

*Hexagon Mining's MinePlan Schedule Optimizer (MPSO) uses optimisation algorithms to find the best solutions*

NPV and optimise haulage and equipment allocation, meet plant production targets and create a consistent waste mining profile. Moreover, the holistic optimisation method identified savings of more than \$10 million. Evolution was able to deliver NPV, stockpiling, haulage optimisation, material movement and plant feed targets holistically.”

Many schedulers focus on optimising material movement, whereas Evolution optimises both haulage and trucking hours simultaneously rather than in two separate steps. This results in time and cost savings, is far more practical and delivers a more achievable schedule.

Coloma acknowledges that while the industry is experiencing huge advances on diverse technological fronts, difficulty remains in unifying these technologies.

Solid scientific or mathematical engineering methodologies must underpin tools to solve the problem, whether it be resource modelling, design compliance or mine scheduling. Maptek says it is looking to the rapidly growing area of complex systems science that can analyse and simulate real life systems comprised of many components that interact with each other, typically in a non-linear fashion. This realises the full potential of real-time data gathering and computing power, and results in intelligent autonomous systems that will be able to react to real time events and mitigate adverse impacts on a mining operation.

“Decision-making has never been so complex, time-consuming and critical. Managers are expected to navigate their way through endless data flows while faced with constant communication, on-demand customer needs and increasing reporting requirements. Maptek mine measurement developments include greater precision in continuous vehicle-mounted

# Planning reinvented

**Today, mining software is becoming far more than just a spreadsheet replacement or data visualisation tool – it is bow behind intelligence that is allowing mine design, planning and scheduling to literally evolve as situations change and optimise the whole operation, reports Paul Moore**

Miners can already choose from a wide range of technology systems across various operational and production arenas. Software providers are continually releasing new tools that target digitalisation, automation and continuous improvement.

However, **Maptek** argues that applications are often still siloed in workflows, and decision makers further along the mining value chain still end up using out-of-date data. Gains could be realised by removing information silos at process, operational and corporate levels. An operation needs to understand the effects of all decisions in a holistic context.

Conversations around the elusive integrated mining solution are getting serious. These considerations are top of mind for new Maptek CEO Eduardo Coloma who leads the METS provider into the next phase of strategic technology development.

“We work in a complex environment,” says mining engineer Coloma. “We need to think smarter and foresee needs rather than react to them. The digital age has introduced new ways to work with data. Actual knowledge can replace assumptions in decision support. We are focusing our efforts on innovations that add cross-operational value.”

In a move labelled as ‘reinventing mine scheduling’, Maptek released Evolution Epoch in 2019 to connect short term planning to the resource model, as well as upstream mine design and downstream mine performance.

“We developed Evolution Epoch with a clear vision,” stated Coloma. “This was to ensure that short term planners can build schedules that

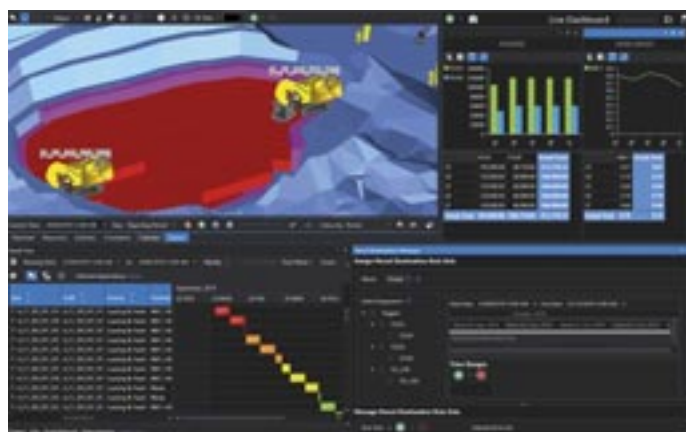
are practical, conform to mining constraints and remain aligned with long term scheduling goals. It may appear unlikely that short term schedule decisions can seriously impact longer term performance, but there are real examples involving resource sterilisation, geotechnical risk, energy use and processing plant performance where value has been lost.”

Engineers use Epoch to produce viable schedules by simultaneously considering excavation, haulage and dump activities. Epoch delivers flexible and automated sequencing, schedule visualisation and dynamic reporting. Integration with the long term schedule and mine planning ensures that plans do not focus on short term gains to the detriment of long term economic value.

Newer technologies help miners avoid risks associated with some traditional approaches which can impact operational productivity and hinder efforts to maximise economic benefits.

Maptek Evolution uses industry-leading genetic algorithms, delivers systematic production schedules along with a practical development plan and is intelligent enough to consider multiple objectives.

“A recent scheduling study using Evolution allowed Barrick Gold Corporation to maximise



*With Maptek Evolution, engineers can prepare short term schedules with confidence they are not losing long term mine value*

3D spatial data capture, with built-in tools to save time on manual processing and streamline analysis and reporting for decision making based on the most current data.”

“Stockpile survey is a brilliant example of where productivity gains can be felt,” Coloma says. “Our workflow outputs a volume without any need for registration.”

Maptek Drive allows for survey data capture from a moving vehicle. “The new inertial navigation system increases angular accuracy by 100%, which improves point cloud data quality and usability. Data displayed live on the scanner controller means surveyors can instantly assess black spots and areas that need more detailed scanning. They can also compare as-builts to design in the field and GPS connectivity ensures the data acquired is in real-world coordinates. The next step will mount units on mining equipment such as diggers and water carts to collect survey-grade data as a by-product of vehicle movement.”

Another innovation which helps close the loop between plans and as-builts allows overlay of georeferenced CAD lines and surfaces and annotation of laser scans. The digital ‘live guide to survey’ enhances interpretation of survey data and reduces the need for mishandling data.

In more good news for miners, a commitment to look beyond siloed boundaries and encompass up and downstream processes has led to development of new technologies. Maptek is now applying machine learning and augmented reality to accelerate tasks such as grade estimation, fragmentation analysis and production tracking. Maptek Vulcan geological modelling and mine planning software encompasses almost 40 years of engineering development. Integration, user experience and flexible customisation are all drivers to make our customers more productive and successful in their work.

“In 2019 we started commercialising Vulcan APIs and SDKs so people can more easily develop sophisticated application extensions to Maptek software,” said Coloma. “Access to the Vulcan SDK opens up possibilities for customers to enhance use of their digital data. In effect, adding value through business process automation. We collaborate with leading industry technology providers to build on or integrate with our systems. Investing in Maptek solutions is proven to unlock new opportunities for safety, efficiency and productivity gains and help miners to future proof their business.”

### Minemax ups the Tempo

During 2019, Minemax continued to make significant functionality and speed improvements to their existing mine planning and scheduling software to provide mine planners with an even

more powerful platform so they can be more effective in their mine planning process.

Minemax’s integrated strategic schedule optimisation software, Minemax Scheduler 6.5.3, now gives strategic mine planners greater control over the spatial requirements in their planning process, improving the practicality of their strategic schedule. With this version, mine planners can set up precedences for entire pit groups to ensure one area is completely mined before moving on to the next one. This helps resolve challenges with fleet allocation across multiple areas and improves efficiencies at the detailed level of planning.

In addition, mine planners can now constrain the maximum number of benches, pits, and pit groups for each individual time period. This is very useful for restricting the number of mined areas in schedules with time periods of mixed lengths.

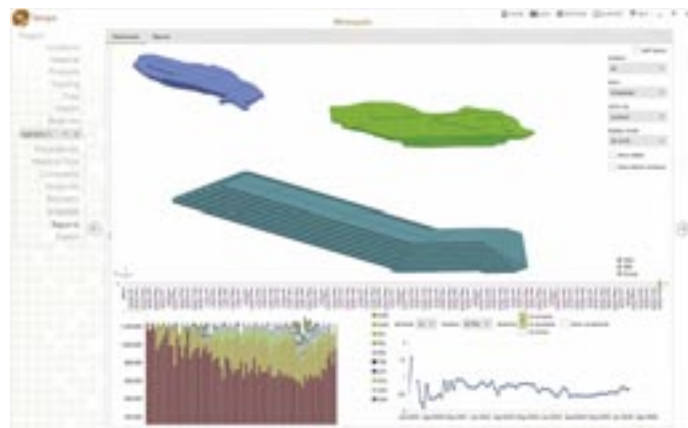
Tempo, re-launched three years ago to be an easy-to-use, highly functional tool for detailed mine planning, has also seen many new functionality improvements. Tempo’s planning horizon has been extended to cover medium-term to long-term planning so mine planners can use a single tool to generate both life-of-mine plans that optimize Net Present Value and medium-term operational plans that optimize plant and equipment utilization.

Recent Tempo development has been focused on integrating mine and waste dump scheduling into a single process, similar to what is available in Minemax Scheduler. This is linked with trucking constraints and Minemax Haulage for calculating truck cycle times so mine planners can more accurately model trucking requirements and associated costs for placing waste onto one or multiple waste dumps. This new version of Tempo is currently undergoing the final stages of user acceptance testing, just in time to be released for SME 2020 in Phoenix.

### Commit Works’ Fewzion’s short interval management software

As David Balkin (former Managing Director of McKinsey Australasia) put it, “It’s quite simple; you guys have shown that coordinating all work on site can reduce shift variability, improve safety and increase production by up to 50%”.

Commit Works argues that despite large investments in planning, Enterprise Resource Planning (ERP), communication, dispatch, fleet



*Minemax Tempo screen with integrated waste dumps*

and more recently internet of things (IoT) systems, it has proven to be extremely difficult for most mining operations to reliably deliver their target development and production results. The old saying “a mine is a large hole in the ground with a liar sitting on top” is as much a truism today as it was when it was coined.

“However, a growing number of smart operations leaders have found a way to change this and gain the trust of investors by reliably delivering incredible results without having to ask for extra capital. Using Fewzion, an integrated short interval planning, scheduling and control system, they have reduced variation and improved performance by 15 to 50% in their mining operations by making it possible for frontline work to be effectively coordinated and executed each shift.”

Mines can be complex. Typically consisting of many departments and processes across multiple shifts and roster patterns so coordinating work across these often siloed teams can be very difficult. “At Commit Works we’ve witnessed many operations using a ‘mish mash’ of spreadsheets and whiteboards to create their shift plans for execution (one site uses 67 spreadsheets to manage daily operations). Such practices are fraught with difficulty and create tensions, poor communication and can reduce cooperation between maintenance, production, development, services and technical functions. Whilst most operations have good analytics packages that tell management what happened yesterday, extremely granular data about exactly what is happening right now and great information about what should happen in the medium-term future; many teams have nothing but spreadsheets and whiteboards to say what is going to happen across the site tomorrow. With a chain only being as strong as its weakest link, the uncertainty of ‘what is going to happen tomorrow?’ is this chain’s breaking point.”

In operations like this, crews often end up with a shift plan that is nothing more than the weekly

target divided by 14 shifts with none of the detail about critical operational work that is needed to meet the targets. For any MOS (mine management operating system) or VMS (visual management system) to work, frontline teams must believe that the shift plans they are asked to execute each shift are possible, safe and productive. “Unfortunately, through bitter experience, crews seldom believe this to be true. They therefore go to work each day taking a ‘best endeavours’ approach knowing that there will be a large number of avoidable disruptions to their work during the shift. Such difficulties result in many compounding but reasonably foreseeable problems for frontline crews to manage each shift – problems which effective planning and coordination can overcome to maximise a mine’s potential.”

The best performing mines are those that are able, on a routine basis, to develop a practical and believable plan for execution by all frontline crews on site and then reliably deliver against it even when the inputs and circumstances change during execution. The Fewzion system from Commit Works it says has already been used to improve frontline planning, scheduling and short interval control in mines around the world. “This software has been shown to enable people at all levels of an operation to reliably deliver highly effective plans to frontline teams allowing



*The Fewzion system from Commit Works has been shown to enable people at all levels of a mining operation to reliably deliver highly effective plans to frontline teams allowing supervisors and crews to consistently deliver on them.*

supervisors and crews to consistently deliver on them.”

Operations using the system “report significant reductions in variability, better operational control and improvements in production of between 15% and 50% in hard rock, soft rock, open cut and processing plant environments across a wide range of minerals.”

Commit Works says its software and approach to implementation have rapid and significant impact because:

- 1.They enable operating management teams to substantially reduce day to day variation in mine productivity, a hugely underrated and misunderstood opportunity to fundamentally lift mine performance, profitability and safety (planned work is safe work).
- 2.They provide an integrated operations

planning backbone that enables all work onsite to be coordinated and controlled in the same system. It is intuitive and easily used by operations teams to fully coordinate and deploy machines, people and material on every shift, every day to dramatically reduce waste and variation in day to day mining activity.

3.This operating backbone replaces the “mish-mash” of spreadsheets, paper and whiteboards that operations generally rely on to manage day to day operations.

4.Implementing the software into daily operations ensures results are delivered extremely quickly.

5.The investment to acquire and deploy the software is low, ensuring a 1-3 month payback.

“As well as bringing all the right data together, Fewzion provides screens for coordinating across the site and for adapting the plan before the crew goes to work. Short term schedule screens are used to ensure everything is organised before the crews execute the plan. Mine control can use the system to ensure crews are working on the highest value work throughout the shift and simple shift plans are available on tablets, phones, paper and big screens enabling smooth handovers, improving ownership of the plan and removing many of the excuses for not following the plan each shift.”

## MODULAR



**Paul Moore spoke to the new CEO of GEOVIA, the mining software arm of Dassault Systemes, to get some insight into her background in the mining industry and using these tools, and now as the head of one of the market leaders, how she believes the mining software industry should develop and is already evolving**



**Q You have the unique perspective of someone coming from a senior technology role in mining itself, taking up a senior role in a leading mining software provider. What were your experiences in using and interacting with mining software packages in your mining career?**

**A** I have been in mining for 30 years so have had a long history with mining software both in terms of planning software. I started as a blasting engineer using Vulcan, as well as dispatching software such as Modular Mining, to more recent experiences with developing our own software in Barrick as we identified areas of need. The experiences have been mixed and changed over time. I remember when I first started in mining the software was relatively advanced compared to the capability I had with consumer tools. I used to go to work to use the faster computers and better software. But as time has gone on the rate of change in the consumer market has increased rapidly, and thus so have expectations of speed, ease of use, mobility. Now, many of our employees go outside the work environment to use tools that are more collaborative or faster, easier to use. Both mining companies and thus the software companies that support them need to change far more rapidly the way they use technology and the processes in the organisations.

**Q Did you see much evolution and improvement over the years while you were on the mining side of the fence? There was some but as suggested not as fast as the changes outside the industry.**

**A** Mining was a leader 30 years ago but was eclipsed by other industries such as manufacturing. The great news though is that we can now leverage the tools and learnings from manufacturing to fast track and leapfrog and again become the industry that is a forerunner. This will not only make us more productive and drive efficiencies, but also

sustainable, and appeal to the future workforce.

**Q Were there things that you wanted to see from mining software that you weren't getting?**

**A** I would like to see it much more integrated, breaking down the silos, it should be really easy to use and drive collaboration, by using easily to understand and communicate tools, and most importantly be 3D. Not everyone understand graphs and spreadsheets but everyone understands pictures and even better 3D objects!

**Q Mining software is traditionally seen as just a "packaged" tool in mine design, planning and scheduling in the main, and mainly based on large datasets not real time data. Are we now at a point where the software can update complex planning and scheduling models in real time and where they can account and correct for unexpected events eg unplanned shutdowns etc?**

**A** Absolutely! The computer power is readily available and cheap on the cloud, we should be driving the connectivity to connect our activities, people and machines to obtain the actuals and then the ability to replan in real time could be a reality. There is still work to be done to connect all of those capabilities but it is a reality that we have seen in other industries that have the connectivity, processes and will to make it happen.

**Q As mines move towards more continuous "mining factory" operations, with greater use of ROCs and autonomous equipment, how is mining software having to evolve to address these changes?**

**A** Mining software will need to evolve to integrate the silos, leverage the power of data

models and connect in the actuals. This is an area where Dassault Systemes can be instrumental because we have some of these same examples in other industries as well as deep knowledge of the mining industry.

**Q Equally, while virtual mines have to date only been used in the main for training operators and as marketing tools – are we now seeing VR and AI becoming more used in real operational scenarios?**

**A** Not quite yet but there are use cases that are starting to appear such as in planning. This will become an important tool in the near term as mining starts to deal with more complex issues, and

requires more unique problems to be solved and engages a more diverse group of people to solve those problems. The beauty of VR is that it utilises the most common language of all in 3D (even if you can understand geology and how 2D maps are represented in 3D we all understand a 3D representation as we rotate and dismantle it) and it also allows us to be immersed in the environment of the issues we are trying to solve, thus have a greater understanding without having to be right there in the field (which could be far away or unsafe). AI of course will be very helpful in providing people solving the problems the best guidance in solving the issues, by being able to assess many possibilities and narrowing down optimal solutions. AI will augment human capability for innovation and creativity.

**Q How do you see Geovia contributing to the mine of the future? Are you working directly with major mining houses to help achieve that and can you give any examples?**

**A** We are working currently with several major mining companies to develop not only tools that are on the platform thus able to leverage the one version of the truth, bring data in from all sources but also break down silos to create greater and faster collaboration, thus better solutions faster to problems, but also to have tools that are on the cloud utilising the power of the computational speed and optimal economics, use mobility devices so that work can happen anywhere, plus using AI and 3D Experiences to help transform the way we plan, tackle problems and visualize our industry. I am very excited to work with a number of partners to bring new tools to the industry over the next few years.

Lastly, analysis performed at the University of Technology Sydney confirms that publicly available production data “shows that nearly all the mines Commit Works have worked with are significantly more productive (between 15 & 50% more tonnes produced) after implementing Fewzion. The number of employee and machine hours stayed the same or dropped slightly over this period, showing that the production improvements above represent a significant productivity gain for the mines.”

Data in Fewzion highlighted that as variability decreased, production increased. Looking into the data from the shifts showed that the number of disruptions (experienced as reduced operating time each shift) reduced significantly over the period of use, but not enough to explain all of the improvement. It seems that, as well as reducing unplanned downtime the teams also improved the production from their machines.

“Recent projects completed in South America, Canada and Australia have shown a similar trend with improvements of 45% in mucked tonnes or 48% more development metres achieved within the first couple of months after going live with Fewzion. The upshot of these results is that Commit Works can confidently expect the mine to get a return on the investment a client makes with them in between one and three months after implementation. In many cases, this has meant that the site has made their money back before

Commit Works have been paid for the implementation project. After eight years of building and implementing this software, Fewzion’s single integrated system undoubtedly gets everyone on the same page. The combination of a fully integrated frontline plan with the ‘plan-do-check-act’ (PDCA) cycle inherent in management operating systems, and the focus on staying on target throughout each shift with short interval control, means operations are able to coordinate work into a single plan for the shift, reduce waste and save users time in the planning and reporting process. Having implemented our software in over 20 mines of all sizes, with companies as diverse as Anglo American, Glencore, BHP, OceanaGold, Yamana Gold, Bounty Mining and Fitzroy Resources, we are proud to be able to reliably help management teams deliver rapid and sustained improvements in their production.”

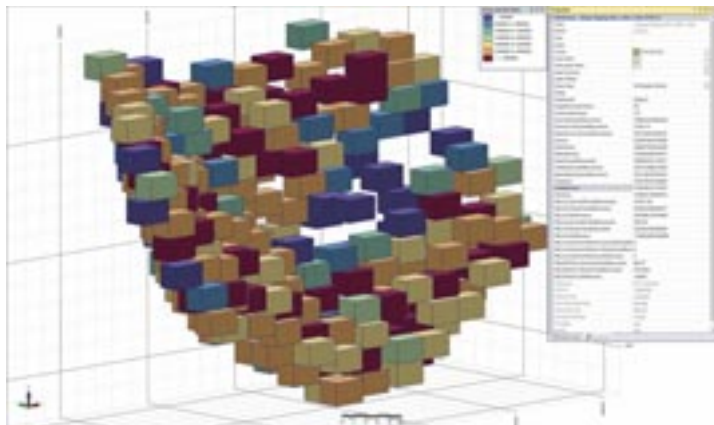
### **MICROMINE and Pitram taking innovation to the next level**

**MICROMINE** told *IM* that the considerable improvements in the application of machine learning have opened many analytical doors that had previously been firmly shut. “We can now analyse large datasets, quickly. This has reduced the cost to clients to complete these tasks and now projects that previously not feasible can now be approached with more confidence. Both

Micromine and Pitram have undergone key innovative enhancements in the exploration and mining space that demonstrates how **MICROMINE** is at the forefront of innovation. In 2020 Pitram is adding new functionality to complement its in-cab mobile solution to provide greater visibility of assets, enhanced opportunity for efficiency gains and potential to reduce reliance on infrastructure upgrades. In addition, Micromine 2020’s ring design functionality has highly interactive tools that allow the planner to define the design and the proximity constraints and receive dynamic feedback which is used to determine the viability of a design out in the field. Micromine 2020’s new Stope Optimiser module generates the optimum configuration of stopes for an underground mine. The Stope Optimiser is the only product of its type that natively supports the use of industry-standard pit optimisation methodology in the long-term planning of underground mines.”

In terms of software allowing real time responses, the company argues that closing the loop is undoubtedly possible today, but that in some cases real-time planning and scheduling are still challenging. “Real-time operational data available is fed back, allowing models to be validated, schedules optimised and updated. The more significant challenge is introducing the industry-wide support of standardised file formats that will enable production-based

## IMMERSIVE



*Micromine 2020's new Stope Optimiser module generates the optimum configuration of stopes for an underground mine*

systems to become interoperable with modelling & scheduling tools.

Still, this function is partly manual because not all parameters can be factored into the mathematic algorithms for real-time mining operations.” MICROMINE is currently in the process of streamlining the flow of information across the various planning systems. “To make this possible, we need to make real-time data more accessible to supervisors, regardless of their location. Next, we need to analyse the decisions they make and then implement methods to teach the application how to replicate this.”

Looking at planning work, historically this was done in isolation. “A plan was created for a time period, and operational teams attempted to work to that plan. The plan's elements (eg block models, pit design, schedules) were created using desktop applications with both the source data and the output information stored on the local computer. This approach is unable to incorporate and respond to a network of people and machines that are continuously reporting their progress and status. We no longer want the ‘isolated user’ approach but a ‘community of users,’ sensors and automated processes working together in an ecosystem to create a digital mine twin. This gives mines the opportunity for real-time data refreshing, collaborative work and task management. However, what is less affected is the mathematical engines that have been developed

over many years to process the data. Most are still just as relevant. But how these engines are incorporated into the ecosystem and how that ecosystem is managed, is new.”

In addition, as mining companies seek to move closer to their digital

transformation goals, MICROMINE says it is continually working with its clients to provide the software needed to enable the mine of the future. “With the combined strengths of its geological database, geological modelling, resource modelling, reserve generation, fleet management and mine control solutions, MICROMINE is well-positioned to continue to be the premium mining software supplier and to make mining easier. Examples around and include automatic updating of resource models with grade control information and blast hole data, optimised vehicle dispatch based on real-time performance data, and automatic updating of mine plans and schedules to reflect current progress and planned downtime.

And AI is now beginning to show up in production systems. Decision support functionality is being augmented with AI, automated data collection is currently being provided or enhanced through machine learning, and dispatching tools are leveraging larger datasets to automate truck and loader operations. The large mining companies are using the virtual mining environment to track all the data they get from equipment, so it is not just marketing anymore.

Finally MICROMINE told *IM* that working with its clients on development is the best option as they understand their businesses and have a great understanding of the problems that they need to be solved. “They can also provide critical insight into a problem's details. We are renowned for delivering outstanding customer support and reacting swiftly to our customers' needs. Our customers are the drivers behind what we do and our stance has always been to

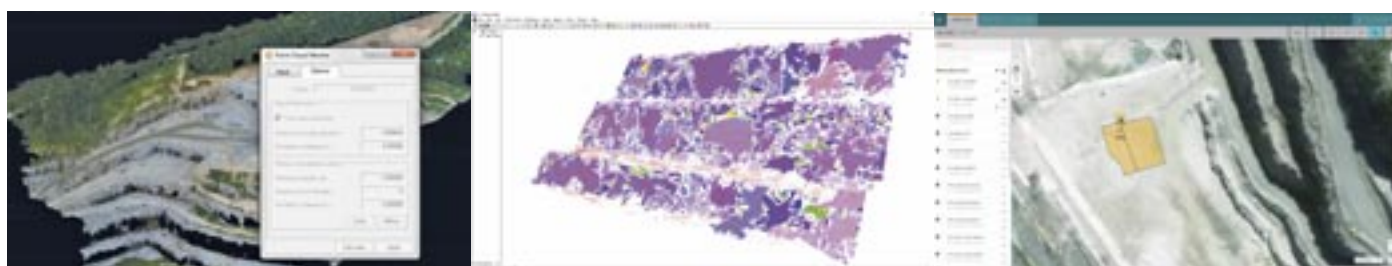
prioritise their needs over other development initiatives. Users become very proficient at using our software, and they provide honest and thorough testing. I can imagine that some future innovative advances will require on-site ‘beta’ implementations. Working mines are generally not keen to be a testbed for new methods – mainly if there is a chance that the results will not always be successful. The key here is collaboration and trust between the vendor and client.”

**Hexagon’s MinePlan for the future**

In 2020, Hexagon Mining says it is focusing a lot of its planning software development on integration with its new technology. “We are leveraging Leica technology to improve our point cloud data processing. We are improving geologic structure visualisation and analysis by incorporating technology from our recent acquisition Split Engineering. Finally, we are continuing to facilitate integration of planning and operations processes by building onto our MineEnterprise Platform; major innovations in drill & blast integration and short-term scheduling are slated for the platform in 2020.”

Hexagon Mining’s planning tools allow for direct access and feedback from actual production data in near real-time (once delays are identified; the schedule can be updated immediately to account for the uncertainty) to compare and allow adjustments to the planned schedule to reconcile with real life. Once delays are identified; the schedule can be updated immediately to account for the uncertainty. In both open pit and underground design and scheduling we can connect with real time data through short interval control.

On the question of increased mining autonomy, the company says constant integration with the data from autonomous equipment is essential in making mining software optimally productive. “Our software focuses on building interoperable systems that allow for easier data input and output for more rapid and automated decision-making. Our planning tools, MinePlan Schedule Optimizer (MPSO) and MinePlan Activity Scheduler (MPAS) both use optimisation algorithms to find the best solutions.” On virtual reality, Hexagon states that the ability to be immersed inside your data and



*Hexagon Mining point cloud, Split FX (stereonet) and D&B scheduling integration*



plan from a remote location is more attractive for mining companies both for training and safety reasons, especially because their staff and their contractors are constantly on the move. “Our core MinePlan software has virtual reality capabilities directly built in to the solution.”

On the mine of the future, Hexagon says it has always worked closely with mining clients to push the boundaries of its products’ capabilities and collaborated to define their future. “Now that customers are modernizing their operations and finding the need to take advantage of all the technology available, we find that interaction with them is essential to create new technology. Fresnillo, Teck, and other major mining companies have worked closely with us on several projects to push toward the modernisation of mines. Rob Daw, our CTO has been collaborating directly with one of our biggest clients in a Peruvian mine to develop actions for the future of mining. One of our advantages is that we are a one-stop shop for mining technology. We are transforming the future of mine planning by integrating our existing technology with our new acquisitions. Examples include IDS, Split Engineering, Blast Movement Technology among others.”

### Optimising short term scheduling

RPMGlobal recently released a raft of comprehensive upgrades to its advanced mine scheduling software — XECUTE— underpinning increased optimisation across the entire mining value chain.

XECUTE is RPM’s short-term scheduling solution that enables miners to maximise value by using intelligent integration to connect planning with other departments within a mining operation.

RPM says it has experienced a significant uptick in the adoption of XECUTE with the solution now operational across iron ore, coal, oil sands, manganese, gold and copper mines. One of the major reasons for this adoption is the unique Product Optimiser functionality which continues to deliver a key planning advantage to users.

Product Optimiser determines the optimal way to process, blend and stockpile products to maximise value from what is about to be mined. The latest XECUTE release includes upgraded optimiser functionality providing further enhancements when integrated as part of the short-term schedule.

RPM’s Chief Technology Officer Paul Beesley said “XECUTE’s rapidly growing customer base was helping to expedite and expand product functionality. The increasing sophistication of XECUTE’s functionality means XECUTE is now capable of going beyond simply planning extraction from the pit. It can now provide optimisation across the entire value chain.”

XECUTE provides planners with a set of tools

### Eclipse Mining Technologies

Mining companies often face unorganised, ambiguous and isolated data as well as tools that don’t work together and software that is difficult and risky to implement. New company **Eclipse Mining Technologies** states: “The world of technology in mining has changed drastically in the last several years. An eruption of point and niche solutions paired with outdated monolithic software packages has left mines struggling to get day-to-day work done. We are left asking: how can I connect data between departments? Or how can I make a report capture changes to my block model since last year? Or reproduce the workflow for building a schedule? Or understand what data was used to create a mine design? Consolidate reserves? Currently, undertaking any of these tasks is time consuming, burdensome and unwieldy – if at all possible.”

Eclipse, headed by Chairman Fred Banfield, the Founder of mining software pioneer MineSight (now part of Hexagon) is tackling this issue with what it believes is the first true mining software platform. “This platform centralises the data and activities that produce results related to a mine. It is designed to help users take advantage of their existing solutions, while adding critical components and tools to help unify data and process. Our platform has been created around supporting complex and large datasets, understanding multi-user environments, and building reproducible workflows. Going back to the opening question: yes, if you click on a geologic interpretation, you’ll know how, why, who, when, and what was done to create it. So, a mining software platform is exactly what the name says – a platform specific to mining data and related software applications. Other industries have worked to tackle these issues – but the gap for a mining specific platform becomes more apparent with each passing year. The reason it hasn’t been done? It’s not easy. The skills, expertise, and time it takes to create it are not easily found.”

that allow users to make dynamic adjustments to mining operations and visualise the impact of these adjustments to mine production as well as the entire downstream value chain. This means that a planner can make decisions based on the impact of planning decisions on not just production in the next shift but also alignment to longer term plans on processing, transport, and shipping.

“With the ability to incorporate processing facilities, transportation and shipments into an XECUTE schedule, the value the robust solution brings to the pit-to-port capability is significantly bolstered,” Beesley said.

RPM’s coal customers will also have increased support with the introduction of coal wash plant features. This functionality allows the planner to schedule the whole way through the plant rather than stopping at the Run Of Mine. This becomes particularly valuable in a multi-product operation and is currently being implemented at one of the worlds most sophisticated coal blending and processing operations.

XECUTE’s innovative architecture means that real-time data is made available through any connected source. By enabling users to have a better understanding of the economic value produced from a commodity, miners are better placed to make decisions about crucial impacts that are generally outside their control.

By way of an example, XECUTE facilitates short term planners visualising changes in the pit through live integration to Fleet Management Systems/High Precision GPS and Drill systems. Deviations from the plan are therefore identified immediately, allowing planners to make adjustments if required. This in turn minimises the time-consuming weekly planning demands on short term planners while helping to deliver high levels of predictability across the value chain.

On top of the Product Optimiser enhancements, other key areas of focus include XECUTE’s User Interface and CAD functionality. Unlike many other linear programming engines, XECUTE has a highly intuitive, user-friendly interface that allows planners to spend more time analysing results, instead of learning how to program the inputs. There are also significant enhancements to speed and usability within this



*RPMGlobal has released a raft of comprehensive upgrades to its advanced mine scheduling software — XECUTE*

XECUTE upgrade, including an 80% improvement in geology and reserving processing speed.

XECUTE mobile improvements enable users to have integrated data feeds from the pit being used in a mobile application to quickly compare the short-term plan to the actual production. This gives planners and supervisors a plan compliance tool while they are on the move. Information such as drill holes, bucket positions and machine positions are fed straight to the mobile user.

“Our innovative software connects systems with information and when it comes to connecting short-term planning with the rest of the mining operation in our view there is no other product on the market as sophisticated or advanced as XECUTE,” Beesley concluded.

### MineRP and ThreeDify collaborate to deliver

**MineRP and ThreeDify** in November 2019 announced an agreement to bring a variety of resource modelling, mine design and optimisation tools currently offered through ThreeDify’s GeoMine Solution to the MineRP Platform. The partnership is aimed at providing the mining industry with another innovative step forward in the eradication of data silos and the removal of long mine design cycles that constrain agile decision making.

Pieter Nel, President & CEO of MineRP says: “The partnership with ThreeDify supports MineRP’s strategy to revolutionise the speed and accuracy with which miners are able to model, design and schedule mines of every type, method and commodity. We have decided to enter into a long-term partnership with ThreeDify to harness the unique capabilities their software currently offers directly through the MineRP Platform.”

ThreeDify’s VP of Operations, Nancy Liu, remarks: “While ThreeDify has been approached by multiple players in the mining technical software world, we have found in MineRP a partner with a similar vision to deliver true digital transformation to the mining industry. By partnering with MineRP, we are demonstrating our commitment to information sharing and collaboration in integrated resource modelling and mine planning.”

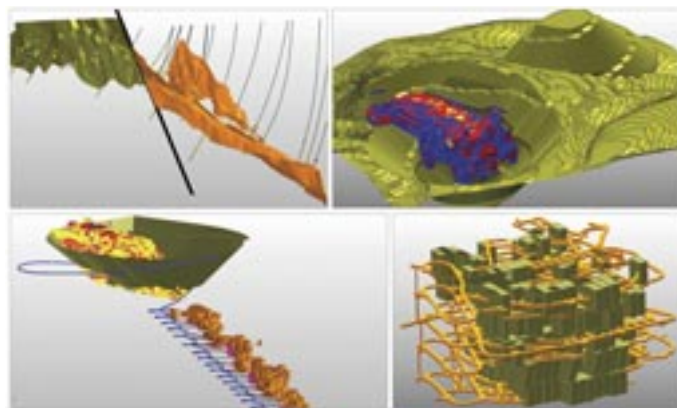
While the companies have worked closely for a long time, it is the extensibility and robustness of the MineRP Platform that provided the flexibility to finally implement a technically sound integration strategy without sacrificing the unique capabilities of either partner.

### ThreeDify evolving GeoMine suite

As a mining software technology company, ThreeDify also says it is committed to continually evolve its GeoMine suite to help its clients maximise the economic potential of their mineral

deposits and improve productivity. “ThreeDify GeoMine is capable of creating resource models in a Universe with a record-breaking size of over 100 quadrillion blocks as opposed to 1 billion blocks offered by traditional mining software packages. This empowers GeoMine users to model their orebodies with smaller block sizes to improve accuracy, or model multiple satellite deposits in a single GeoMine project. The dynamic anisotropy interpolation functionality coupled with geostatistical analysis tools simplifies the resource estimation process for complex narrow vein and irregular orebodies. Results from this module can be used as input for subsequent tasks such as reserve estimation, mine design and scheduling in a fully integrated platform which is composed of twelve independently licensed modules for both open-pit and underground mines. An integrated platform eliminates the tedious, time consuming and error-prone process of importing and exporting data between multiple software packages.”

After putting in the groundwork for effective support for planning resource extraction for any underground mining method in a safe and sustainable manner, ThreeDify says its team made all the modules and tools in the GeoMine underground solution compatible with pillar supported, artificially unsupported and caving mining methods. “In the first half of 2019, the team focused on re-architecting the stope optimisation algorithms in GeoMine-Stopemizer. The re-architected stope optimisation algorithms enable our users to easily create Dynamic Anisotropic Movable Shapes (DAMS) that aim to minimise dilution and maximise recovery while respecting basic geometric and geotechnical constraints such as minimum and maximum stope sizes, minimum and maximum dip angles, as well as hanging-wall and foot-wall trough angles. Dynamic Anisotropy (DA) as used for resource modelling allows anisotropic rotation angles defining the search ellipsoid and variogram model to directly follow the trend of the mineralisation at each cell within a block model. To mine such an orebody using an underground stoping method, a set of movable shapes that follow a group of user-defined DA paths is then superimposed on top of the block model. As the DA paths are created to follow the mineralisation trend, the resulting movable shapes would maximize recovery and minimize dilution.”



*ThreeDify GeoMine is capable of creating resource models in a Universe with a record-breaking size of over 100 quadrillion blocks*

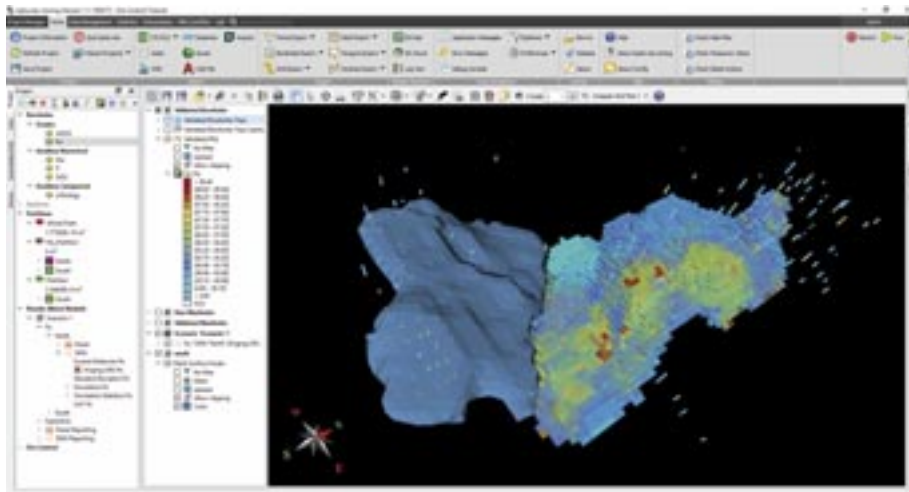
Other differentiators of the re-architected GeoMine-Stopemizer include its speed and interactive nature as well as its flexibility. Mineable shapes in the new version can be previewed interactively in seconds for shape fitness before being committed as a design, affording the user to conduct rapid what-if scenario analysis. External constraints can be easily incorporated through GeoMine’s built-in attribute creator and formula builder. The year 2019 also witnessed the introduction of GeoMine-GSM modules. Modelling of stratigraphic deposits, such as coal seams and oil sands or other layer type mineral deposits, requires many techniques that are fundamentally different from those designed for hard-rock mining. Usually, stratigraphic deposits’ XY extent is considerably larger (ie multiple km) than the Z-extent (ie <1 m). This imposes challenges to conventional 3D block modelling because the number of blocks required to accurately model such a deposit would be prohibitively large. The addition of the GeoMine-GSM suite significantly augmented GeoMine’s scope of applicability with its highly efficient algorithms for 2D gridded seam modelling, Margin Ranking and pit design. The GeoMine-GSM suite has received very positive feedback from several early adopters for its simplicity and ease-of-use. With the introduction of the GeoMine-GSM suite, ThreeDify GeoMine stands out as a fully integrated resource modelling and mine planning software solution for mines of every type, method and commodity.

### Geovariances makes geostatistics accessible

In mid-2019, **Geovariances** launched Isatis.neo, its new generation software solution in geostatistics.

With Isatis.neo, Geovariances says it offers its customers all the functionalities available in its historical and flagship software solution Isatis, but in a completely new intuitive and user-friendly Windows-native interface. Users will





A screenshot of Geovariances' Isatis.neo's interface

continue to benefit from the quality of the algorithms Geovariances is recognized for, while improving their efficiency in their work.

The new design of Isatis.neo's user-interface should help a more significant number of users to implement geostatistics. Whereas Isatis (coming from the Unix world) required users to open several successive dialog boxes to set up parameters fully, Isatis.neo reduces the amount of software manipulation thanks to carefully streamlined applications and functionalities.

To meet the specific requirements of the mining industry even better, a special version of Isatis.neo, Isatis.neo Mining Edition, has been made available. The software groups the power of its predecessors, Isatis and Minestis (workflow-based software for mineral resource estimation), offering advanced functionalities for comprehensive geostatistical studies and a pre-configured workflow for an optimised way to resource estimation and classification (including ore control and reconciliation).

This dedicated version enables thorough data exploration, complex geological and geometallurgical analysis, fast and reliable in-situ and recoverable resource estimation, extensive uncertainty and risk analyses through conditional simulations, and workflow automation.

In particular, Isatis.neo includes:

- A new integrated and interactive application for Exploratory Data Analysis,
- Sub-blocked modeling,
- A powerful calculator with Python syntax,
- Enhanced automation possibilities through
- A word processing editor to quickly produce study reports

Users can also find one-of-a-kind tools, such as a powerful machine learning-based application for the automatic definition of geological and geometallurgical domains or an original technique for robust resource

classification. "That makes Isatis.neo Mining Edition a comprehensive, flexible, and scalable software solution in geostatistics that meets the whole resource team needs. With Isatis.neo, mining companies will share a single software solution between headquarters and mine sites, geostatisticians, resource managers and geologists, and external consultants. It becomes easy for resource managers to set up and automate the estimation workflows that will be used by mine geologists for the daily update of resources."

### Datamine broadens its portfolio acquiring IMS from ABB

The IMS business, including MineScope, MineMarket, Production Accounting and CCLAS, was last year acquired by Datamine, a wholly owned subsidiary of Constellation Software. "With over 5,000 existing customers, **Datamine** is entirely focused on providing software to seamlessly plan and manage mining operations. Spanning from exploration data and resource modelling, to open pit and underground mine planning, Datamine has the widest portfolio of software solutions covering the entire mining value chain. With this new acquisition comes a stronger offering for our users and helps us provide more solutions to the industry's most pressing problems. With offices in 18 countries providing services to customer sites in over 100 countries, the addition of the IMS team of over 80 staff will ensure the most seamless transition from ABB to Datamine."

Datamine says the IMS products are highly complementary to the existing Datamine product range with minimal overlap. "All IMS products will continue to be actively developed and supported, and Datamine is excited about the opportunity to take these technologies to additional geographies and improve integration between products for a more seamless user experience. We have always taken pride in our ability to offer reliable solutions for niche problems and markets within the industry and this acquisition will not only complement, but

strengthen Datamine's software portfolio, further increasing our competitive edge within the industry." MineMarket and Production Accounting it says is a substantial addition to Datamine's supply chain portfolio for the areas of trading, logistics and marketing of mineral commodities, while MineScope extends its current geological modelling and mine design capabilities. "CCLAS offers an intelligent and comprehensive laboratory management system; a perfect addition to our current suite of data management solutions."

In its planning software Datamine continues to innovate in terms of optimisation and automation of design. The Mineable Shape Optimiser, developed by AMS, another Constellation acquisition, continues to improve to automatically build objective stope designs. Within the open pit mine planning space, Datamine Studio OP's automated rule-based pit design software has somewhat changed the accepted paradigm of how to explore alternative pit designs. Engineers can now test alternative haulage routes, dump designs and pit configurations in minutes rather than hours or days with no more awkward and time consuming user interaction.

In addition to auto pit design, Studio OP has mid and short term planning functionality with the ability to optionally submit optimisation runs for execution on the cloud. With an increasing amount of practical constraints being included, such as the detailed modelling of loader movement and drill and blast cycles, Studio OP's scheduling is moving further to the short term.

Mine geology products have long been a mainstay of Datamine and this is continuing. The latest version of Studio RM, released in early 2020, contains further improvements to its resource estimation and automated structural modelling capabilities. Datamine is working directly with several customers in South Africa and Australia on production geology systems for mine mapping using tablets. These systems are designed to work with Datamine's existing geological modelling products; there is a focus on ensuring mapped data is used to update reserve models as quickly, automatically and objectively as possible.

In the exploration space Datamine Discover's use has significantly expanded since its acquisition by Datamine. An Android sister application to Discover was released in 2019 with an IOS version due for release in the first half of this year. These mobile apps are used in the field for recording sample collections and surface mapping. A version of Discover for ESRI has been built in collaboration with selected customers and is now in beta testing. This version will make it easier for many customers to extend its use within their portfolio of exploration software products. 