Functional safety and behavioural economics: understanding human error risk in autonomous operations

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ABSTRACT

Over the last decade the adoption of autonomous technology has proven its potential to fundamentally alter the mining industry, offering significant improvements in safety and productivity. Automation levels are now increasing exponentially across all parts of the supply chain from drilling, haulage, processing, rail and shipping to the maintenance of the above. However, the management of human error risk is also becoming increasingly complex as the disconnect between the people who operate and interact with mining equipment and those that design the autonomous systems grows in terms of skill and expertise. Furthermore, as comfort levels with automation increases amongst operators, complacency is increasing as the initial functional safety benefits have been realised. This paper introduces an innovative concept that unites two distinct fields, functional safety and behavioural economics, to address the complex issue of human error risk in autonomous mining operations.

Functional safety, a well established field in engineering involves identifying potential hazards, assessing risks, and designing systems in a way that minimises the chances of accidents and limits their consequences. Meanwhile, behavioural economics takes a data centric approach to analysing the psychological aspects of human decision making, acknowledging, and seeking to understand the errors that can originate from cognitive biases and heuristics.

This paper seeks to bridge these domains by emphasising that human error in autonomous mining is not solely a technical issue but is deeply influenced by human behaviour and decision-making processes. By incorporating insights from behavioural economics, we can better predict, prevent, and manage human errors in the mining sector. By applying principles from both disciplines to recent incident examples from different parts of the supply chain we will explore how cognitive biases can impact peoples' interactions with autonomous mining equipment.

This interdisciplinary approach will not only enhance the design and implementation of functional safety measures in mining but also lead to the development of people centric solutions that consider the inherent fallibility of people. We will explore how human centred design can help bridge the gap between these two domains and apply systems thinking for a universal approach. Through an in-depth analysis of case studies and empirical data, our research aims to provide actionable insights and practical recommendations for mining industry professionals, regulators, and stakeholders involved in the safe integration of autonomous systems.