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Determining the Tractor Fleet Size in an Underground Coal Mine through Simulation Modelling

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Abstract

Sasol Mining is moving from its current three shift system, containing two 10 hour production shifts and an overlapping 10 hour maintenance shift (excluding weekends), to full calender operations. Under the full calender operations there are two 12 hour production shifts along with a six hour window shift for every day of the week. This enables the Sasol Mining complex to keep up with the 40mt/pa demand from its Secunda factory. This new shift system positions each mine for 24 hour production.

The problem considered in this project is that of determining the effect of the full calender operations on the tractor fleet size by designing, developing, validating and implementing a simulation model depicting the different processes and variables at the mine. The objectives pursued in this project is (1) to determine how the move to 24 hour operations affect the tractor support services, and (2) to make a recommendation to the Bosjesspruit mine regarding their tractor fleet size based on output from the simulation model.

A systematic approach in the design and development of a simulation study is followed in the development of the simulation model. The simulation model output is validated through the use of equivalence testing. The results obtained through the equivalence tests confirm that the model is an accurate representation of the tractor operations at the Bosjesspruit mine.

The simulation model output provides a clear indication of the impact that the implementation of the full calender operations will have on the tractor support services at the Bosjesspruit mine. Based on the output analysis, the Bosjesspruit tractor fleet will not be able to perform at the current level under the full calender operations.

This model serves as a tool for decision making in a very high pressure and uncertain operating environment. By mitigating the risks associated with testing different scenarios in the real-world operations at the mine, the model enables the testing of different scenarios. Based on the analysis of these scenarios, it is recommended that the tractor fleet is pooled and that additional shifts are utilised over weekends. This will enable the Bosjesspruit mine to reduce its tractor fleet, whilst improving the performance of the tractor support services.