

Applications everywhere

Paul Moore reports on some enhancements to existing block caving software packages, as well as a new offering in this area, as well as more rental options, an imminent social collaboration offering, and as usual the latest planning and scheduling software updates

For a long time, software in mining has been much more than a technical tool only used by mine planners. It now underpins everything on a modern minesite from exploration through to reclamation, and in an operating mine, beyond planning and scheduling, it is at the core of Enterprise Resource Planning (ERP) solutions that integrate everything from fleet management packages through to production reporting. But one additional interesting area is how software can enhance collaboration between mining staff in terms of file and knowledge sharing.

In a November 2017 GEOVIA blog post, Raoul Jacquand, GEOVIA CEO at Dassault Systèmes stated: “The mining industry will not be immune to digital disruption – consider the sharing economy, where ride-sharing and apartment-sharing has become the standard today in industries we once regarded as traditional. What if mining is, too, transformed by the sharing economy? Building on the theme of sharing and collaboration digitally, I would like to introduce our GEOVIA community to GEOVIA POWER’BY, a set of rich applications leveraging the power of a social and collaborative enterprise-level platform. These applications are tied to Roles offered on the 3DEXPERIENCE platform, such as Business Innovation, Industry Innovation and Geology Modeler, which enable you to access different capabilities and benefits. Think of it as your digital workspace, starting with the Business Innovation role which allows you to

share your files dynamically, visualise models in 3D, dashboard your data, start a community to collaborate on projects and more.”

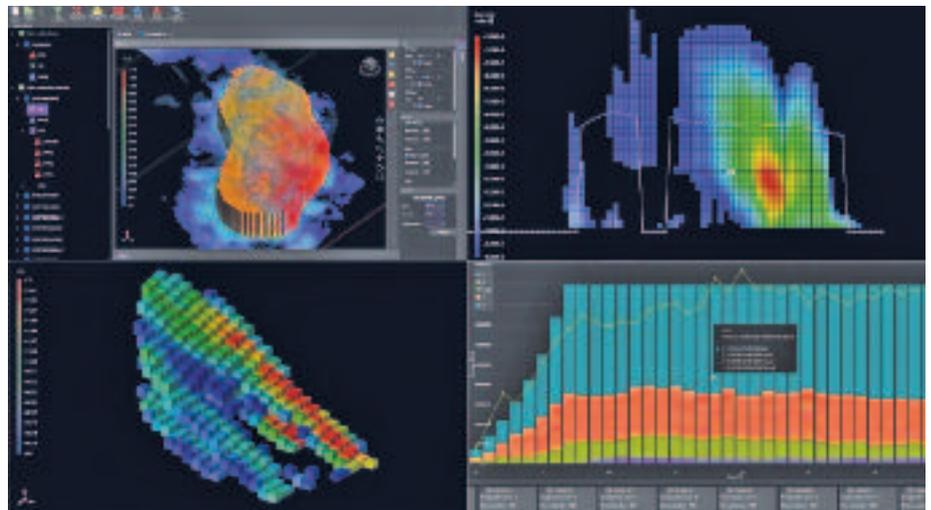
This post was followed up in December with another launching the Business Innovation role under the POWER’BY umbrella. “As your personalised social and content collaboration platform, the Business Innovation role enables teams to work, share and learn on the cloud.” An online video, available at <https://youtu.be/1lCP7LYlODo> shows a typical mining scenario, end of month reporting, and how the platform enables better collaboration and communication between GEO team members.

GEOVIA’s new POWER’BY is a set of rich applications leveraging the power of a social and collaborative enterprise-level platform

This workflow demonstrates a typical use of the platform’s social collaboration features in a mining context. The official launch of POWER’BY Social Collaboration to mining customers is expected in Q1 2018.

Block caving and stoping software

Moving on to another topic entirely, block caving is an increasingly important mining method in terms of overall contribution to commodities supply, with new high tonnage, long term



Maptek CaveLogic incorporates operational and geotechnical constraints and takes dilution into account by generating multiple scenarios for assessment

projects being developed all over the world, from Wafi-Golpu in PNG to New Afton in Canada and Argyle in Australia.

A new strategic panel caving product developed by **Maptek™** “targets the most cost effective underground mining method in a transparent, analytical way while maximising productivity.” Panel, or block caving, is widely considered the ‘new frontier’ as mining operations move towards underground methods.

Maptek CaveLogic allows engineers to more effectively plan and reduce the financial risk associated with this subsidence mining method that involves massive volumes of material and large investment. “The Maptek solution quickly and easily simulates multiple scenarios for identifying the best option,” said Vice President, Maptek South America, Marcelo Arancibia who previewed the new tool at the recent South America Users Conference in Viña del Mar. “Dynamic analysis using CaveLogic considers the economic environment and generates practical production plans quickly, easily, accurately and interactively. The point of difference with the Maptek approach is the flexibility for handling project complexity and individual customer needs.”

“CaveLogic incorporates operational and geotechnical constraints and takes dilution into account by generating multiple scenarios for assessment. Unlike other panel caving systems, results are readily visualised for determining sequencing and are auditable for confident decision support,” said Arancibia.

“Because the projected promised economic value is associated with realistic plans, operations will also benefit from tighter integration between planning and operational areas. Importantly for users, the calculations in CaveLogic are transparent. The planning engineer is in total control of tracking all of the variables and processes. This leads to better strategies with direct implications for improving business outcomes.”

This latest Maptek development references globalised environmental values and targets the natural trend toward underground mining where automation is the key to unlocking productivity, safety and efficiency. The system works directly with Maptek Vulcan™ mine planning systems.

CaveLogic is applicable to greenfield and brownfield projects. It can also guide management decisions at open pit operations where feasibility studies are required to evaluate the transition to underground mining.

For decades, mining companies have already trusted GEOVIA PCBC’s footprint finder application to quickly and effectively evaluate the footprint of block cave operations. Now PCSLC (for sub-level caving) has its own tool to

Footprint Finder for SLC (FFSLC) has been designed to quickly evaluate sub-level caving scenarios using minimal inputs for simplicity

rapidly evaluate sub-level cave scenarios to determine which option will be most attractive and robust.

Footprint Finder for SLC (FFSLC) has been designed to quickly evaluate sub-level caving scenarios using minimal inputs for simplicity. The application converts a column of blocks above a level into “rings”, and evaluates the economic footprint for each SLC level. Extraction percentages can be set to defaults or can be optimised using the Footprint Finder application.

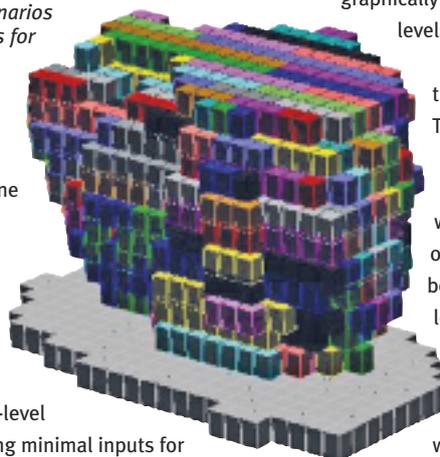
A basic face shape can be set by azimuth, and a rate of face advance used to determine the sequence of mining. These parameters are easily modified so that multiple SLC scenarios and strategies can be modelled and compared.

The FFSLC determines the economic footprint within a clipping boundary and applies the extraction percentage profile based on the number of levels (blocks/rings) that are above the current level. In the image below, blocks on the first level are all coloured in blue, these blocks are all given an extraction percentage of 60% from the excel extraction profile input because there are no rings above these blocks. On the level below, there are both green and blue blocks.

The green blocks sit directly below the first level, and will be given the extraction percentage of 80%, while the blue blocks on the second level have no blocks/rings above and will be given the extraction percentage of 60%. Thus FFSLC is able to quickly model a desired extraction percentage profile.

Furthermore, the FFSLC is able to optimise the extraction percentage profile by using the minimum and maximum extraction percentages suggested to run multiple iterations and return best result. The aim of the FFSLC is to achieve the highest value which it accomplishes by minimising dilution and maximising ore recovery. It is able to do this by adjusting the extraction percentage of each column of blocks to match the shape and grade distribution of the orebody.

The level spacing can be quickly modified and tested for sensitivity as the minimum and maximum elevation for each level can be easily set within excel. Mining levels are designated with the type M, while block rings and external material use the designation B and X



respectively. The results can be displayed graphically with X, Y and Z offsets so that levels can be shown side by side.

Grade elements are used for tracking Primary, Secondary, Tertiary and Quaternary material movement. These grade elements can be plotted to see where material is coming from on each level. Individual clipping boundaries can be used for each level to further restrict to footprint shape as desired.

The sequence is easily controlled by integers set within the sectors attribute of the block model. The desired face shape can be created as an XY Curve and these curves can be applied to each sector at a specified azimuth.

The table sheet controls the period, target tonnes, max active levels, and the maximum advance distance for a given period. These all combine to produce a production schedule for the desired SLC scenario.

Christina Ludwicki, GEOVIA CBU Senior Application Consultant at Dassault Systèmes, concludes: “The FFSLC is exciting new tool which can be used to rapidly evaluate and analyse a wide variety of sub level caving scenarios, quickly and efficiently.”

In another development, Dassault Systèmes and **Alford Mining Systems (AMS)** in 2017 signed a distribution agreement that will see the AMS Stope Shape Optimizer (SSO) software embedded and distributed within GEOVIA Surpac in 2018. The AMS SSO software generates optimum stope shapes for a range of underground mining methods and produces stope inventories from a block model that spatially represents the location of the mineralisation. SSO provides a stope shape that maximizes recovered resource value above cut-off grade whilst also catering for practical mining parameters such as minimum and maximum mining width, anticipated wall dilutions, minimum and maximum wall angles, minimum separation distances between parallel and sub-parallel stopes, and minimum and maximum stope heights and widths. Integration of the SSO software within Surpac will benefit underground mining customers and facilitate a seamless user experience.

In June 2017, Hexagon Mining introduced Stope Optimizer, a strategic mine planning tool for underground. It automates the design of stope shapes for a range of stoping methods. Using constraints and design parameters, Stope Optimizer provides the optimal stope shape design to maximize the value of an orebody. The outputs (stope wireframes, coded block model,

and reports) are suitable for use in strategic and tactical planning.

“Stope Optimizer allows you to quickly and easily perform feasibility studies for underground, as well as investigate stoping frameworks and economic scenarios. Its integration with the MineSight Mine Planning Suite saves time and money because by integrating with the block model and MineSight 3D, the output can be easily used in our scheduling tools.”

“Mineral and metal deposits for global consumer and technology evolution are located deeper and deeper under the overburden of our earth,” said Product Manager, Alyson Cartwright. “Stope Optimizer is the latest addition to our dynamic catalog of standalone and full integration-ready modules. These build upon our specific product lines in pit mining and include our latest acquisition, MiPlan tablet-based task management.”

Hexagon adds HxGN Logic and Sigma

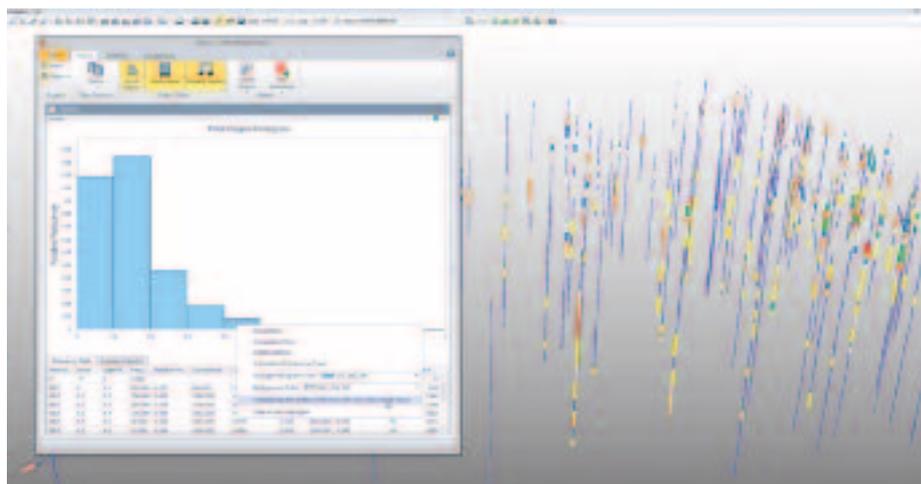
In September 2017, **Hexagon Mining** introduced to its MineSight mine planning suite, HxGN Logic, a product designed to help users easily create process workflows for modelling. “The block model is the foundation of all planning tools, and to build a sound block model requires several steps and checking along the way,” said Leo Fernandes, Director, Product Management. “Logic assists you through this process, and builds an easy-to-understand set of steps.”

Logic includes security roles, an audit trail, and flexible data sources, assisting users in managing the process from drillholes to a model. It builds upon the foundation of proven MineSight Basis routines, moving them into an easy-to-follow workflow-building tool. It also integrates with MineSight’s other geology solutions, allowing users to launch products such as the Model Calculation Tool, or MineSight Reserve from directly inside the tool. Other features include:

- Modern interface
- Security and user roles
- Support for multiple languages
- Flexible data connections

The introduction of Logic was part of an upgraded MineSight release that also includes an improved MineSight 3D (MS3D). “MS3D Version 12.50 is an exciting update for the planning flagship product, and including the following features”:

- Support for extremely large images on surfaces and new file type support
- Persist and remove surface “colour by” options (i.e. strike/dip)
- Point cloud enhancements
- Adds ability to query points in a point cloud
- New properties dialog



- Adds the ability to snap, volume clip, query, and show 2D views
- Adds the ability to view an AutoCAD drawing directly from within MS3D

These releases followed the introduction of Sigma, a comprehensive package of statistical and geostatistical programs to analyse and evaluate drillhole, blasthole, and model data. Part of the MineSight mine planning suite, Sigma includes time-saving workflow features for resource geologists and other mining professionals tasked with building a block model. It's fully integrated with MineSight Torque and MineSight 3D to produce sophisticated and customisable reports, charts, and graphs.

Product Manager, Alyson Cartwright: “Sigma assists the user throughout the analysis process, increasing reliability. Sigma also saves time by quickly updating results with the latest field information. It achieves the fine balance between guiding users and allowing full user controls.” Among Sigma’s features is a statistical application for univariate, bivariate, and spatial analysis of geological data. It sports a modern and intuitive user interface for batch creation, viewing and editing of graphs. Global refresh options allow for quick updates.

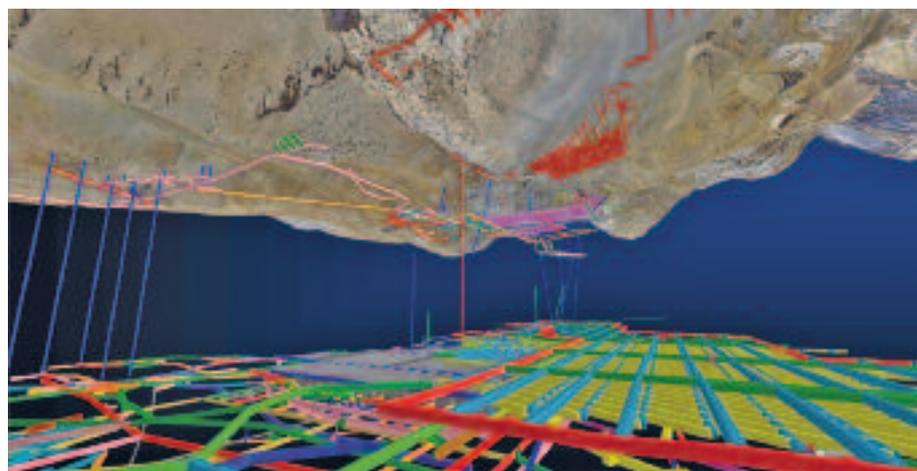
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A busy 2017 for Datamine

Highlights of 2017 from **Datamine** included the company welcoming more than 200 new customers as part of the MapInfo Discover acquisition, while deepened the connection as over 200 other sites were already using both the Discover and Datamine products. Datamine also rolled out Studio OP to over 120 customers and delivered the new auto-design features for rapid bench and ramp design, as well as implementing a new touch-mode in DHLogger to make field-work use easier.

The company also continued to add user-suggested features to all major product lines, such as dashboards in Fusion Report Manager and improved charting and implicit modelling features in Studio RM. Datamine has completely re-written Studio 5D Planner from the ground up - readying it for customer rollout as Studio UG in 2018.

Version 1.0 of Studio UG was released in June 2017 to give customers a taste of the new 3D design environment and access to the latest MSOv3 technology. Studio UG v2.0 will deliver a



Datamine’s Studio UG is a brand new technology leading the way for integrated design and scheduling in underground mines

replacement for Studio 5D Planner scheduling functionality that users have been awaiting. Internal beta testing of this version is currently underway. Customers will have access in early 2018 and the upgrade will be progressively released throughout the year as customers have time available to do their own testing and familiarisation with the new product. “At Datamine we are very excited about the speed, efficiency and quality improvements in Studio UG that make the job of mine planners a pleasure to undertake.” The key improvements are summarised as follows:

- Single step processing - one click delivers all your wireframes, evaluation results and schedule entities such as derived activities
- Huge speed improvements – completely new wireframing and segmenting algorithms deliver the data in a fraction of the time
- Multiple design files per type - makes it easier to manage multiple designs in a single scheduling project, avoiding the need for combine and write-back processes.
- Improved EPS integration – dynamic connection with changes reflected instantly
- 64 bit for large data sets, long field names, multiple 3D views with independent controls, Ventsim integration, unlimited design definitions, new auto-linking options

Elsewhere, the latest DataBlast update, Version 2.0.0 is now being rolled out to customers. DataBlast Version 2.0.0 “is a great advance for the product with much of the changes driven by feedback from customers. With a multitude of enhancements, bug fixes, and additional features added, this latest version of DataBlast has been a massive undertaking. The ability to integrate realised drill data back into DataBlast has been an incredibly powerful tool, making QAQC of drill patterns just simple. Having this ability makes Charging and Initiation designs much more accurate and helps users understand their operations quicker and easier.”

Now added to the extensive list of supported Drill Navigation systems, is Modular ProVison. DataBlast features multiple methods of collecting and integrating realised data from drill and blast operations, making a powerful drill and blast software system with the advantages of a robust database. “Recognising the many weird and wonderful ways people around the world manage drill and blast, DataBlast now also allows users to bring in realised data via CSV imports. With this added flexibility, using the DataBlast database system is even easier.”

DataBlast has now added a Fragmentation Module, further closing the loop in drill and blast operations. “Model multiple rock types and compare particle size distribution of your drill and blast designs to best achieve the blast result desired. The module outputs elegant particle size

distribution graphs and tables to store against your design.”

Mine planning – new Tempo

Minemax has announced the release of an all-new Tempo for developing practical detailed mining plans. Tempo has been redesigned based on extensive industry collaboration to address the challenges of translating strategic plans into operational plans. “We’ve talked to many mine planners out there who put a lot of effort into developing high-value strategic mine plans, but face difficulties transforming them into workable detailed mine plans. The new Tempo is here to bridge this gap and improve collaboration between both levels of mine planning,” explains Jim Butler, Minemax CEO.

With Tempo, planners can develop practical plans that align with their strategic plan. Outputs from any strategic scheduling software can guide detailed planning in Tempo. For Minemax Scheduler users, there is the added benefit of effortless Scheduler-Tempo integration.

Tempo can also be used as a standalone tool for creating optimal detailed plans respecting mining, processing and trucking constraints. The interactive user interface and guided workflows make it easy to set up models for both block- and polygon-based schedules.

Tempo incorporates multiple scheduling technologies including the very fast Bienstock-Zuckerberg (BZ) algorithm and the same 20-year industry-proven MILP optimisation technology found in Minemax Scheduler.

“Strategic mine planners can spend days just trying to get a smoothed schedule – one where the trucking or total material movement (TMM) doesn’t have drastic peaks and valleys in it. This process can be frustrating and take up valuable time: when you fix one glaring dip or peak in the

schedule, another one appears somewhere else.”

The new smoothing constraints in Minemax Scheduler 6.4.1 “give planners the ability to produce a smooth practical schedule without all those tedious manual iterations. The automated smoothing means more time for running additional scenarios or analysing results, and there’s also the bonus of greater accuracy, and even a better NPV.”

Minemax Scheduler’s new smoothing constraints accomplish this by giving engineers more control on the upward and downward differences in material movement from one period to another. “You just need to set this up as difference constraints in your scenario and let the optimisation find the best value schedule.”

This new release also solves another problem planners have been struggling with: how to ensure enough waste is mined for infrastructural projects like roads and tailings dams before processing can begin. Minemax Scheduler’s new cumulative constraints make sure the necessary amount of waste has been mined for construction without over-constraining the schedule.

Minemax Scheduler 6.4.1 is available for download to all maintained users the next time they launch Minemax Software Manager (MSM).

Pitram success in Kazakhstan

The President of Kazakhstan, Nursultan Nazarbayev, recently spoke about the implementation of MICROMINE’s Pitram fleet management and mine control solution at the Maleevsky mine. Nazarbayev was speaking on the recently finalised concept of the Digital Kazakhstan Program which includes a number of innovative projects that aim to further develop the country’s economy.

The Maleevsky mine is Kazzinc’s largest underground operation, and was commissioned



MICROMINE’s Pitram fleet management and mine control solution has been implemented at the Kazzinc Maleevsky mine

in June 2000. It has a production of around 2.25 Mt/y.

President Nazarbayev introduced the Pitram system and discussed the importance of digital innovations in the mining industry and the wider economy. MICROMINE Regional Manager Central Asia Erick Kanaev commented: "It was a real buzz for the MICROMINE team to hear the President of Kazakhstan introduce the Pitram solution and discuss the role data and technology will play in the mining industry in the future."

Pitram is a leading fleet management and mine control solution that records data related to equipment, personnel and materials, providing an overall view of the current mine status and therefore enabling improved control over operations. Greater control allows sites to increase production, reduce costs, and improve safety and business intelligence. The Maleevsky implementation took place in 2016 and comprises of Pitram Mobile including Shift Planner. Pitram Mobile enables the equipment operators to capture data manually, via touch screens, or automatically via integration with on-board systems. By recording data related to equipment, locations and operators, and comparing this data to target values, management will be able to gain greater control of the production process. The 'who', 'what' and 'where' of mining activities are displayed so management can monitor, analyse and respond to events as they occur, eliminating obstacles affecting the achievement of targets.

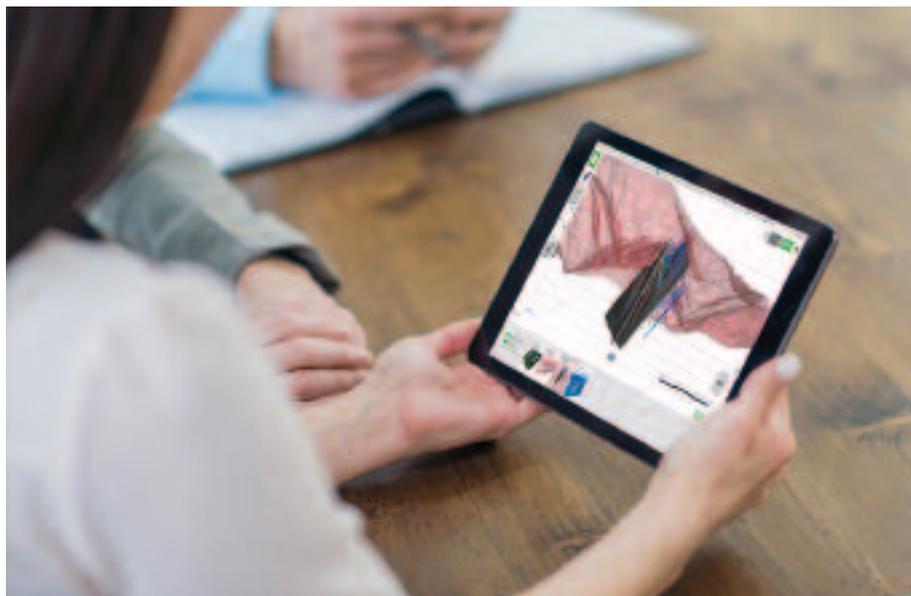
The Shift Planner module reflects the dynamic environment of the mining operation by allowing managers and supervisors to determine the best way forward when delays or unexpected occurrences affect task completion times.

"The Pitram implementation at Maleevsky was a key strategic priority for Kazzinc and has provided the company with greater control over their operations," Kanaev added.

Pitram will assist with increasing production, reducing costs and improving business intelligence and safety across the site.

Terrative and MineRP progress

Dundee Precious Metals Inc last year announced that it had entered into a definitive agreement with **MineRP Holdings Proprietary Ltd**, a provider of integrated mining technical solutions, whereby DPM has combined its proprietary wireless underground communications technology, managed within DPM's Terrative Digital Solutions division (**Terrative**), with MineRP, and acquired a majority interest in MineRP. The deal was completed in October 2017 when DPM acquired a 78% interest in the common shares of MineRP Holdings Inc, a new Canadian subsidiary, which holds all of the shares of MineRP, in exchange for an investment of approximately \$20 million in



cash and the transfer of the assets held within Terrative.

"We are pleased to announce that the transaction between DPM and MineRP has been completed," stated Rick Howes, President and CEO at the time. "The combination of Terrative and MineRP will create a leading technology provider well positioned to further capture the rapidly growing demand in the mining industry for digital innovation," added Howes.

With the August 2017 release of MineRP 4.0, MineRP was in a position to extend its data-integration capabilities to real-time operational monitoring and control. For this purpose, the cost effective, robust communication and data acquisition technologies developed by Terrative, combined with MineRP's solutions will offer the mining industry a fully integrated communications platform and information management framework to practically enable millisecond mining.

"MineRP has always been at the forefront of innovation focused on the Enterprise Big Data in mining. Combined with the advanced digital communication technologies offered by Terrative, MineRP's enterprise solutions provide a revolutionary platform for robust digital transformation for mining. The transaction provides MineRP with the means to aggressively implement our Spatial Enterprise Integration strategy across the globe," said Pieter Nel, CEO of MineRP.

Seequent frees up Leapfrog 3D online

Seequent, a world leader in visualisation for solutions for earth, environment and energy challenges, and formerly known as ARANZ Geo, has announced the launch of new web solution 'View' to allow Leapfrog 3D geological models to be freely shared and interacted with online. The company has also announced the release of Leapfrog Geo 4.2, with new data analysis

Seequent has launched 'View' for sharing Leapfrog models online

capabilities to significantly advance the 3D geological modelling solution.

Shaun Maloney, Chief Executive, Seequent, said: "View allows a wide range of stakeholders to freely connect with Leapfrog models online. This is the sort of advanced flexibility we know our customers need for effective communication and collaboration. We've also continued to make advances with Leapfrog Geo to ensure we continue to set the standard in geological modelling and provide added value for our customers."

Leapfrog users can readily share key model views with team members and stakeholders via an internet browser. Users can instantly see shared views and interact with the model for rapid and effective communication and collaboration. View runs on any modern internet browser with no need to install software or pass large files around. View is free to use, and there is no limit to the number of people it can be shared with.

Director of Cloud Architecture, Rowan Cockett says: "Visualising and analysing data in 3D helps understanding and empowers decision-making. Being able to readily share this 3D vision with a wide audience takes communication to a whole new level. View enables everyone to instantly see, comprehend and interact in a way that isn't possible when using more traditional presentations. View helps data tell a story in a compelling and visual way that everyone can understand. Having a shared view improves understanding, speeds up decision making and boosts efficiency."

View's secure data storage, authentication and upload tools allow users to be specified through permission options to experience key 3D views of Leapfrog models. Easy rotate and slice tools

allow users of any experience level to see the model from all angles and interact either with a mouse or by touch-screen. Cockett adds: “It’s also possible to tell the story of the modelling process using compelling perspectives saved as ‘slides’, which help to focus the conversation on key points of interest. View democratises access to the data under discussion and the simplicity of the web interface makes it ideal for all user types.”

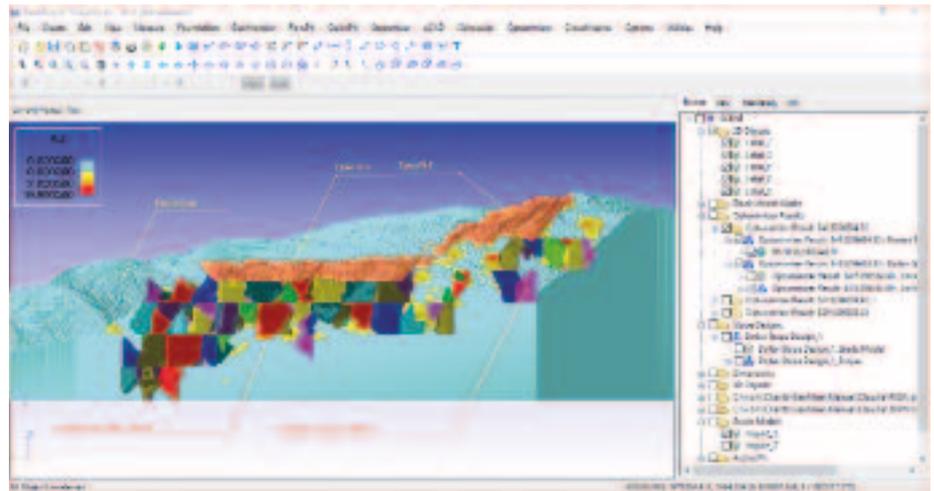
Leapfrog Geo’s latest 4.2 release significantly advances capability with new tools for data analysis. These new tools include scatter plots, Q-Q plots, box plots, histograms and compositing graphs, making effective use of Leapfrog’s highly visual and interactive environment while helping users gain new insights. Examples include the ability to select data in the graph on the grade distribution chart, filter in the 3D scene and then visually interact and categorise. Users can also visualise pre and post-composite histograms in a single chart to validate compositing. Visualisations have a sharp look and feel with a report-ready appearance.

Seequent’s Director of Product and Innovation Tim Schurr says: “We are committed to the continual improvement of Leapfrog Geo to ensure we set new standards in geological modelling. We are well known for making frequent and significant Leapfrog Geo upgrades and we plan to maintain this trajectory. We are equally committed to identifying new solutions like View that extend Leapfrog’s value across our product range and punctuate our intensive release programme.”

Finally, Seequent has launched mineral resource estimation solution Leapfrog® EDGE. Leapfrog EDGE supports and advances industry practices in mineral resource estimation by applying the highly dynamic, intuitive and visual capabilities that Leapfrog 3D geological modelling solutions are world-renowned for. In a streamlined workflow, Leapfrog EDGE introduces innovative 3D visualisation to resource estimation alongside industry standard tools for estimating, domaining, geostatistical evaluation and reporting.

Maloney stated: “Reliable resource estimation is critical to create confidence for all levels of decision makers. The geological model is the foundation of any resource estimate so it was a natural progression to develop a Leapfrog solution for resource estimation. Leapfrog EDGE builds on the success of Leapfrog Geo which allows 3D geological models to be built in a very dynamic and intuitive way.”

Using Leapfrog EDGE within Leapfrog Geo creates a fully integrated workflow between the geological model and the resource model, allowing users to stay in the very visual and dynamic Leapfrog environment. Estimates are



built from the Leapfrog model, avoiding data corruption and error. A key feature of this integration, is ‘dynamic updating’, where users can add data or revise their interpretations at any stage in the workflow and these changes will automatically flow downstream and update.

Schurr says: “This seamless connection increases confidence as the user can give a stronger emphasis to providing a robust geological model to underpin the estimate. Introducing this simple but substantial step delivers major benefits as users can manage change as they continue to interpret the geology and make use of the latest information.”

Leapfrog EDGE’s highly interactive data visualisation tools for resource estimation help users gain a greater understanding of their data. Users can rapidly iterate and test different parameters and then view the results in the rich 3D environment, whether it’s variography estimation results or reporting and summarising. The variogram tool is an example of a feature that takes full advantage of Leapfrog’s highly visual environment. Users can see the variogram orientation and ranges in both 2D and 3D, and then manipulate them directly in the 3D scene. Changes dynamically update the variography and block models. Schurr says: “We’ve had excellent feedback from the pre-release programme. Users are gaining new insight and clarity from visualising and interacting with their resource estimate the Leapfrog way.”

Leapfrog EDGE “has been thoughtfully crafted with flexible workflows and uncluttered work spaces designed to improve productivity and reduce training time.” Schurr explains: “The tools are user friendly, intuitive and easily accessible so users can focus on the resource estimate rather than mastering software. With sound experience in resource estimation a new Leapfrog EDGE user takes only a matter of days to become proficient, while comparable software can take months.”

ThreeDify has announced the site-wide deployment of its flagship product GeoMine to the Institute of Mineral Resources Engineering (MRE) at RWTH AACHEN University

GeoMine deployed at RWTH AACHEN University

ThreeDify has announced the site-wide deployment of its flagship product GeoMine to the Institute of Mineral Resources Engineering (MRE) at RWTH AACHEN University, the best German University for Miners and Mining according to the 2016 QS Rankings. This is a significant win for ThreeDify as GeoMine is replacing other General Mine Packages (GMPs) for teaching and training of both students at the University and mining professionals registered for the European Mining Course (EMC) program, “thanks to its integrated workflow, high performance and ease of use. ThreeDify is constantly evolving its products to help its clients to be equipped for tomorrow. And with its academic licensed software, ThreeDify is doing the same for the next generation of mining professionals.”

Recent developments in ThreeDify have been focused on further refining the existing integrated workflow between all GeoMine’s 10 modules to enhance flexibility and functionality, and improve the overall user experience. “A key differentiator for GeoMine over other GMPs is the fact that GeoMine is a fully integrated solution from geological modelling to production scheduling in a single, unified workspace with no data silos. This eliminates the need for incremental import/export steps, and hence greatly increases users’ productivity.” The following is list of a few highlights:

- GeoModeler’s state-of-the-art surface based Dynamic Anisotropy (DA) interpolation system helps geologists improve accuracy of their resource estimates.
- Octree based hybrid modelling kernel enables handling of large and complex ore deposits in a single session, which impose challenges to conventional block modelling

techniques. The maximum model space is half a million x half a million x half a million instead of 1000 x 1000 x 1000 from traditional mining software packages.

- FlowPit is more than 10 times faster than most other pit optimizers on the market and it can handle 100 million non-air blocks without use of super-blocking. It is well-known that super-blocking materially affects NPV or solution accuracy.
- QuickPit is a rapid pit design tool which allows mine planners to build a complete pit or dump design with ramps in a matter of minutes.
- The stope designs created by Stopemizer are not only optimum for a given stope layout, but also practical for engineering use as it produces optimal mineable shapes in respect of important geotechnical and geometric constraints. Stopemizer can be applied not only to all stoping methods, but also to all caving methods including longwall, sub-level caving and block caving.
- uCAD is a specialised CAD tool with both manual and automatic level editors for underground mine layout design.
- Optimizer, an Open-pit to Underground transition optimizer, is the only transition optimization tool available in the market.
- OptimCut is a dynamic cut-off grade and production rate schedule optimizer with an integrated workflow and easy-to-use graphical user interface (much easier to use than other optimal scheduling tools which are Excel spreadsheet based).
- iScheduler is an integrated activity and resource based 3D mine production scheduler for surface and underground mine scheduling. It features a fully interactive 3D activity and dependency editor, activity and resource Gantt Charts, a PERT chart and a Network Diagram, as well as a Resource Leveling algorithm.

GeoMine has good compatibility with most other file formats from 3rd party GMPs. "In addition, our products are easy to use and cost effective. Our licenses are very flexible. All the modules within GeoMine can be licensed independently. We provide web-based and on-site training based on our customers' needs."

Deswik short-range ore control modelling & design

In 2017, Deswik released its short-range ore control modelling & design tool, Deswik.OPSTS (Open Pit Short-Term Scheduling). This tool allows open pit mine planners to quickly produce a production plan for the 9 to 12 weeks planning range up, down to a daily planning resolution from a single pit shell solid.

The overarching aim, when developing

Deswik.OPSTS was simplicity and speed. The idea was to build a tool which could simply have a single pit shell solid fed into it and within a few seconds have a schedule created which has been benched out and blocked. We have achieved this, while also catering for complexities which come from operating in the real world.

"The tool has been intended to provide immediate feedback. As soon as you move a point in your polygon or digitise a line, the solids are cut, interrogated against the block model, your formulae executed, and the task in the scheduler updated with the new duration, and the schedule recalculated. Normally a laborious process in other products, it is executed immediately in Deswik.OPSTS."

"With the 2017.2 release, we have also included support for drill and blast activities which have a different shape to the excavation task. As is the case in many operations, the drill and blast process is run independent of the excavation process, but, of course, they are inter-dependent. So, if you have your blasting over a 15m bench defined using blast master polygons, and mining is over 5m benches and you want to allocate material destinations on a daily basis (which is a lot smaller than the blasted area) – Deswik.OPSTS can cater for this. Ensuring that only blasted material is mined is also taken into account automatically using dependencies generated by the tool."

As with all Deswik products it is nicely integrated with other modules, including the Deswik.OPDB (Open Pit Drill & Blast) and Deswik.DO (Dig Optimizer) to streamline the process.

Acquisitions: RPMGlobal acquires MinVu

RPMGlobal (RPM) recently entered into an agreement to acquire 100% of the issued share capital of MinVu, a privately owned Australian headquartered group of companies and leading global provider of mine-wide operational reporting and analytics software solutions to the mining industry.

This transaction represents the 7th software acquisition RPM has undertaken in the past three and a half years. It continues RPM's determination to deliver a complete Commercial Off-the-Shelf enterprise platform for the mining industry, built on open industry standards which delivers a step change in value chain optimisation through investments in software innovation.

MinVu are headquartered in Brisbane, Australia and have been providing enterprise operational software to their global customers for over 18 years. Miners rely on the MinVu products to understand exactly what their mining equipment is doing at any time of the day or night.

Development of the MinVu product has involved significant customer engagement since formation of the company in 1999. This collaborative nature of development has resulted in a comprehensive suite of integration adaptors and data validation functionality being built. The integration adaptors feed operational data into a structured Operational Data Store which is used by more than 250 standard reports and real time dashboards.

The ability to connect and extract real-time data from operational systems and then turn this data into meaningful transaction based information is at the heart of the MinVu solutions. This includes, but is not limited to, Fleet Management Systems (FMS), Dragline Monitoring Systems, Dozer, Loader and Drill positioning Systems and On-board Machine Health Systems. All of this data is extracted, validated and augmented to ensure that the reports that are presented to operational management can be used with absolute confidence.

The mining companies that use MinVu every day in their mining operations include BHP, Glencore, Anglo American, South 32, Yancoal, US Steel, Canadian Natural Resources, PT Bumi, Ok Tedi, New Hope Corporation, Dominion Diamonds, and Wesfarmers. MinVu allows these mining companies to have a real-time view of operational data (from all of the discrete items of mining equipment operating in a mine) in one report.

Commenting on this acquisition, RPM CEO and Managing Director Richard Mathews said, "Since acquiring a copy of the Fewzion Short Interval Control (SIC) product twelve months ago we have been building the underlying architecture to enable us to deliver a fully automated Short Interval Control system. Having the ability to automatically take live data feeds off our customer's operational systems will dramatically accelerate our move into the Short Interval Control space where real time plan verses actual performance is the goal."

"MinVu is the only company that we know of who have built a comprehensive suite of standard integration adaptors across all key operational systems that operate in a mine. As such we believe the integration, data validation, structured Operational Data Store (ODS) and associated reporting will give RPM a commanding head start over other software vendors who decide they want to provide a mining Short Interval Control system in the future."

"While the major consideration for this acquisition was advancement of our Short Interval Control System many of our other products will benefit from access to operational data via our enterprise planning framework (EPF)."

“The company’s Ultra Short Term Planning product XECUTE will be able to immediately utilise the MinVu integration adaptors to bring back data such as Equipment GPS coordinates, actual bucket positions, material movements, drill-hole details, actual production rates and incorporate them into the production plan. This will extend the functionality of XECUTE whilst increasing the number of modules in the RPM suite.”

“Our strategic maintenance product AMT will use MinVu’s Operational Historian to store actual health data from on-board systems to be compared against planned maintenance events and feed this into our Dynamic Life Cycle Costing engine. This will bring together asset life cycle costing and condition based monitoring.”

“Having an Operational Data Store enables RPM to not only deliver rich plan vs actual analysis, but we can use this data to adjust planning parameters to align with what is actually happening in the operations. This seamless integration helps planners increase the level of predictability in their production plans.”

“RPM’s HAULSIM and SIMULATE products will also benefit from being able to take direct feeds from many different FMS systems. The GPS position data as well as a detailed breakdown of the haulage cycles will accelerate model calibration. Importantly MinVu already has the logic to clean the data (removing erroneous results) which has always been the major issue with the use of on-board data feeds.”

“The combination of RPM and MinVu’ product offerings will create the most advanced single vendor Short Interval Control System for mining companies. It will assist to reduce the cost of mining as operational staff will be able to monitor the performance of their equipment in real-time using the most advanced user interface in the industry.”

Co-Founder and Director of MinVu, Mike Taylor said: “For the last 18 years we have worked tirelessly building software solutions with our customers that help them improve their operations. We have always wanted our products to be integrated with the industry’s leading production, costing and simulation systems and this transaction delivers exactly that.”

“We have been very impressed with RPM’s vision for the industry and the investment they are making in their products in what has been a difficult period for suppliers to the mining industry. We are convinced that the MinVu product suite will benefit from increased investment and the sales and marketing support which RPM can offer it right around the world. As evidenced by the structure of this deal and the consideration we have accepted for RPM shares, we firmly believe in this complementary

combination of the two product suites and management teams.”

Case study: Mapek Evolution scheduling

A high-grade gold deposit in Western Australia is now relying on Mapek Evolution cloud-based technology to solve scheduling challenges. The Enterprise deposit is located 68 km northwest of Kalgoorlie within the Ora Banda district on the eastern limb of the Kurrawang Syncline. Historically mined by open cut methods to 100 m Enterprise is a large high-grade deposit and an important component of the Norton Gold Fields production plans in the next five years.

The technical services department wanted an optimal scheduling solution for the open pit operations that would allow them to work directly with Multiple Indicator Kriging (MIK) block models and non -MIK block models in the same multi-mine schedule scenario. This would reduce the amount of data manipulation required and mitigate mine planning risks. Moreover, the cost associated with waste material was an important factor. In addition, the encapsulation required to isolate the acid reactive material had to be considered. Norton Gold Fields, part of Zijin Mining Group, has acquired Mapek Evolution software to help address these challenges.

At a strategic level, alternative scenarios generated in Evolution will be evaluated from a cutoff grade optimisation point of view, with particular emphasis on the haulage component. The productivity rate for each hydraulic excavator model is associated within the block model for each material type. This provides full flexibility for the mine planning team to evaluate multiple alternatives in a short time using cloud-based technology.

Waste dump encapsulation is one aspect that requires special attention from an environmental viewpoint. Encapsulation needs to be controlled during the scheduling process. Information is imported into Evolution to allow simulation of different mine schedule scenarios, ensuring that this important variable cannot be ignored and is managed efficiently.

The graphical interface provides the visual link for communicating the mining implications of

different scenarios with various stakeholders, improving understanding and subsequent actions. Every piece of data is populated back into the block model, allowing information to be managed and shared across different departments for incorporation in the short-term mine planning process.

“Evolution has given the mine planning team at Norton Gold Fields all of the tools and options required to evaluate and add value to the Enterprise project.”

Case study: Enhancing narrow vein interpretation

The Klondex Mines Ltd underground gold-silver mine uses Mapek™ Vulcan™ to optimise various stages of their operation. The Fire Creek Mine, located in north-central Nevada, is a high grade epithermal vein deposit. Underground bulk sampling began in 2013 and commercial mining commenced in 2014.

Fire Creek uses cut and fill and long hole stoping mining methods. Both methods require narrow mining dimensions to minimise dilution and maximise ore recovery. The behaviour and development of the veins at Fire Creek can be complex, therefore detailed geological modelling is required to optimise success.

In an effort to build a better model of the deposit, geologists review historic core logs and photos. As with many projects, geologists’ interpretations of drill core vary and logging data is often inconsistent through different generations.

Fire Creek is no exception. The geology team has spent significant time sifting through historic core photos and re-analysing core logs. To facilitate this work, the geology team needed a way to incorporate diamond drill core photos that illustrate lithology, alteration and the various styles of mineralisation alongside the geological data within Mapek Vulcan.

Using Vulcan fundamentals learned on the job, brainstorming sessions during a Mapek site visit, and skills newly acquired during a lava scripting course, the geology team was able to turn this concept into reality.

A custom lava script was built off existing Vulcan functionality to enable users to display



The Klondex Mines Ltd Fire Creek underground gold-silver mine uses Mapek™ Vulcan™ to optimise various stages of their operation

images of core boxes directly down the drill trace. At the macro scale, geologists are able to view the differences in lithology, rock conditions, and alteration throughout multiple holes on drill fans and in three dimensions. “It takes time up front to set up the naming convention and then roll out the new process to make sure the photos are actually usable. But once the leg work is done, being able to spin the drillholes around with the photos loaded, adds a whole new dimension to how we use our data,” commented mine geologist Eric Hobbs.

The output allows the team to quickly review, correct, and test broader interpretations, providing a better understanding of the ore system, which results in improved models.

With computing enhancements delivered in Vulcan 10 and higher, the team is able to review the image registrations, assay data, and other geological information. Geologists can zoom out to view broader alteration and lithology differences between holes, or zoom in to the full resolution of the photo to look at individual vein textures and characteristics.

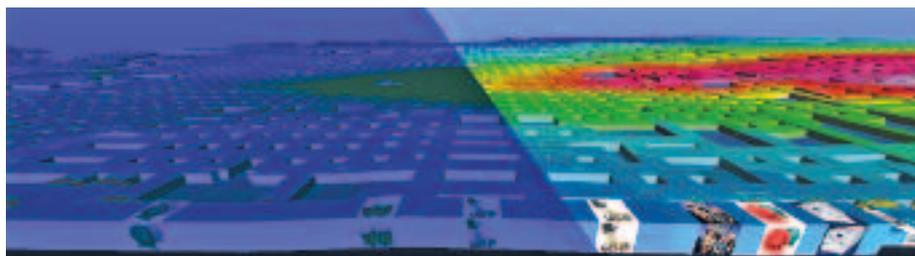
“When I am flagging a new drillhole, I load the vein and lithology triangulations alongside the core photos. I can see exactly what the intercepts look like in relation to the surrounding drillholes and data,” said Hobbs. “I can quickly view the core photos for multiple drillholes from the same drill fan and see how the vein behaves along strike, changes in elevation, lithology and so on. I can then make a confident judgement on how to flag that intercept and adjust our lithology triangulations on the fly,” he concluded.

The biggest benefit to the mine site is an increased confidence and understanding of the deposit. They are able to build and update geological models significantly faster than previously. This leads to more consistent logging data, allowing for faster target recognition for surface and underground drilling programs, and ultimately results in better ore/waste calls from the ore control geologists.

Through ‘out of the box thinking’ and lava scripting training, Klondex geologists have created a step change in the level of understanding of the Fire Creek deposit.

Ventilation software partnership

RPMGlobal (RPM) in 2017 entered into a software integration partnership with Chasm Consulting to enable RPM and Chasm to further develop an integration between the industry leading Chasm mine ventilation software Ventsim™, with RPM’s underground software solutions. RPM’s underground software solutions provide a platform for successful mine planning in underground mines around the world. With the latest in technology innovation at the core of RPM’s software solutions, partnering with Chasm



for best-of-breed ventilation software was a natural fit.

RPM says it knows that it is through the connected, digital mine that mining companies will be able to reduce costs, maximise operations, increase productivity and deliver shareholder value. “Our solutions have always put the mining enterprise at the centre to ensure that information across the entire mining value chain is not siloed but shared empowering stakeholders across the business to make informed decisions about their operations. This integration partnership illustrates RPM’s continual drive to only deliver enterprise wide solutions.”

Chasm Consulting’s Ventsim product is the leading underground mining ventilation software and was originally introduced to mining operations in 1994 to help visually design, improve and optimise underground ventilation systems. It is now licensed to over 1,000 mine sites, consultants, universities, governments and research agencies around the world.

Under the integration agreement, RPM and Chasm will collaboratively develop tight integration between RPM’s Underground Solutions and Chasm’s Ventsim, allowing joint customers to quickly simulate mine ventilation as the mine develops.

Commenting on the new software integration partnership, RPM’s CEO and Managing Director Richard Mathews said: “We are pleased to have entered into the software integration agreement

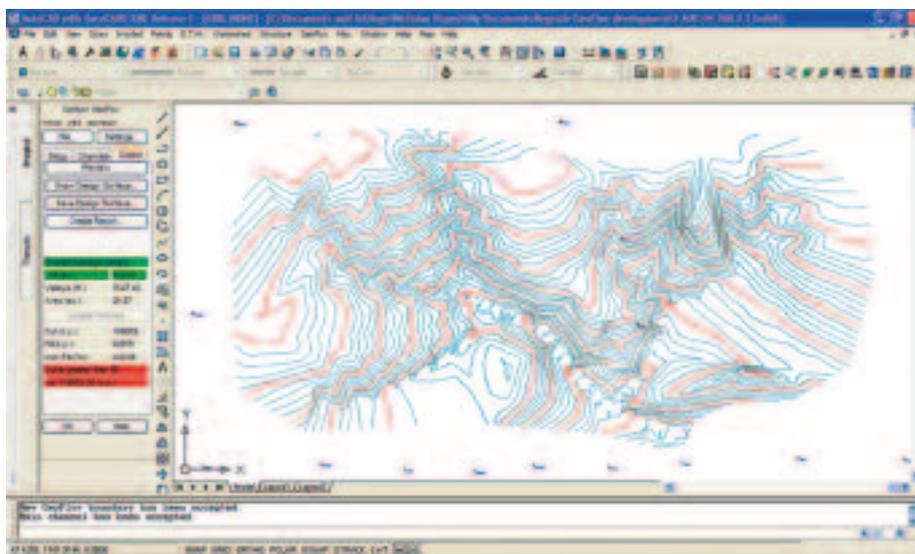
RPMGlobal last year entered into a software integration partnership with Chasm Consulting Pty Ltd (Chasm) to enable RPM and Chasm to further develop an integration between the ventilation software Ventsim™, with RPM’s Underground software solutions

and partnership with Chasm Consulting that will allow RPM and Chasm to continue their work to develop the integration between our market leading solutions”

Mathews concluded “With over 1,000 customers of the Ventsim solution, they are clearly the industry leader in underground mine ventilation and we look forward to furthering the integration of our respective products to deliver real value to our underground mining customers in delivering the digital mine.”

Geomorphic reclamation using Carlson Natural Regrade

A recent article detailed a geomorphic-based process of mining reclamation carried out at the El Site of El Machorro mine in Spain. Machorro mine (at the edge of the Alto Tajo Natural Park, East Central Spain), which utilised the GeoFluv™ method within Carlson Natural Regrade software. It was used to design small watersheds as part of the mining reclamation topographical solution. In addition to detailing the design and reclamation with Natural Regrade, the paper also describes their monitoring of the site for five years (2012–2017) and the positive results following the reclamation. Highlights include:



The GeoFluv™ method implemented by the Carlson Natural Regrade software has been used at El Machorro mine to design small watersheds as a mining reclamation topographical solution

- A geomorphic reclamation (GR) process – designing, building and monitoring- is described

- After adjustments to grading errors, the reclaimed area has high landform stability.
- GR performed as an efficient alternative to traditional mining reclamation.

“This research describes a geomorphic-based process of mining reclamation carried out at the El Machorro mine (at the edge of the Alto Tajo Natural Park, East Central Spain) and its monitoring for five years (2012–2017). The GeoFluv™ method implemented by the Natural Regrade software has been used to design small watersheds as a mining reclamation topographical solution. The procedure included: (i) finding a suitable reference area with stable landforms and acquiring inputs from them; (ii) designing two first-order stream watersheds; (iii) building the planned landscape; and (iv) monitoring the hydrological and erosive – sedimentary response of the reclaimed watersheds. This process is in itself a contribution to global advancement of reclamation best practices, because there are very few geomorphic-based mining reclamation examples, and even fewer that include their multi-annual monitoring. Sediment yields were obtained comparing Digital Elevation Models (DEM) acquired by Total Station (TS), Terrestrial Laser Scanning (TLS), differential Global Positioning System (GPS) and topographic reconstructions (interpretations). An H-flume with turbidity and water pressure sensors allowed quantifying runoff and suspended sediment. Sediment yield progressively decreased with time attaining a current low value ($4.02 \text{ Mg ha}^{-1} \text{ yr}^{-1}$). Water discharge and suspended sediment concentration have also decreased with time. Initially, high sediment yield values were obtained. They are interpreted as being triggered by grading errors that deviated from the design, so that runoff adjusted construction irregularities during that period by erosion and sedimentation. After those adjustments, the reclamation surface became more reflective of the design and the resulting surface remained very ‘stable’. The deduction is that the geomorphic-based reclamation has re-established an approximate steady-state or dynamic equilibrium, where hydrological and erosive – sedimentary functionality operate now at rates comparable to the surrounding natural land. Although further research is required to confirm long-term stability, geomorphic reclamation appears as an efficient mining reclamation alternative solution to the traditional approach of gradient terraces and drowndrains, which require frequent and costly maintenance, in the highly erodible setting of the Alto Tajo Natural Park surroundings, as well as in most open pit mines.”

Alastri’s tactical mine scheduling solution

In late 2016, after four years of development, **Alastri** announced the release of the Alastri Tactical Scheduler (ATS) for detailed tactical scheduling in open-pit hard rock mines. At the time the company stated: “Creating mine plans in today’s cost-cutting environment requires that engineers produce detailed schedules which can be verified and trusted to ensure site production targets will be met while adhering to strict restrictions on available equipment and operating expenses. ATS offers users the ability to easily model their operations in an unparalleled level of detail, incorporating schedule solid creation and reserving, mixed-fleet dynamic haulage (including autonomous haulage), optimised grade targeting and blending, and branching scenario scheduling.”

ATS had successfully passed rounds of client testing on two of the largest and most complex iron ore operations in Australia. Managing Director Daniel Narayan commented: “We are very pleased with how quickly new users were able to configure complex scenarios and generate practical schedules. Not only are our clients generating more detailed and verifiable mine schedules, they are also generating results far faster than before.”

ATS is focused on detailed tactical mine scheduling for any time horizon. For short term scheduling, users are offered the ability to precisely restrict their schedules based on available loading and hauling units, including fleets with different types of equipment with complex loader-truck matching rules. For longer term scheduling, users can provide ATS with grade/blend targets and plant constraints, and ATS automatically sends material to the right destinations to achieve the highest value.

The scheduler is the achievement of a dream that has been almost 20 years in the making for Principal Consultant Max Bygraves. “Scheduling is often about achieving a delicate balance between multiple competing objectives – a balance that can take years of experience to master. We’ve incorporated domain knowledge from decades of mine scheduling into ATS, so that producing accurate schedules in time and on budget is easier than ever.”

Alastri says it has a strong history of delivering high-performance mine planning software. This includes Haul Infinity and Rapid Reserver, which are best-in-breed solutions for haulage modelling and generating scheduling reserves respectively, and are part of the ATS mine scheduling software suite. “Historically, we have drawn on pc gaming technology to create easy-to-use, attractive, and responsive software for the mining industry,” said Daniel Narayan. “In the course of creating

ATS, we have continued this trend, and have developed new technology for automated setup, faster scheduling, and more detailed and visually impressive schedule animations.

Geosoft releases 9.3 software update

Geosoft has announced the release of its 9.3 software update for Oasis montaj, Target and Target for ArcGIS. The release includes new 3D visualisation features and enhancements, including more voxel display options, improved 3D rendering, and the ability to create animated videos from snapshots.

Geosoft’s 9.3 release delivers an improved 3D experience, with new voxel smoothing and display options, upgraded 3D graphics performance, and the ability to create animated movies of 3D models. The voxel smoothing option uses real-time interpolation of data to display a smooth image, making it easier to interpret and understand the data by allowing you to see more detail than with raw voxel cells. New voxel caching and pyramiding algorithms with OpenGL shader technology provide better performance when displaying large voxel models. The 3D animation tool combines multiple 3D snapshots to create a video which can be saved and shared, as a WMV or MP4 movie file, with project stakeholders.

Within Target and Target for ArcGIS, new classified colour options for 3D drillhole collars and traces provide a convenient way to display additional information about drillholes, such as the drillhole status, project name, zone name, or the year it was drilled. A new legend tab in the 3D Viewer enables quick and easy access to the colour legend bar and editing tools.

The release also includes updates for many Oasis montaj software extensions, with new features added to VOXI Earth Modelling, Drillhole Plotting, Induced Polarization, UXO Land, UXO Marine and UX-Analyze.

RPM now offering rental options

In October 2017, RPMGlobal commenced providing rental options for users of its software as an alternative to its customary perpetual licensing approach. Commenting on this strategic change, RPM’s CEO and Managing Director, Richard Mathews said: “After extensive consultation with our investors we have decided to evolve our conventional licensing approach, which sees the company’s annual results heavily impacted by ‘once off’ perpetual software license sales that historically occur during our fourth quarter each year, to include a software rental option for our customers.”

“Whilst the key objective of this change is to transition the company towards a recurring revenue stream and reduce our reliance on fourth quarter software sales, we do believe our

customers will be appreciative of the flexibility to consider more than one way to gain access to our software.”

“Technical mining software vendors have been slow to provide rental or subscription type offerings to their customers due to the strain this approach puts on the company’s balance sheet with the licence revenue, development costs and potential infrastructure costs spread across multiple years. Our already strong balance sheet coupled with the timing of the company’s annual maintenance invoicing to its customers which occurs at the beginning of each calendar year, means the time is right financially to make this important structural change.”

“Software users across all industries have for some time considered renting software as the way of the future. However, mining is usually carried out in isolated regions of the world which have connectivity challenges not seen in other industries. This is why miners have traditionally struck with on premise software applications operating on their own infrastructure. We have of course been monitoring this trend over time and the improvements in connectivity and technology advances mean different methods of software interaction are now becoming more commercially and technically feasible.”

“In the mining industry traditional “cloud competing” offerings will not always make sense – especially where there are data intensive applications, usage at remote sites where network connectivity is poor or non-existent or where the software needs to be interfaced with different products that may not be network or server enabled. Because of this RPM will continue to offer the ability to procure licenses to its software that can be installed on the customer’s own IT systems at site.”

“RPM’s new rental models will enable our customers to scale software usage up and down over time according to their actual requirements with minimal upfront risk or capital outlay. We will also be offering a number of different licensing options for our software products to provide our customers with alternatives to the traditional “user” type license restriction with a “unit of measure” more applicable to our customers’ operations. For example, in the case of our AMT asset management software, we are considering offering options where the customer’s license is linked to their number of “assets under maintenance”.”

Mathews concluded by saying “While this change will affect many aspects of our business including sales, marketing and product development, the main impact will be a timing one as traditional upfront revenue will instead be spread across future years. Whilst the annuity revenue delivered by software rentals will result in a stronger underlying business our reported



annual financial results will understandably be impacted in the first couple of years for the benefit of future years.”

Software for virtual mines

Mining3 is commercialising a 3D-based software platform that can create and simulate a virtual mine. By positioning precisely where things are underground, it opens up opportunities such as controlling robots and tracking movement of ore of different grades. “Imagine being able to control a vehicle or drone inside a mineshaft from anywhere in the world without fear of it crashing into mine walls or workers. Picture being able to track the metal in a car chassis from ore to finished product. Or, consider the ability to store data so that it interacts automatically with information from other sources to provide a more profound understanding of a mine and its grade. Such things are fast becoming possible using a new 3D-based internet platform known as VoxelNET.”

The technology has been developed through Mining3 — the industry-funded partnership between industry, original equipment manufacturers (OEMs) and several research groups that include CSIRO. “VoxelNET is all about a more efficient way of storing, analysing, sharing and visualising spatially-based information,” CSIRO 3D system researcher and Mining3 technology leader, Charlotte Sennersten, says. “It is ideal for spatially-based enterprises, but particularly for the mining and minerals industries.”

The internet systems currently used to store, analyse, transmit and display information was built for handling 2D text and documents. It has to be modified with software plug-ins to work and display information in 3D and VoxelNET supports this directly. VoxelNET can be used to generate a virtual mine and simulate its operation in 3D. It stores remote sensing information on the fly and enables the tracking or control equipment or material remotely. It is also

Mining3 is commercialising the VoxelNET 3D-based software platform that can create and simulate a virtual mine

able to be shared and accessed by different devices simultaneously and can pull data from a range of sources such as sensors, CAD files and point cloud devices.

The virtual 3D space is made up of voxels, an equivalent to 2D pixels on a screen. Voxels are cubes, the size of which can be defined to fit the task at hand. Each voxel in VoxelNET can be precisely located. The voxels can hold information such as density, ore grade, rock hardness, or even safety regulations and legal requirements. They can be programmed to store, integrate and cross-correlate data from many different sources. They can also act autonomously to find and process data, and to interact with each other in precise ways.

The voxels come in several different varieties. “Spatial voxels”, for instance, are linked directly to a precisely defined one-metre by one-metre grid of the Earth’s surface — from 5 km underground to 20 km above ground. They can be used to simulate and connect to reality. Whereas, the matter within “material voxels” can be labelled and traced wherever it moves. Every step and change can be accounted for using the new blockchain technology. The provenance of ores of different grades can be sourced and traced to enable precise planning for mining with lower impact.

Voxels and the data they contain can also be subject to different defined layers of security. Broad access can be allowed to some information or simulations, while access to more confidential information can be restricted. Data can be spatially tagged or completely anonymised. The platform already allows input of drillhole data, real-time vehicle data, remote-sensing data and 2D and 3D maps by a single client or user. The applications supported include simulation, remote vehicle control and interactive visualisation.

At present, VoxelNET is only available through consultation with researchers at Mining3. This year, it is hoped it will be released as a commercial product. Mining3 is looking at how to support its ongoing development into a cloud-based distributed platform. **IM**