work with an AOR of 0.34 (0.20, 0.58) and 4.04 (1.40, 11.66) for age. A correlation existed between absenteeism and workplace exposures [cement exposure 0.53 (0.30, 0.92), Heat AOR of 2.60 (1.55, 4.35), and dust 1.79 (1.11, 2.90)]. An AOR of 3.49 (2.36, 5.16), 1.77 (1.05, 2.97), and 1.96 (1.12, 3.45) for workplace injuries, chronic flu, and pneumonia-related pains indicate the existence of an association between the dependent and the independent variables.

The findings of this study showed that there was a statistically significant association between absenteeism and occupational health and safety factors. The probable association between the dependent variable and independent variables implied correlation, not causation. Further research with a focus on causative factors was recommended.

Keywords: absenteeism, construction workers, exposure, health ailments, workplace exposures



## Protecting the Image - PPE or branded workwear? A mega-project case study

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High visibility workwear has become ubiquitous on most large construction sites in many countries across the world. Short-sleeved 'tabards' have been superseded on many sites by full length trousers and jackets. The main overt rationale is conspicuity for the safety of the wearer. However, it has become common practice for organisations, and sometimes projects, to use the workwear to advertise their name or corporate logo. As part of a transformational health, safety and wellbeing strategy, London infrastructure mega-project, Tideway, has gone one step further, by designing and procuring a new suite of workwear, moving away from the standard yellow or orange to red and teal. They have also developed a new type of work boot, based on snowboarding footwear. The project team's desire was to create a distinctive style and also to stimulate a positive project *belonging* as part of their health safety and wellbeing culture. However, producing a new set of workwear from scratch created some unexpected challenges for the project team. As part of a three-year longitudinal study, funded by IOSH, researchers followed the design and procurement of this transformational PPE, deriving lessons for future projects considering similar interventions. The paper draws on data from face-to-face interviews, site observations and field notes from meetings over the full three years.

Keywords: Health; Safety; Wellbeing; PPE; Workwear; Mega-Projects; Vision



## **DETERMINING THE ROOT CAUSES OF ABANDONED COMPLETED COMMUNITY-BASED HEALTH PLANNING AND SERVICE IN GHANA**

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This paper evaluates the root causes of abandoned completed Community-bases Health Planning and Service (CHPS) projects in Ghana.

The study was conducted in four phases. These include; awareness and background knowledge of the problem, extensive literature review, development of quantitative instruments, piloting of the research instrument, data collection and analysis, interpretation, and discussions of the results. Forty-six possible root causes of abandoned completed CHPS projects were identified. Purposive sampling techniques (PST) were employed to select 20 respondents from each of the 16 regions totaling 320 respondents. The respondents identified were taken from Government officials, Consultants and End-users within the 16 regions of Ghana who were directly involved with the CHPS projects. The descriptive statistical analyses of the data were adopted.

The result identified 6 most critical root causes of completed abandoned CHPS projects. In ascending order; inadequate project selection criteria, lack of political interest, delay of project approval, unresolved dispute, changes of priority, corruption/bureaucratic bottlenecks.

The quest for good health care delivery in the rural communities by the ministry of health and the Ghana health service was impeded when completed CHPS projects were left un-used. The significance of the identification of the root causes is to help government or stakeholders involved in health facilities development to execute strategies to curb health completed abandonment projects in the country to have project success.

**Keywords:** Abandonment, CHPS building project, Project completed, Root causes, Rural health project.



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# Healthy Mind: Stress & COVID

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## OCCUPATIONAL STRESS AND SITE WORKERS' WELLBEING: A CASE STUDY OF GHANA

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Stress and its effect on workers' wellbeing are a concept that is well-documented in the academic sphere. The construction industry is no different and may even possess a slightly higher problem due to its macho culture. Site operatives such as skilled tradesmen often fall under the hard-to-reach category and tend to be missed out on many investigations. This could be as a result of the transient nature of their roles and time of site. Construction site workers are exposed to excessive job demands and this increases the risk of prolonged stress which adversely affects their wellbeing. Unfortunately, very little research and documented guide exists in the case of many developing economies particularly Ghana. This research aimed to investigate the elements of occupational stress that affect the wellbeing of site workers in Accra, Ghana. 20 semi-structured interviews were conducted with site workers. This was followed up with two focus group sessions. Some key themes that emerged were task-related stressors, work environment stressors and overall organisational stressors. It was identified that most stressors affected the workers' physical, social and psychological wellbeing. It was a common perception that the wellbeing of Ghanaian construction site workers needed to improve significantly. The identified stressors were widely agreed to affect the workers' productivity; a vital point that employers failed to pay attention to. This research offers some important recommendations based on relevant literature and respondents' views to aid in the improvement of site workers' wellbeing in Ghana and possibly countries bearing similarities in construction project practices.

Keywords: Ghana, occupational stress, site workers, wellbeing





## **Rethinking Construction Health and Safety Legislation Compliance: Lessons Learnt from COVID-19 – Pilot Study**

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Despite numerous attempts to enforce construction health and safety legislation, low levels of compliance with health and safety requirements and high rates of accidents continue to exist in the construction industry. The far-reaching impact of the novel coronavirus has spawned the attention of international and national regulatory bodies and has led to the promulgation of emergency legislations both temporary and permanent. This study aims to identify lessons learnt from the COVID-19 pandemic to rethink the significance of health and safety legislation. The study further identifies how these changes have improved the overall safety landscape on construction sites. A quantitative method of data collection was adopted, and data were analysed using IBM Statistical Package for Social Sciences (SPSS) version 25. Descriptive and inferential statistics were used to analyse the data collected. The sample size for the study was 21 contractors in the region of Kwa-Zulu Natal province in South Africa. This is a pilot study which forms part of an ongoing empirical research. The study reveal that construction companies are conducting COVID-19 risk and mitigation plans, detailing the implementation plans for the safe re-activation of construction sites and the industry. It is incontestable that the pandemic has succeeded in probing the alertness, readiness and commitment of construction stakeholders as they are obliged to protect, respect and fulfil the rights to health of their workers. Although there are challenges regarding the susceptibility of the industry to the consequences of COVID-19 such as contractual obligations, additional provisions, pricing strategies and supply chain changes; the rapid response to the pandemic by construction stakeholders is unprecedented and commendable. It is hoped that after the pandemic, contractors will maintain the level of commitment and compliance with health and safety legislation in pursuing the full realisation of the health and safety of their workers as a do or die situation.

**Keywords:** COVID-19, Compliance, Construction, Health and Safety, Legislation



## Perspectives on Mental Health among Asians in America under Impacts of the COVID-19

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Mental health is a national public health concern, especially during the COVID-19 pandemic. However, little is known about the perspectives on mental health among Asians in America and its influencing factors relating to work and life. Therefore, this study aims to explore mental health and its influencing factors for Asians in America under the impact of the pandemic. A nationwide survey was conducted with Asians ( $n=56$ ) and non-Asians ( $n=108$ ) in America. Two-way Analysis of Variance (ANOVA) results showed that there were no significant differences in mental health, social support, and work-life balance between Asians and non-Asians, while significant differences were identified in work stress. Asians in American had a higher satisfaction level towards work stress. Also, simple linear regression carried out of the Asian samples revealed that younger individuals represented better mental health, lower work stress, more social support, and better work-life balance. Women also obtained more social support and achieved a better work-life balance than men. Last, the perspective on mental health and its influencing factors was shaped by simple linear regression, which showed that the satisfaction level of work stress, social support, and work-life balance all had positive relations with satisfaction level toward mental health. This study contributes to a deep understanding of mental health for Asians in America. The findings help in guiding policies, strategies, and supports to ensure mental health for Asians in America for current pandemic and future challenges.

Keywords: Mental health, COVID-19 pandemic, Asian, Work, Life.



## EXPLORING ACCULTURATION STRESSORS OF ETHNIC MINORITY WORKERS IN THE CONSTRUCTION INDUSTRY

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Due to the shortage of labor, the number of ethnic minority workforce is increasing in the construction industry of Hong Kong. However, ethnic minority construction workers (EM-CWs) may expose to various stressors and experience a high level of stress when working in a foreign country. Although it is well known that excessive stress severely influences individual performance, the ethnic minority problems in the construction sector has not been studied substantially. This study, thus, aims at identifying the stressors and stress of EM-CWs in the industry. Three standardized focus groups were conducted with EM-CWs from Nepal, Pakistan, and India in Hong Kong. Using a contextual analysis of focus group discussions, the findings explored four acculturation stressor items including *strange feeling, adjustment, new environment, and difficulty to find a job*, three stress symptoms (i.e., *anger, tension, and fear*), and three types of *task performance* (i.e., *working speed, making mistakes and losing focus*) for EM-CWs in the industry. This study is a preliminary effort toward the first step in developing a stress management model for EM-CWs. It is envisaged that the findings will help to devise an integrated Stress-Performance model for EM-CWs in Hong Kong. Based on the findings of this study, companies hiring EM-CWs have to take special care of them, e.g., offering trade skills training, language courses, and mentorship schemes. Moreover, assistance to assimilate in the new culture and work setting to reduce unemployment of EM-CWs are suggested.

Keywords: Construction workers, Ethnic minority, Performance, Stressors, Stress.



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## A STUDY OF EXPOSURES TO ERGONOMIC INJURY FROM MOVING HEAVY OBJECTS MANUALLY ON CONSTRUCTION SITES

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This study was focused mainly on the ergonomic issues and injuries experienced when manually lifting, carrying and/or removing heavy objects on construction sites. The aim of the reported study was to answer the question: Why do ergonomic injuries, caused by lifting, carrying, and removing heavy objects, persist on construction sites? Primary data were collected for this phenomenological study during access granted to six construction sites in Johannesburg, South Africa, to conduct interviews. Six construction sites were visited during the study and appointments were scheduled to conduct face-to-face interviews with personnel who were involved directly in work related to the research topic. Five people participated from each construction site, which gave a total of thirty people who were interviewed during the study. The data were analysed thematically based on the interview protocol. The findings revealed that wearing personal protective equipment (PPE) is emphasised in current health and safety methods stipulated in legislation, which is the least intervention if the general principles of prevention (GPP) are considered. The skewed reliance on PPE accounts indirectly for why ergonomic exposures continue to be a challenge on the construction sites visited. Contractors, together with construction workers, agree that current methods that rely on PPE alone are not effective in reducing ergonomic injuries, specifically those resulting from manually lifting, carrying and/or removing heavy objects on construction sites. It was concluded in this paper that ergonomic injuries, caused by manually lifting, carrying and/or removing heavy objects, persist on construction sites because legislation is not viewed as a minimum when addressing health and safety concerns. It was recommended that the method statements and construction practice be reviewed to consider ergonomic injuries caused by manually lifting, carrying and/or removing heavy objects on construction sites.

**Keywords:** construction ergonomics, cumulative trauma disorders, health and safety, musculo-skeletal disorders, repetitive motion injuries.



## **Risk myopia among UK construction workers: Refining the Prescription for our Safety Glasses**

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Risk assessment and the consequential implementation of control forms the foundation of health and safety legislation in the UK. However the process of risk assessment inevitably remains subjective. Although training exists, it has not yet effectively eliminated risk recognition issues and accidents where it is a contributory factor still occur, suggesting a level of 'risk myopia' among the workforce. Knowledge of the form this myopia takes, and how risk recognition is influenced by other factors, could improve understandings of how construction workers experience risk. A survey of n=30 construction site workers explored the extent to which different factors influenced how they: perceive risk; accept risk; question the risk assessment; ignore infringements; and disregard the risk assessment mitigations. Descriptive and inferential statistical analysis revealed that trust is critical to risk perception, and identified a risk myopia around perceptions relating to the natural and man-made environments. Worker age and the years worked in the industry were found to significantly influence risk perception, whilst job role was only influential on some aspects whilst questioning risk, ignoring infringements and personal disregard of risk protocols were not influenced by job role, suggesting workers and supervisors are more similar than dissimilar in these aspects of risk perception. Forms of 'risk myopia' do exist on sites, which should be acknowledged by managers when assessing work tasks and worker compatibility, and further research undertaken to better understand and so address it in practice.

Keywords: safety, risk perception, risk-myopia, workforce



## **An Evaluation of Manual Handling Training for Non-Lumbar Musculoskeletal Injury Prevention**

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Musculoskeletal disorders (MSDs) form one of the leading causes of occupational ill-health globally and affect workers of all ages, with construction having one of the highest rates of MSDs in the UK. Strenuous manual labour is often cited as the leading cause of these disorders, with manual handling training commonly implemented as part of an intervention strategy to combat this. Though these handling injuries are often associated with the lower back (lumbar) area of the body, MSDs may also occur in the 'non-lumbar' regions (encompassing the lower and upper limbs), areas which may be neglected by current training methods. This study aims to evaluate the effectiveness of current manual handling training in preventing non-lumbar injuries and propose factors to increase the efficacy of this intervention method. A case study approach has been adopted for this research, analysing the manual handling training utilised by a major multidisciplinary engineering firm through nine qualitative employee interviews. A general lack of effectiveness in transferring knowledge of non-lumbar injury was identified, despite the organisations' course being a clear improvement on commonly used methods of manual handling training. A lack of focus on the significance of non-lumbar disorders and variations in course content were identified as potential causative factors for this, with little reason for organisations to opt for more costly tailored training over less-effective generic courses. Recommendations for industry are proposed, with a focus on enhancing regulations to mandate better training practice, aiming to reduce injury in the short term before the fulfilment of the behavioural change required for the implementation of more radical solutions. Overall, this study contributes towards the body of literature around MSDs through analysing manual handling training from a non-lumbar perspective, an area previously underexamined in research.

**Keywords:** manual handling training, musculoskeletal, wellbeing, workplace injury.