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Selection of an optimal lateral ore transportation system using the analytic hierarchy process for the blanket mine expansion project

Mandidi, Sydney

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ABSTRACT

Blanket Mine (BM) is undergoing a production ramp-up phase and has recently sunk and commissioned a new Central Shaft up to 34 Level which is 1,010m below surface, enabling it to access deeper parts of the ore body. Previously, the mine`s deepest workings were at 26 Level which is 870m below surface. The ramp-up drive by the mine has witnessed the mine introducing to its underground transport systems, trackless machinery such as Load-Haul-Dump (LHD) equipment, dump trucks and belt conveyor systems in addition to the rail system which has been operational at the mine since the mine started operations. All these underground ore transport systems have been used at BM and have performed at different efficiency levels. However, no systematic approach has been followed on the mine on which transport system was best and decisions were based more on preference or application. As the mine got deeper costs have been generally increasing. To achieve the production ramp up within the targeted costs of between US$700 – US$800 / oz of gold produced, the underground ore transport system has been identified as an area which must be optimised.

Optimisation in mining transport systems requires a system with the lowest impact on the environment that can be operated safely with best performance parameters, and with lowest overall cost. This makes the optimisation problem a multi-criteria one which must be solved using Multi-Criteria Decision Analysis (MCDA) techniques to select the optimal transport system. It was, therefore, the aim of this research study to review and select an optimal underground ore transport system to use for the BM expansion project. The literature review revealed that the Analytic Hierarchical Process (AHP), which is an MCDA technique was the most appropriate technique to use in the selection of optimal transport system(s). The AHP model was used to rank the transportation options based on three main broad criteria which are economic, environmental/safety and technical. The identified criteria were derived from a literature review of similar related studies on transport selection from other mining operations.

The research established that the belt conveyor system is the optimal system followed by the locomotive and lastly, the dump truck system. The approach used for this research can be applied to similar problems that require ranking of competing alternatives. Decision makers and

management can adopt a similar approach using pairwise comparison and the AHP model in dealing with challenges associated with decision making in mining operations.