

Operating value optimisation using simulation and mixed integer

Abstract

Mining operations around the world will increasingly need to operate at greater depths. This significantly influences the complexity of ore extraction and ore transportation to the surface. The increase in mine depth leads to increases in haulage distance from mine areas to the mine surface. This results in an increase in energy costs to haul material further. Due to the increasing cost of future operations, the choice of the haulage method becomes an important factor in the optimisation of the mine plan. The haulage process is one of the most energy intensive activities in a mining operation, and thus, one of the main contributors to energy cost. This paper presents the comparison of the operating values of the mine plans at depth levels of 1000, 2000 and 3000m for diesel and electric trucks, shaft and belt conveyor haulage systems for the current and a predicted future energy price scenario. The aim is to analyse the impact of energy requirements associated with each haulage method, as well as the use of alternative sequencing techniques as mine depth increases. This study is carried out using a combination of discrete event simulation and mixed integer programming (MIP) as a tool to improve decision-making in the process of generating and optimising the mine plans. Results show that energy cost increases across each haulage method at both current and future energy prices, with increasing depth. This study thus provides a broad and up to date analysis of the impact on operating values that may be experienced with the use of the main haulage systems available at present. Also, the study shows how the combination of discrete event simulation and MIP generates a good tool for decision support.

Keywords: discrete event simulation; mixed integer programming; deep mining; haulage energy