TRACKLESS MOBILE MACHINERY DIGITAL TWIN: TOWARDS SAFER MINING OPERATIONS

The CSIR seeks to offer industry futuristic solutions that resolve potential risks in mining operations. As part of this drive, the organisation has developed a trackless mobile machine collision avoidance system digital twin to predict the performance of traffic management systems.

The digitalisation of mining operations has become an area of significant focus for the mining industry in South Africa, as well as on the international stage. Increasingly, mining companies around the globe are improving the efficiency of mining operations through the progressive implementation of fourth industrial revolution technologies. Various digital innovations continue to be explored and investigated in the quest to improve operational efficiency, safety and compliance in the sector. Among these technological nuances, the mining industry is adopting automation in mining as an emerging specialty.

Automation in mining focuses on the development of technologies to digitalise mining operations for the enhancement of daily operations. However, trackless mobile machines (TMM) have contributed 10% to the fatalities reported in the industry in the past year. In keeping with industry standards derived from immersive consultation and continuous collaboration with industry, the CSIR has developed a TMM collision avoidance system digital twin, which can be utilised to predict the performance of traffic management systems in terms of vehicle interactions that directly link to safety and risk management. The project demonstrated that the TMM collision avoidance system digital twin can be used by the mining sector to model the effectiveness of vehicle interaction controls, identify highrisk accident areas in the mine and evaluate the effectiveness of the risk mitigation controls. This will enable timely and evidence-based decision-making, including the formulation and implementation of appropriate controls to prevent TMM accidents. The primary value add of the TMM collision avoidance digital twin is shifting the process of risk evaluation from a subjective framework to an objective one. The CSIR-developed TMM digital twin technology aims to offer a close-to-real time and continuous safety risk management solution, focusing on assessing and improving the effectiveness of vehicle interaction controls. This technology has the capability to proactively identify high-risk areas and activities per shift, including assessing and quantifying the various risks within the traffic management system. The CSIR is also focusing on future modules, which will be centred on the decarbonisation of TMM fleets and estimation of vehicle fuel usage, given certain usage models. The TMM collision avoidance system digital twin has the ability to generate heat maps, giving an indication of areas that are more prone to TMM collisions. The process will support mining companies in making informed decisions on continuous safety improvement initiatives.

Contact: Hartmut Brodner | **E:** hbrodner@csir.co.za | **www.csir.co.za**

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These initiatives can include review of the effectiveness of vehicle interaction controls, review of the traffic management plan and required training and behaviour change interventions. The CSIR is continuously working on predictive solutions that will resolve potential risks in mining operations. These include the simulation of multiple vehicle interaction events and the identification of potential gaps within the traffic management plan. This is achieved through employing a systematic methodology that involves applying predictive analysis, setting up a configuration and presenting possible scenarios. The TMM digital twin simulation platform will, in the long run, significantly reduce vehicle collisions, ensuring smoother operations and safer environments within mines.

INDUSTRY COLLABORATION FOR ADVANCEMENT

Drawing on its organisational values, the CSIR adopted industry collaboration as its strategic direction in advancing industry solutions. This has been achieved by working closer with industry to develop solutions that are relevant to the market and bring effective solutions to industry challenges. The TMM collision avoidance digital twin was developed in consultation with various stakeholders. They have added crucial inputs to the development of the software with the aim of supporting the mining industry's digitalisation journey. (please put in coloured block as a side element)

ABOUT DIGITAL TWINS

A digital twin is a virtual representation of a physical product or process, used to understand and predict the physical counterpart's performance characteristics. Digital twins are used throughout the product lifecycle to simulate, predict and optimise the product and production system before investing in physical prototypes and assets. By incorporating multi-physics simulation, data analytics and machine learning capabilities, digital twins are able to demonstrate the impact of design changes, usage scenarios, environmental conditions and other endless variables – eliminating the need for physical prototypes, reducing development time and improving the quality of the finalised product or process. *Source: Siemens*

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