DEPARTMENT OF MINING ENGINEERING RESEARCH

Optimisation of the load-and-haul operation at an opencast colliery

The current coal-mining climate is characterised by coal price volatility, political instability, high labour costs and increasing operational costs. This is exacerbated by a steady decline in the growth of global coal demand due to the increased use of alternative and renewable fuels in the energy industry. Locally, the overall mining cost inflation indices show a yearly increase of 2% over the national consumer inflation rate. In order for coal mines to survive and mine profitably, they need to capitalise on the opportunity to improve their productivity and focus on one factor they can control: operational efficiency. Increasing productivity is one of the key drivers to counter diminishing profit margins. Increasing production effectively reduces operating costs. However, the emphasis should not only be on increasing output with the same input, but increasing the output while decreasing the input, and ultimately adding optimum value to current resources. Research shows that an increase in production will ultimately decrease the operation's unit cost, especially fixed costs.

In this study a load-and-haul fleet optimisation approach has been used to identify the opportunities for operational improvement at an open-cast colliery. The study combines the results of a literature review, on-site time studies and statistical data analysis in order to determine the best loadertruck fleet combinations for increased production. Several relevant key performance indicators (KPIs) for the evaluation and identification of productivity improvement opportunities were defined during this study. These KPIs are bucket fill factor, loading conditions, loading cycle time, utilisation and deviation from schedule. The priority delays determined by on-site time studies compared to the time book for each delay showed that idle or waiting time by the loaders, face preparation and relocation, and process delays had significant deviations. However, the results showed that this operation is under-trucked, hence optimising the loader-related inputs proved less effective than optimising truck-related inputs. The results indicated that a homogeneous truck fleet consisting of five Caterpillar 789C trucks, combined with a Caterpillar 994K loader, is the most efficient fleet option and will produce 1 455 t/h. The combined optimised effect of each identified KPI of production led to a tonnage improvement opportunity of 5 421 t per shift.

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