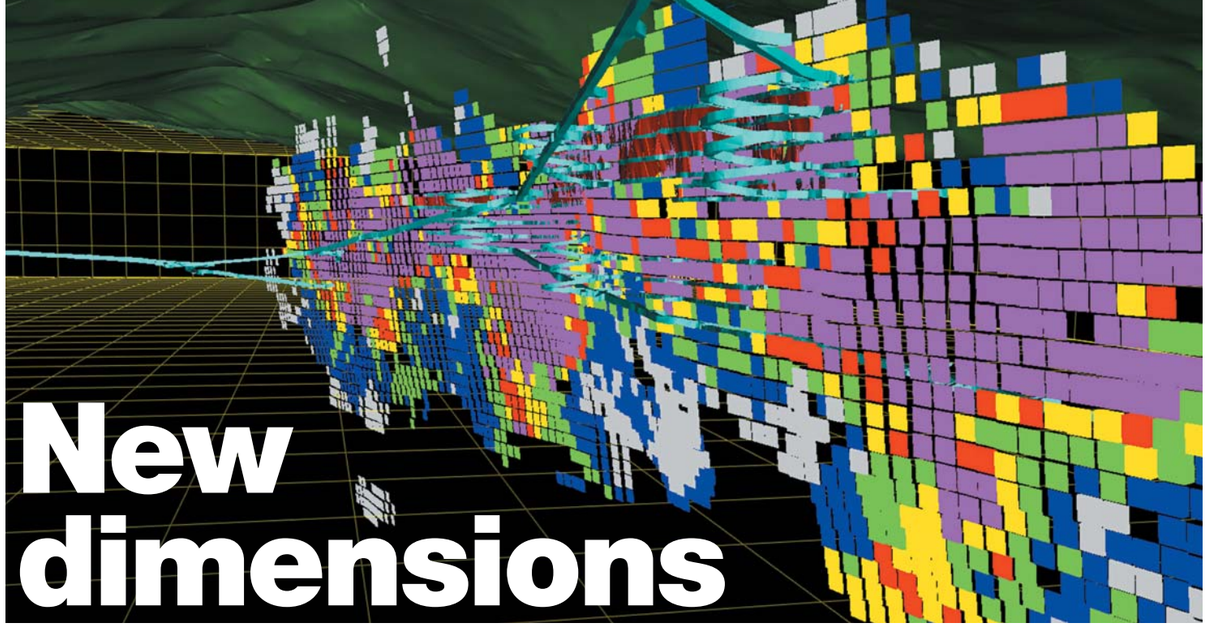


New dimensions in mining software

Mining is now heavily reliant on a battery of specialist software to help meet the demands of today's tough marketplace. Accurate modelling, for example, can create a virtual mine long before the trucks roll in, reducing project risk. Duncan Lee reports.

Although many see mining as a palaeotechnic industry, nothing could be further from the truth. Today's industry is subjected to global markets and as a consequence, for a mine to remain competitive it has constantly to look for new ways to increase output while keeping costsat a minimum. This results from the simple fact that in real terms metals and minerals have neverbeen cheaper.

As in other industries, miners have turned to computer software to provide fast, accurate, cost effective and efficient tools. Every aspect of mining uses some form of software – from exploration through to production and finally mine-site rehabilitation.

Many software packages are aimed at one particular market, such as database management and surveying. Others concentrate on CAD functionality. More recently a number of software packages have been developed to carry out virtually all of the functionality required to run a mine or exploration project.

View of a block model slice and underground workings produced by Maptek's Vulcan mine modelling software, main image

Geology and mining is essentially a three-dimensional activity and there is a strong requirement to generate visualisations and models of the ore body. Based on this information, the mining method, equipment, and scale of operation are determined before the first shaft or decline is cut. The operation of dragline, cast blasting, bulldozing, and truck and shovel operations, for example, can also be effectively simulated to develop a series of optimised range diagrams.

Mining software allows the user to bring all these areas together to provide the best planning solution for a deposit. However, as many operations progress, issues arise that may cause the operation to divert from the original planning procedure. These diversions can be costly but by implementing modern day software, they can be kept to a minimum and problems realised sooner. Common ways to plan for these events is to determine a number of possible scenarios that could potentially occur. Therefore software not only provides future planning capabilities, but also real time developmental changes.

Mining software companies are constantly under pressure to evolve products to meet these challenges and solve new problems, and the development of software is a result of both programming foresight and reaction to industry demands. Without feedback from the mining industry many of the products now available would probably not exist.

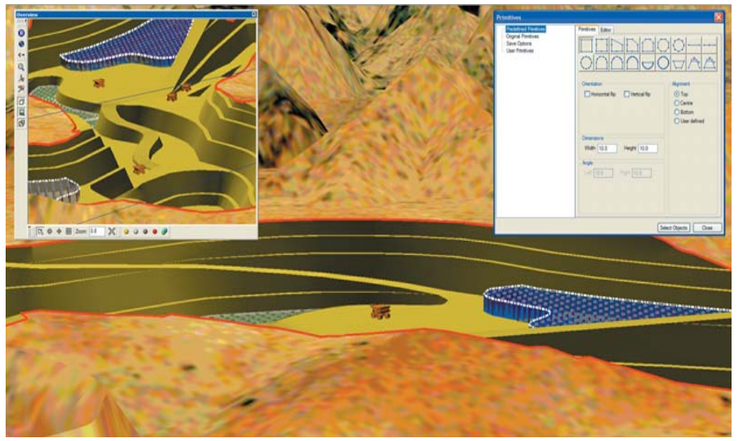
One software developer, Maptek/KRJA Systems, was first established in Australia to provide software solutions to the coal industry in the early 1980s. Its goal was to develop a true interactive graphics application for the mining industry, and by the mid 1980s its aim had been achieved in the form of Vulcan, the world's first true 3D mining software tool. Since its first release the package has evolved to meet industry demands for a complete package with ever-increasing functionality.

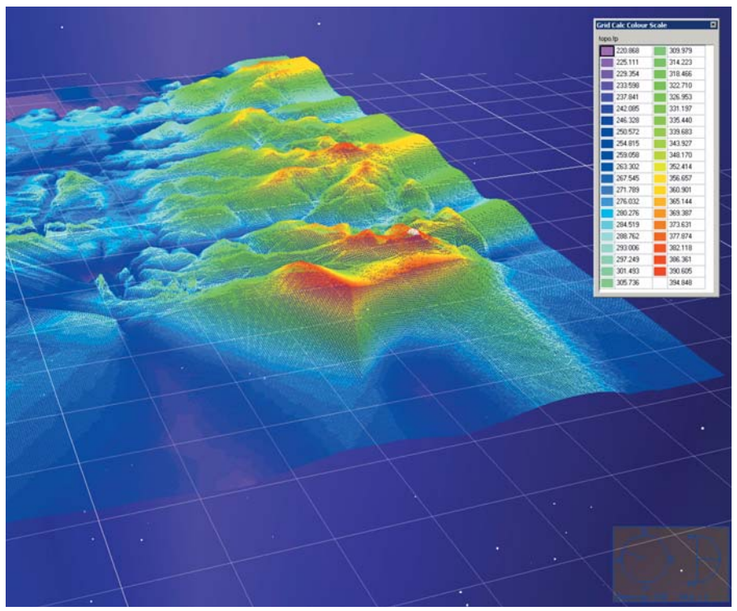
User friendly

It is essential that the user is able to interact with software easily and effectively. To facilitate this, Vulcan uses a customisable graphical user interface

with the traditional mouse and navigable icons. Known as 'Envisage', it has the capability to allow a 3D block model of an orebody to be 'sliced' on any axis [illegible]on any axis and moved through the model. This function combined with any other slice. This function highlights the relationship between variables within an orebody, model block or geological section. It also allows any variation of grade (concentration of metal) within an orebody, which is crucial in mine planning.

In addition to modelling and visualising the ore geology, other factors of the proposed mining plan can be factored in using software. Today, libraries of information on the performance of mining machinery are available, and these real-life specifications can be incorporated into the software. For example, blasting patterns can be integrated into the operation using data obtained elsewhere. And by developing more complex algorithms the behaviour, advantages and limitations of machinery can be monitored, providing a more accurate design outcome.





Full-scale simulation – a multiple view Vulcan visualisation of an open pit showing blast hole design benches (blue), above. Software such as this allows more accurate project planning and helps reduce the inherent risks of mining activity. Grid modelling using Vulcan, below

Increasing power

Not long ago a bespoke computer was needed to meet the demands of Vulcan software. But the rapid development of computational capacity (especially in the area of random access memory and the use of 64-bit file systems) now allows block models with multi-billion blocks (extended block models in Vulcan) and triangulation models with billions of triangles to be run on the latest laptops. At the same time, the introduction of new graphics systems with over 128Mb of specialised memory and ultra fast graphics processors makes it possible to visualise complex and large structures on high resolution display units at a low price.

One new model structure that is gaining popularity in the computer graphics industry is the tetrahedral model. Tetrahedral models can be considered an extension of the well known triangulation models in true 3D space and can be used to model structures not only by their external surface (as solid triangulations do), but within their volume. This is a useful tool for performing structural analysis (variography) and grade estimation in structurally deformed ore bodies.

The functionality of these processes can be enhanced by the application of scripting languages. Vulcan's Lava scripting language is an extension of the well-established Perl language and enables the user to construct basic to advanced programs that build upon the existing functionality, hence optimising the system's abilities.

Improved integration

Integration with other data and systems is crucial in mining software. Modern exploration combines multiple data sets of 3D mapped geology, geochemistry and geophysics all integrated within a geographical information system (GIS). By providing an interface with one of the leading GIS packages, the Vulcan system allows the importing and exporting of special data, such as digitised geological maps.

Another trend of today's mine planning packages is the ability to communicate data and reports from database systems, design structures and models with other specialised or general software packages in a generic file format. The character separated variable (csv) file format is becoming the norm for most operations as it allows easy transfer of data between the most common spreadsheet and database software packages, or even simple text editors. Vulcan provides this integration facility in a number of its modules including the Chronos scheduling package.

Keyboard power

Looking to the future, the mining industry is expected to become increasingly reliant on specialised software. As ore deposits become more marginal, new features and procedures will need to be developed to make these deposits economic. To take advantage of these new circumstances, the view that software is an optional extra on top of investment in equipment is no longer tenable. The new generation of mining software, such as the Vulcan system, can create a virtual mine long before the first truck arrives, so that by detailing and costing a number of scenarios, an optimum plan and investment strategy can be devised. Perhaps the keyboard is now mightier than the pen, pick or hammer.

Author details

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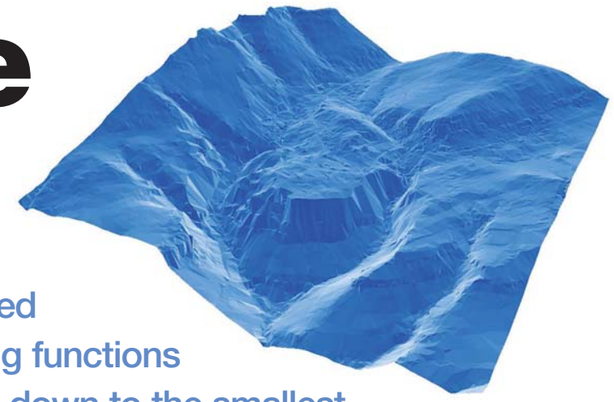

Mining software and high-powered computers can perform modelling functions that allow the planning of a mine down to the smallest detail. Mark Campodonic of SRK Consulting discusses recent advances in resource estimation technology.

Mining projects that lay dormant for decades due to political instability, metal price, or lack of technology have now become attractive prospects. These projects often have a vast paper trail in the form of maps, plans and book-sized volumes of tabulated data, and accurate digitisation of this data is prerequisite to the application of mining software.

Maps and plans, for example, can be scanned as high resolution Jpeg images and imported into geographic information systems software – such as MapInfo – where they are digitised and exported into Dxf files, the common 3D file interface type. This data then allows 3D geological models to be constructed and the creation of digital terrain models representing topographic data (see picture above).

Geological sample information, such as borehole, data can be tabulated in spreadsheets or databases. Data sets can be very

Digital terrain model of the topography surrounding the Jabali zinc, lead and silver deposit, Yemen (Image: ZincOX)