The geospatial-driven digital mine: Leveraging AI, reality capture and data fusion to optimize safety, conformance and production

Riley Smith (USA)

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SUMMARY

As the global mining industry faces increasing pressure to enhance operational efficiency while meeting stringent safety and environmental targets, the role of the surveyor is evolving from a data collector to a provider of strategic, actionable intelligence. This presentation explores how the convergence of high-fidelity reality capture and Artificial Intelligence (AI) creates a transformative value proposition, moving beyond raw spatial measurements to a "Digital Mine" ecosystem. By leveraging these tools mining operations can integrate geospatial and other domain data, such as drilling, blasting, and geotechnical, into a unified digital twin that drives value across four critical application areas.

First, we examine haul road conformance, where AI-driven analysis of point cloud data allows for the automated detection of road gradients, cross-falls, and safety berm heights. By ensurice contributing to resilient infrastructure, innovation, and reduction of waste.

ng strict adherence to design specifications, operations can significantly reduce fuel consumption, tire wear, and haulage cycle times, linking geospatial precision to carbon footprint reduction. Second, the talk addresses slope management and stability. We highlight how the integration of robotic total stations and GNSS with automated monitoring software provides a real-time "nervous system" for the pit, utilizing automated feature extraction and segmentation of point cloud data to distinguish high risk precursory failure signals, thereby safeguarding personnel and contributing to resilient mine infrastructure. Next, the presentation will highlight an optimized drill and blast workflow. By utilizing high-resolution reality capture to create accurate pre-blast faces and post-blast muckpile models, surveyors can optimize fragmentation and minimize dilution, which are the primary drivers of downstream processing efficiency. Finally, we explore productivity increases with the use of reality capture tools in underground extraction. Through specialized field software

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and laser scanning workflows, the traditionally arduous task of underground mapping and "as-built" verification is streamlined. This allows for rapid conformance checks against mine designs, ensuring that development remains on track and reducing the time surveyors spend in high-risk underground environments.

By bridging the gap between field-captured data and office-based decision-making through cloud environments like Trimble Connect, these technologies redefine the mining value proposition. This session concludes that the future of mining lies in extracting more value from geospatial data, where the surveyor’s mastery of spatial information becomes the cornerstone of mine safety, production efficiency, and plan conformance contributing to resilient infrastructure, innovation, and reduction of waste.