

## ABSTRACT:

Human Factors Design for Diversity: Safety approaches can be fortified when a different lens is applied

*A human factors' approach to design for diversity can arise from fundamental task (re)design that may be traditionally stationed in the areas of work, health, and safety (such as manual task risk reduction), but the practice, from this orientation, can provide a practical means to integrate the activity of business units. Recognition of the outcomes arising from these approaches can convey and advance organisational strategy and, thus, engage executive leadership so that these programs continue to receive support.*

### Keywords

Human factors, design for diversity, leadership engagement, service justification

### Introduction

It is theoretically possible to remove or reduce the risk of adverse safety events through better design of work equipment, tasks, or environment. It may be possible to employ a human factors' approach to design to advance an inclusivity policy and aid recruitment and retention of a diverse workforce. If accessible work is not considered, recruitment efforts to attract a diverse population of workers will be hampered by a lack of available tasks that match fitness-for-work. The long-term benefits of this human factors' strategy may, in turn, positively affect safety outcomes, lead to innovative work practice, and advance leadership initiatives. The initiative of achieving a more gender-, culture-, or age-balanced workforce portfolio may be promoted, for example. Business unit integration may be more likely when each unit is invested in the measurement and outcome of a safety activity and, as such, traditional safety programs can garner more support when taking a broad, ecological approach to describing, analysing, and promoting the work.

### Background

"Healthy and safe by design" is one of seven key action areas of the Australian Work Health and Safety Strategy 2012 – 2022.<sup>i</sup> This is likely in response to the phenomenon of "design-induced error". For example, technical design complexities limit human adaptive systems and result in human error. When this occurs, the human-machine interface is sub-optimal. Technology-centred design may be ill-suited to promoting high levels of sustained human performance over a wide range of conditions and circumstances in the natural environment.<sup>ii</sup> Studies that capture this data clearly substantiate the ideas that poor design of machinery, safety measures, or work systems play a significant role in elevating risk of occupational injury.<sup>iii</sup>

Studies outline work incidents where inadequate design was a major contributing factor:<sup>iv</sup>

- 1989 – 1992: Australia: 233 plant-related work fatalities in 225 incidents and in 117 (52%) of these at least one design flaw contributed to that fatal outcome, such as poor guarding, controls, or safety equipment.<sup>v</sup>
- 2000 – 2002: The role of design in fatalities increased with 90% of incidents attributed in some part to design issues. Primary design issues include inadequate guarding, poorly situated control devices, inadequate interlock safety systems, sticking drills, and equipment failure.<sup>vi, vii, viii</sup>

Heavy industry contributes to an inordinate percentage of workplace injury and fatality. Hazardous exposures related to the operation and maintenance of equipment used in heavy industry may include working on uneven or imbalanced terrain with risk for slip, trips and falls from ground or at height; performance of hazardous manual tasks; exposures to heat, chemicals, and whole-body vibration; vehicle roll overs; and collisions with other vehicles, environment or pedestrians.<sup>ix, x</sup> The design of industrial mobile-plant and equipment restricts the range of workers that can operate and maintain them: women, for example, are marginalised when it comes to equitable design that can enable their interface with industrial equipment. For those that do, unnecessarily high injury risks exist.

Office-based work may expose workers to the hazards of direct and indirect glare, distracting noise, prolonged and poor seated postures, sedentary behaviours,<sup>xi</sup> awkward postures, and repetitive upper limb activity.<sup>xii</sup> Traditional fixed-height office desks, for example, accommodate best a marginalised percentage of the population: the 95% height measure of a male.<sup>xiii, xiv</sup>

A framework of design for diversity is emerging. Initiatives have been undertaken by a work group of the Earth Moving Equipment Safety Round Table (EMESRT) to identify initiatives as a committee for Human Factors Design for Diversity (HFDD). It may be possible to embrace such strategy to achieve cross-industry advancement of good work design. For example, the HFDD hosted a two-day workshop on 29 & 30 May 2018 to discuss issues relating to design philosophy and equipment manufacture and this was attended by diverse representatives of Anglo Coal, BHP, Glencore, Peabody, & Rio Tinto. The HFDD objectives are to:

- i. Identify and describe design issues with current mining equipment which are a barrier to workforce diversity;
- ii. Document and evaluate remedial control measures currently undertaken at sites; and
- iii. Communicate the results of the investigation to equipment designers and construction managers.

If a human-centred approach to work is undertaken, work engagement may be beneficial.<sup>xv</sup> Work may be conditioning (physically and cognitively), socially inclusive, and provide for economic stability.<sup>xvi, xvii</sup> The ISO Standard 27500:2016 (The human-centred organisation – Rationale and general principles) provides guidance to support these practices<sup>xviii</sup>. A human-factors' approach to design for diversity is one means to advance these principles.

## Methods

Case studies will be examined that highlight issues of concern in terms of design for diversity. A “diversity design lens” will be applied to task (re)design strategy so that a compelling argument may be presented about why it is important to consider this framework. An overview about what “design for diversity” may encompass will be provided and this can serve as a practical take-away for delegates to review in consideration of their own workplace agenda. Linkages will be made about how these initiatives can integrate activity among business units and compel an executive leadership team to consider design for diversity as a practical and tangible means to advance their inclusivity policies. Recommendations will be made about how an organisation may begin to operationalise such design concepts and features into their work systems.

## Key Findings

A human factors' approach to design for diversity provides a new initiative to garner support for safety initiatives that contribute to continuous quality improvement, productivity and engagement,

safety management, innovation, improved social systems, and general worker health. It exemplifies the argument that by taking a broad, ecological approach to describing, analysing, and promoting the practices of human-centred design, more opportunities for task (re)design and work improvement may arise.

### Discussion / Conclusion

Participants will be challenged to consider how their work can advance the agenda of the organisation in terms of the recruitment and retention of a diverse workforce, and how they can better articulate the connection between their safety initiatives with the objectives to address occupational health and wellness. Participants will be introduced to an outline of design for diversity concepts and features broadly and through case study illustration. The idea of better business unit integration and leadership engagement through shared investment in design objectives, measures, and outcomes will be presented.

## References

- <sup>i</sup> Safe Work Australia (2012). Australian Work Health and Safety Strategy 2012–2022: Healthy, safe, and productive working lives. Canberra, ACT: Safe Work Australia, retrieved from: <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/719/Australian-WHS-Strategy-2012-2022.pdf>.
- <sup>ii</sup> Endsley, M R. & Jones, D. G. (2012). Designing for Situation Awareness: An Approach to User-Centered Design (2<sup>nd</sup> Ed.). Boca Raton, FL: CRC Press.
- <sup>iii</sup> Driscoll, T. R., Harrison, J. E., Bradley, C., & Newson, R., S. (2008). The Role of Design Issues in Work-Related Fatality in Australia. In *Journal of Safety Research*, 39, 209 – 214. <http://www.cdc.gov/niosh/topics/ptd/pdfs/Driscoll.pdf>
- <sup>iv</sup> Horberry, T., Burgess-Limerick, R., Storey, N., Thomas, M., Ruschena, L., Cook, M., & Pettitt, C. (2014). A User-Centred Safe Design Approach to Control. In *Safety Institute of Australia, The Core Body of Knowledge for Generalist OHS Professionals*. Tullamarine, VIC: Safety Institute of Australia.
- <sup>v</sup> NOHSC (National Occupational Health and Safety Commission) (2000). Work Related Fatalities Associated with Design Issues Involving Machinery and Fixed Plant in Australia, 1989 to 1992. Sydney, NSW: NOSH. [http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/293/WorkRelatedFatalitiesAssociatedWithDesignIssues\\_Machinery\\_FixedPlant\\_Australia1989-1992\\_%20NOHSC\\_%202000\\_PDF.pdf](http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/293/WorkRelatedFatalitiesAssociatedWithDesignIssues_Machinery_FixedPlant_Australia1989-1992_%20NOHSC_%202000_PDF.pdf)
- <sup>vi</sup> NOHSC (National Occupational Health and Safety Commission) (2004). The Role of Design Issues in Work-Related Injuries in Australia 1997 – 2002. Canberra, ACT: NOSH.
- <sup>vii</sup> Driscoll, T. R., Harrison, J. E., Bradley, C., & Newson, R., S. (2008). The Role of Design Issues in Work-Related Fatality in Australia. *Journal of Safety Research*, 39, 209 – 214.
- <sup>viii</sup> Creaser, W. (2008). Prevention through Design (PtD) Safe design from an Australian perspective. *Journal of Safety Research*, 39, 131 – 134. <http://www.cdc.gov/niosh/topics/ptd/pdfs/Creaser.pdf>
- <sup>ix</sup> Safe Work Australia (SWA) (2015b). Worker Fatalities. Safe Work Australia: Canberra, ACT: Accessed 24 February 2015: <http://www.safeworkaustralia.gov.au/sites/swa/statistics/work-related-fatalities/pages/worker-fatalities>
- <sup>x</sup> Safe Work Australia (SWA) (2013). Construction Fact Sheet. Safe Work Australia: Canberra, ACT:, Accessed 1 November 2014: <http://www.safeworkaustralia.gov.au/sites/swa/about/publications/pages/fs2010constructioninformationsheet>
- <sup>xi</sup> Buckley, J. P., Hedge, A., Yates, T., Copleland, R., Loosemore, M. Hamer, M., Bradley, G., & Dunstan, D. W. (2015). The sedentary office: A growing case for change towards better health and productivity. Expert statement commissioned by Public Health England and the Active Working Community Interest Company. *British Journal of Sports Medicine*, 49, 1357 – 1362. DOI: 10.1136/bjsports-2015-094618
- <sup>xii</sup> Hedge, A., Morimoto, S., & McCrobie, D. (1999). Effects of keyboard tray geometry on upper body posture and comfort. *Ergonomics*, 42(10), 1333 – 1349.
- <sup>xiii</sup> Qutubuddin, S. M., Hebbala, S. S., & Kumarb, A. C. S. (2013) Anthropometric consideration for designing students desks in engineering colleges. *International Journal of Current Engineering and Technology*, 3(4), 1179 – 1185. DOI: 10.1080/09709274.2007.11906027
- <sup>xiv</sup> Pheasant, S., Haslegrave, C. M. (2015). Table 10.11: Anthropometric estimates for U.S. adults aged 19 – 65 years. *Bodyspace: Anthropometry, Ergonomics, and the Design of Work*. (3<sup>rd</sup>. Ed.) Boca Raton, FL: Taylor & Francis Group. ISBN 9780415285209
- <sup>xv</sup> Pazell, S. (2018). Good work design: Strategies to embed human-centred design in organisations. Brisbane, QLD: Sustainable Minerals Institute: University of Queensland.
- <sup>xvi</sup> Australian Institute of Health and Welfare (AIHW). (2013). Australia's Welfare 2013: Australia's Welfare No. 11. Cat. No. Aus 174. Canberra: AIHW.
- <sup>xvii</sup> Waddell, G. & Burton, K. A. (2006). *Is Work Good for Your Health and Well-Being?*: London, UK: TSO.
- <sup>xviii</sup> International Standards Organisation (ISO) (2016). *Human-Centred Organisations*. ISO Standard 27500:2016.