

Extracting wealth from minerals- mathematics is essential

David Lee, Emeritus Professor , University of SA

May 2006

‘Minerals and energy production and processing are now relatively larger in the Australian economy than at any time since federation’ according to Alan Wood (The Australian, 20th May 2006) reporting on a recent address to treasury officials by Ross Garnaut. Modern mining, and the technology it uses, depends heavily on advanced mathematics, from the algorithms which support the signal processing of exploration data through the optimal design of mines to efficient materials handling systems at the production and export stages. Australian mathematicians have been active in supporting the advancement of the mining and its associated specialist software industry.

Consider the development of a new underground mine or major expansion of an existing mine such as Callie in the Northern Territory. A new shaft is a \$100 million decision; the question is whether it is better to extend a decline and truck haul system deeper or install a vertical haulage shaft and if so what is the optimal location and depth of this shaft. The answer is informed by advanced mathematical network and geometric analysis embedded in a program developed by a mathematics team at Melbourne University. This team has explored a number of optimization questions for the underground mining industry over the last decade and has developed software to optimize mine layouts which has already been used in more than 10 mines through Australia. Underpinning this new software is mathematical research which has led to significant theoretical advances in the construction of three-dimensional networks with the gradient and turning circle constraints encountered in underground operations. Savings, where comparative designs were available, have been of the order of 10% on a life of mine basis. But equally, with the current shortage of experienced mining engineers, savings relate to enhanced productivity of the design engineers supported by such tools. Furthermore these design tools allow management to explore alternative development options on an objective basis. Note that costs of development and operations in underground mines are so large that even a 10 metre reduction in the length of haulage paths - which may be many kilometres long - can correspond to a \$100,000 saving, taking into account construction, ventilation, maintenance and haulage costs through the life of a mine. Companies such as Newmont Australia Limited, BHP Billiton and MPI Mines have been significant supporters of this work.

The profitability of bulk mining enterprises such as those in Australia’s Pilbara iron ore province depend on efficient transport and logistics operations. Major mining companies have used software developed at the University of South Australia in collaboration with rail transport consulting group TMG International to optimize train movements and plan for future expansion of their rail system. This software has the potential to provide major benefits for the operations of coal, wheat and general freight long haul train networks through Australia.