

Multi-criteria selection of a travelling way development method at a case study conventional underground platinum mine

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ABSTRACT

Conventional underground platinum mines on the Bushveld Complex in South Africa, such as the Marikana Operations (Marikana), extract shallow-dipping, narrow, tabular reefs to produce platinum group metals. The reefs are accessed via a network of development openings that include travelling ways, which are inclined tunnels connecting lateral development openings to the upper reef horizon. Marikana had been using the conventional hand-held drill and blast tunnelling method to excavate travelling ways. Marikana then trialled the inverse drop raising tunnelling method and proved its viability in excavating travelling ways, thus, necessitating the selection of a preferred travelling way development method at the mine. The selection is a multi-criteria decision analysis (MCDA) process because the different travelling way development methods must be evaluated by simultaneously considering a set of decision criteria. The Analytic Hierarchy Process (AHP) was selected as the MCDA evaluation technique because of its applicability under conditions of discrete alternatives and criteria. The AHP ranked the inverse drop raising tunnelling method in preference to the conventional hand-held drill and blast tunnelling method by a 7% difference when mined at the standard Marikana travelling way dimensions of 3m wide, 1.8m high and 15m long. Sensitivity analysis subsequently performed in *SuperDecisions*® software supported the robustness of the solution because rank reversal only occurred for the 'Excavation cost' criterion. All the other five criteria showed that the inverse drop raising method remained the preferred travelling way development method. The findings were shared with and endorsed by relevant technical staff at Marikana. This is the first time that a multi-criteria practical selection of a travelling way development method has been done at a conventional underground platinum mine. Therefore, other conventional underground platinum mines can adapt the approach presented in this paper to evaluate other tunnel development methods applicable to their site-specific travelling way development requirements.