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The Fourth Industrial Revolution and industry 4.0 considerations during the production phase of the mining value chain: an underground conventional deep-level gold mine case study

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Abstract

The mining industry plays a significant role in the economy by providing employment and contributing towards the fiscus. While South Africa prides itself in having some of the deepest mines in the world and the third largest gold reserves, mining in these operations has become an arduous challenge as there is constrained safety and production. This is as a result of mining at depth, low-grade reserves, illegal mining and labour issues. The Fourth Industrial Revolution (4IR) has brought forth digital mining technology that has potential to increase safety, profitability, and life of mine through the use of smart sensors and software. The purpose of this study is to determine how 4IR can be implemented in conventional deep-level mines to address the challenges encountered in the industry. A conventional deep-level gold mine was used as a case study to create a mine modernisation blueprint highlighting how production during the mining cycle can be modified to increase safety and efficiencies. The study revealed that the adoption of 4IR in the conventional mining industry has a significant potential impact on reducing occupational hazards while enabling the industry to mine reserves which were previously inaccessible. To ensure successful adoption of technology in conventional mines, the research proposes the creation of a digital level. This digital level will be a testing station for new technology at the mine. The successful adoption of various technology at the digital level can then be rolled over to the rest of the mine. This ensures sufficient time to gradually implement technology without causing too much of a shock to the system and to understand the technology before adopting it on a larger scale. However, the implementation of technology in the conventional mining industry is challenged by the lack of adequate infrastructure, competent skills as well as the potential of worker resistance.