Enhancing efficiency and ESG performance

In demand and in transition, the mining software community continues to help mining companies optimise their way of working and adapt to today's 'new normal', Dan Gleeson reports

GEOVIA's Mauro DelleMonache is confident the company's 3DEXPERIENCE platform will become even more sought after with mining companies seeking to quantify and potentially improve on their Scope 1, 2 and 3 emissions in line with climate goals

The past 18-24 months has seen a constant string of corporate activity in the mining software space as sellers look to cash in on relatively high premiums and buyers from various sectors look to gain a foothold in a market growing in importance.

Just a few of the big recent transactions to have been announced or completed include AspenTech's planned purchase of Micromine, 'Datamine's acquisitions of iRing, Scenario and LandTrack Systems, Sandvik's incorporation of Deswik, and Epiroc' bringing MineRP into its offering.

The numbers associated with these deals have been positively affected by a wider tech drive across the financial sector, yet they also reflect the growing need for productivity-enhancing solutions that make a dent in mining companies' ambitious environmental, social and governance (ESG) goals.

IM spoke to some of the movers and shakers in the space to find out more.

Automating for optimisation

Maptek Chairman, Peter Johnson, says some of the same trends influencing M&A activity are also behind the mining sector's re-evaluation of its relationship with technology.

As the mining sector contends with the shortage of skilled personnel available, it is also facing the dual challenges of depleting ore grades in some metals and increasing investor expectations for strong financial and safety performance, aligned with its ESG performance.

"This is driving the value of mining technology higher as mining companies recognise the latent value and benefits from leveraging technology in areas and ways they may not have fully taken advantage of before," he told ***IM***.

The other major trend driving corporate activity in the mining software space of late is a "dwindling" set of options for investors to find and invest in "sound, profitable recurring revenue streams" from sustainable long-term business, he said.

This is a category many mining software vendors fit into, according to Johnson.

"In reality, the valuations now being applied to mining technology companies are only catching up to other tech companies, and the maturity of the market we work in means that many well-run, successful companies can be found by those seeking to grow in this space," he said.

"All of this occurs against a backdrop of the long-term demand for metals and global electrification gathering pace, alongside forecasts of dramatically increased demand for the commodities and metals produced by our customers.

"This long-term growth will cause the first two aspects to intensify in the future, and so there is a rush to get a foothold as early as possible."

Maptek is a party to this M&A stampede, having in the last year invested in K2fly to become the biggest shareholder of the company, a provider of resource governance solutions for net positive impact in ESG compliance, disclosure and technical assurance.

In line with this transaction, the two companies have also been working on integrating the K2fly Resource Reporting solution – which provides a way to capture raw data, track data ownership and accurately adhere to all reporting requirements to meet global stock exchange reporting rules – and Maptek Vulcan – the geological modelling and mine planning software.

Johnson, who recently joined the K2fly board as a Non-Executive Director, said the integration of these two platforms would further improve data transparency.

"Mining companies leverage resource and reserve reporting across applications such as tailings management, heritage obligations, landform remediation and closure liability planning, which is why it makes sense for integration with Maptek Vulcan geological modelling and mine planning software," he said. "When mineral resource and reserve estimates generated from Vulcan block models are ported directly to the K2fly database, publicly reported information can then be traced back to the source block model and parameters used to generate estimates can be queried."

This type of integration into third-party solutions is endorsed by Maptek, with the

company open to collaboration across the mining technology space.

It has been involved in South Australia's Mining Innovation Consortium, for instance, partnering with the University of Adelaide on a research program to determine the effect of uncertainty in geological models on the net present value resulting from a long-term mine schedule.

It has also collaborated with Minviro, with the two companies combining their technologies to provide a solution to minimise an operation's environmental impact while simultaneously optimising the material movement schedule.

And, in 2021, it become the first mining design software company to sponsor the Coalition for Eco Efficient Comminution. This is where the company's work in reducing the burden on mine engineers for blast design is of particular interest.

Eduardo Coloma, CEO of Maptek, explained: "An ever-growing requirement to engineer for control and profit in practice means benchmarking blast design scenarios to better evaluate the interrelated factors that influence performance."

Automating this process can improve the outcomes and allow engineers to concentrate on other tasks, hence the reason why Maptek has pursued a new design approach that only requires a polygon, surfaces and array of blast design variables from the user.

"The variables are randomly manipulated to converge on the best possible solutions from competing blast objectives such as cost, fragmentation and vibration," Coloma explained.

"Generating optimum blast outcomes, and generating them earlier in the value chain, allows that evaluation to occur as part of short- and medium-term planning, adding value to the entire mine operations workflow."

Maptek BlastMCF does exactly this, harnessing automation, data analytics and optimisation for the best blast performance, according to Coloma, providing an opportunity for surface mines to achieve more with every blast.

The company's BlastLogic solution is then able to record these outcomes, acting as a central data repository that is updated in near real time and used by mines to drive operational and engineering improvements based on learnings from past performance.

In one example, Maptek worked closely with mining consultant MEC Mining, artificial intelligence (AI) specialist Insight and engineers at the BHP Mitsubishi Alliance-owned Caval Ridge operation in Queensland, Australia, to develop a suite of Power BI dashboards linked to BlastLogic that allow engineers to source the correct data to learn from past blasts and better inform their decision making for planning, designs and scheduling.

"The dashboards compare design against actuals for a wide range of blast metrics, with pie charts and spatial plots of holes coloured by dipping, backfilling, charging and wet hole information," Coloma explained. "Leveraging BlastLogic's SQL data warehouse provides access to years of information at the click of a button, which is made available on all devices. Rapid deployment to other sites or operations is another advantage."

Maptek – as can be seen – has hands in many pies in the mining software sector, with Coloma believing the most transformation currently taking place is in the industry's use of machine learning and AI.

"Reducing the time from data collection to value creation is a major driver for success, particularly when industry is struggling to find experienced personnel," he said. "Machine learning embeds years of knowledge and delivers results faster in a repeatable process for domain modelling."

He offered up an example here involving a trial of DomainMCF, the company's domain modelling solution, at IGO's Nova mine in Western Australia.

Back in 2022, geologists at the operation trialled DomainMCF in parallel with the standard workflow as part of a resource update at the project, noting that the improved resource modelling process resulted in better quality drill hole logging.

"Where the annual block modelling process typically took several months to complete, IGO geologists found machine learning much faster, resulting in more time for training less experienced core loggers," Coloma said. "In addition, the machine-learning model returns an objective measure of uncertainty in the geological model, which is likely to be useful in mineral resource classification and mining reconciliation work."

Modelling all possibilities

GEOVIA CEO, Mauro DelleMonache, puts the recent M&A glut in the software space down to the entry of a set of "nimble" organisations with shorter "ideation cycles" able to quickly bring their offerings to the market.

This has stimulated an interest in M&A, he claims, bringing with it new-found dynamism the whole sector is benefitting from.

Alongside this, there has been significant change on the demand side of the mining software business.

"The mining sector has traditionally been seen as risk averse, with many of the companies perceived to be in the 'swim lane' of technology developed specifically for mining," he told ***IM***. "What I have seen over the last several years is mining organisations starting to implement technology, thought processes and capabilities from adjacent industries."

GEOVIA, Dassault Systèmes' natural resources and urban planning division, is benefitting greatly from this, bringing its modelling and simulation design and virtual twin learnings in industries such as aviation and manufacturing to the mining space.

"We are finding there is some openness from the mining companies to start looking at those technologies and seeing how they can apply in mining," DelleMonache said. "For us, that is of great benefit as we have this expansive toolkit.

"It is now a matter of continuing these dialogues with companies, showing them how these solutions could be of benefit to their organisation and working together to realise the value of applying them."

These dialogues are increasing in regularity around mining company ESG evaluations, with GEOVIA and Dassault Systèmes offering input for educated decision making on considerations such as resource evaluation, mine design, mine production and more.

"Our brand has a promise of modelling the sustainable planet," DelleMonache said. "We realise that, in the mining context, the more criteria you can include, the more value we can bring to these models."

This has seen the company break down the silo mentality often observed within mining and create a collaboration platform for all aspects of a mining operation – from exploration and mining, to processing and closure.

"If you were to break down those barriers, you create visibility of the entire system and the flow from exploration to rehabilitation," DelleMonache said.

"The only way you can do that is get your organisation to collaborate – externally as well as internally. The challenges in adopting a piece of software suggests it is likely to fail, yet, if you adopt a spirit of collaboration around a defined solution, the likelihood of value generation is that much greater.

"That is something we are advocating for in the 3DEXPERIENCE platform."

This platform connects people, ideas, data and solutions in a collaborative environment, offering a "single version of the truth" to anchor outcome-based processes and capture all activities in one place, according to the company.

The platform is aiding collaboration within the context of the Electric Mine Consortium, which includes 23 members made up of mining companies, vendors and service suppliers, all looking to accelerate progress towards the fully electrified zero CO_2 and zero particulates mine.

GEOVIA is providing access to the 3DEXPERIENCE platform for the Electric Mine Design working group, working with several members to model and simulate what this future-proofed mine could look like.

DelleMonache says this type of collaboration is representative of the right approach towards decarbonisation and electrification. The findings will allow the wider industry to obtain a glimpse into how they could implement such changes at their own mine sites.

He explained: "The consortium allows you to generate these small-scale references with several industry partners to provide the wider industry with something tangible."

DelleMonache is confident the company's 3DEXPERIENCE platform will become even more sought after with mining companies seeking to

Isatis.neo: resource estimation and mine reconciliation

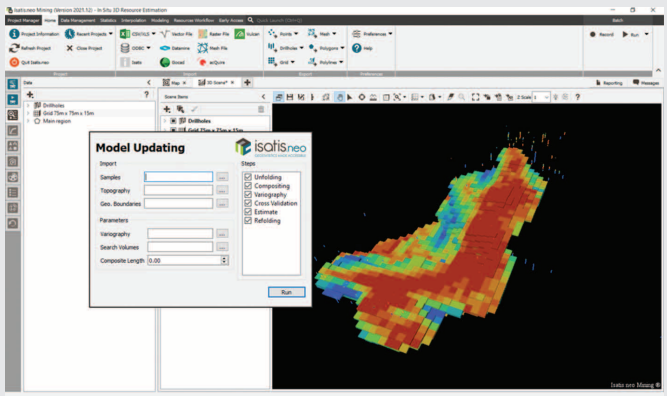
Principally dedicated to resource estimation, Isatis.neo, the reference geostatistics software by **Geovariances**, is also being used across the sector for mine reconciliation.

The Geovariances consulting team regularly helps mining companies implement automatic workflows combining Isatis.neo batch and Python coding to update their resource models periodically. These workflows can be enhanced with custom and simplified user interfaces, ensuring they can easily run as a background process.

"Coupled with some training by Geovariances, they permit mining operators to feel confident in independently running the routines in the planned intervals," the company says.

Geovariances has worked on several projects in this guise, with one assignment for a uranium mining company that required a routine to allow their global mining operations to update in-place ore volume estimations. This saw Geovariances develop a workflow to calculate the ore volume in each stratum by comparing the topography of the open pit at two dates. A specific user interface was also proposed to the teams.

Another example of this type of collaboration comes from the company's work with a major iron ore producer that sought a solution to update its resource models on a weekly – instead of monthly – basis to improve the decision-making process regarding the destination of the mined materials. Geovariances developed automated routines based on Isatis.neo batches and Python coding that, it says, have performed consistently.



An example of the user interface for model updating in Geovariance's Isatis.neo

The software provider also applied the same process for a valued gold-producing client, looking to establish an automated update method for both medium- and long-term underground mine modelling.

The company concluded: "These examples show that the programming capacity of Isatis.neo geostatistical software, reinforced by Python scripting, makes users capable of implementing customised workflows for resource estimation and periodic updates. Multiple tools and a flexible programming structure makes the software relevant for diverse mineralisation types and diverse operating practices."

The **ThreeDify** GeoMine platform has just gone through a transformational year with four modules added in 2022 to round out the software package.

The platform, a solution for mine modelling and planning, is now home to 16 individually licensed modules, allowing users to choose whichever one suits their varying needs at different stages of their projects.

OreChaser

GeoMine-OreChaser (OreChaser) is an infill drilling plan optimiser for both open-pit and underground mines. It allows the drill planner to determine the optimum number, positions and lengths of additional drill holes required to maximise the resource uplift for a given drill budget.

It features a proprietary 3D Genetic Algorithm with the choice of two search strategies – RocDP (Randomized Ore Chasing Drilling Plane) strategy and (FRD) Fully Random Drilling strategy – both aimed at maximising metal recovery while minimising kriging variances under the specified drilling budget.

Unlike most other competing drill hole optimisers that can only generate non-directional drill holes, the auto-generated infill drill holes in OreChaser can be directional or non-directional with an optional fan-out configuration, ThreeDify says. They can start either from a topographical surface (for open-pit mines) or from mine accesses (for underground mines). Furthermore, OreChaser provides many options that allow users to quickly adapt and customise the underlying generic algorithm to suit the specific data set.

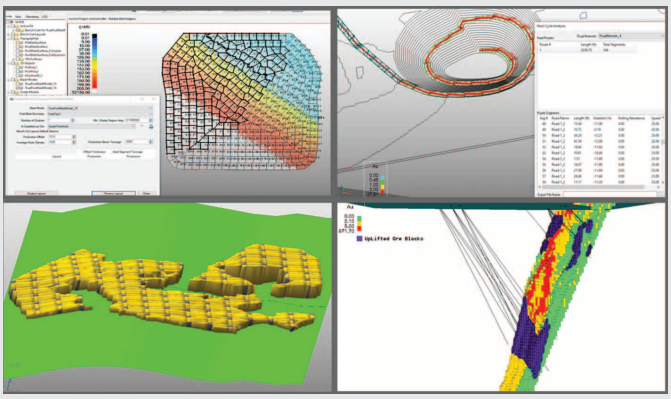
OreController

GeoMine-OreController (OreController) is an open-pit grade controller designed to create and sequence fine-grained dig units based on 3D blast movement modelling to minimise dilution and ore losses for bench mining, ThreeDify says.

"Traditional grade control practice usually entails determining the dig limits for bench cuts of an open-pit bench against an in-situ block model," the company explained. "Unfortunately, this fails to model the reality: after a blast is fired, blocks on the bench will break, throw and mix with their neighbouring blocks, invalidating the predefined dig limits for all but trivial cases. The dilution and ore losses have also been hard to quantify and are usually a guesstimate or determined after the fact."

A better approach emerging in recent years has been to consider the impact of 3D movements of the rock being blasted, with OreController designed specifically for this purpose.

"With OreController, the user only needs to specify an in-situ block model and a pair of topographical bench surfaces before and after the blast," the company says. "A post-blast model will be generated automatically and can be used to create fine-grained shovel/truck dig units, which can then be scheduled by GeoMine's iScheduler-OP module against the blast model."



Threedify GeoMine's new additions: OreController, HaulCalc, FSO and OreChaser

HaulCalc

GeoMine-HaulCalc (HaulCalc) provides a detailed analysis of haul routes and is, the company says, an ideal fleet budgeting tool. For example, it can determine the truck fleet required to meet a target production rate or the achievable production rate based on a given truck fleet.

This module comprises Road Network Manager, Fleet Manager and Haul Route Analyzer. The Road Network Manager adds a suite of road generation and editing tools to the GeoMine platform; the Fleet Manager features an extensible truck database; and the Haul Route Analyzer partitions a given road network into road segments and performs route analysis on the user-selected route.

A benchmark comparison of GeoMine-HaulCalc and Excel-based tools have been conducted with the following benefits:

- The ability to analyse a haul route within seconds based on the fleet requirement and actual route conditions;
- Offering a suite of automatic and interactive tools for open-pit and underground ramp generation makes constructing multiple alternative road networks for haulage analysis simple;
- The ability to add/update truck types to/in the built-in truck database and allow multiple road networks for wide adaptability; and
- The ability to generate detailed segment-by-segment route analysis reports for a given route in a CSV format.

FSO

GeoMine-FSO (Flat Shape Optimizer) is a mineable shape optimiser and parametric designer for room and pillar/room and board mining methods for flat or moderately inclined thin tabular/seam orebodies, such as coal, potash, trona, limestone and manganese. FSO includes an automatic boundary optimiser and a parametric room and pillar designer.

The company explained: "Given a grade model and a set of economic parameters, FSO automatically determines the best optimum mining boundary and interactively generates the best fit room and pillar design."

quantify and potentially improve on their Scope 1, 2 and 3 emissions in line with climate goals.

"The only way to capture a lot of that – especially with Scope 3 emissions – is through collaboration and connecting your suppliers, customers and contractors," DelleMonache said. "When I look at what we have to offer as GEOVIA, we have some great virtualisation technologies, but, as Dassault Systèmes, we have an even bigger platform that allows these organisations to digitally connect, share information and highlight where the big opportunities are to focus on and make a sizeable impact on sustainability metrics."

Such modelling and simulation also benefit the 'S' and 'G' of the ESG dynamic, allowing miners to display how they will meet regulatory requirements with their ongoing development plans while retaining their social licence to operate with all relevant stakeholders.

"We are trying to show not just government bodies, but the broader community in which an operation is located, that the plan for a mine is in everyone's interest," DelleMonache said. "We will also have a community portal within this platform so all parties can feel involved and listened to in terms of understanding their challenges.

"This all comes together to show what the mine will look like, how it is going to operate and the ESG impact of those operations. Bringing all those processes together is very valuable."

A top-down approach

Datamine has been one of the key protagonists in the recent M&A story being played out in the

Datamine has purposely developed its portfolio and capabilities to meet the future needs of its customers, according to Esa Immonen

software market, acquiring numerous companies on its way to becoming a powerhouse in both software and consulting.

Its latest purchase involved adding iRing, the creators of Aegis – a market-leading underground drill and blast package – to its vast offering.

An expansion into underground drill and blast planning software was the reason for this move, but Datamine's wider corporate strategy is to keep its customers operating efficiently, according to Esa Immonen, Global Talent VP.

"We support the drive to ensure our customers are operating at the most efficient point possible even with currently installed equipment," he told ***IM***. "This is done by taking a holistic approach – such as our mine-to-mill solutions – where the real energy and cost drivers are understood and managed across the entire mining value chain from an operational perspective."

Immonen said this focus reflects the corporate approach mining companies are taking to their use of software, some of which may be driven by influences such as a heightened focus on ESG.

"ESG has placed accountabilities on corporate companies which is cascading through to the sites and operational level," he said. "There is increased volatility and uncertainty, too, as new regulations are being designed to tackle issues such as climate change.

"ESG is also driving greater transparency along the supply chain, such as the provenance of metals or carbon tracking, as customers demand to understand more about what they consume, eg is there metal from conflict areas, or potential for modern slavery or child labour? This needs to be tracked and reported, so this is another area where we are providing solutions to the industry."

Unsurprisingly – and in accordance with most companies ***IM*** spoke to in the software market – the most transformation in the mining software space is tied to generating total business visibility and ESG, according to Immonen.

"ESG will continue to be a focus, as the market is driving the industry to understand and control its activities – whether it be the impact they are having on local communities or the carbon they are emitting as part of their process and logistics," he said.

Datamine has purposely developed its portfolio and capabilities to meet the future needs of its customers, according to Immonen, who mentioned not only the software offering, but also its expanding consulting business

"[This] provides our customers with the greatest insights to lead their businesses, not just operations with real focus on visibility, accountability, sustainability and safety," he said.

An example of this comes in the form of the company's Centric software, which pulls together an entire enterprise into one integrated ecosystem to present a view of a mine's or series of mines' performance. This, according to the company, eliminates inefficient processes related to data acquisition, reporting and analysis that keep mines from realising their full potential.

Such a solution – along with many others in the Datamine portfolio – provides actionable insights to be evaluated, focusing on cross-functional activities, according to Immonen.

Speaking of cross-functional activities, Datamine says it is open to collaborating with its customers and other third-party providers to ensure data flows freely throughout a mine site or corporate office for optimal decision making.

"Our focus is on providing the best solutions to best fit the customer's current and future requirements, tailoring packages which will deliver true cross-functional benefits," he concluded.

Out for transparency

David Batkin, Executive General Manager of Product Strategy at **RPMGlobal**, says many of the M&A targets in the software space have been populated with mine planning solutions that offer the sector new-found levels of transparency.

"For miners and contractors, planning helps to provide the transparency that is being called for by the wider community and gives management and shareholders confidence that they are on the right path," he told ***IM***. "For OEMs (who have been very active in the M&A space), planning software provides the first step towards

RPMGlobal's David Batkin says there has been increased demand for the simulation of alternative trucking fleets through such solutions as its HAULSIM software. Pictured here is the trolley line (in green) and charging station being simulated in the background

automation as anything automated in the mining space needs a very robust plan to start from."

Greater stakeholder transparency and accountability requires not only lots of data, but the ability to use this data to generate a plan for operations that can be understood by all stakeholders involved in mining.

RPM, as a company with enterprise level software solutions, says it is able to provide this context with an offering across the entire mining value chain.

Looking for transparency across all levels – site-, corporate- and community-level – more mining companies are looking to incorporate enterprise-level solutions, according to Batkin. In the mine planning space, this is seeing more companies tie planning with simulation to test options and scenarios that don't have the ticket price of technology trials but do provide a visualisation that can inform all stakeholders.

In terms of where the most transformation is

At the project development and deposit exploitation stage, more focus is increasingly placed on converting the data generated by mining assets into near real time actionable insights that allow a faster reaction to the changing environment of operations.

Limited communication at the underground mine can create inefficiencies in scheduling and managing machines' availability and uptime. These can include longer-than-planned maintenance periods, with more time spent on administrative tasks than actual revenue-driving activities. As a result, there is a need to eliminate variability and unknowns from production and equipment maintenance processes to keep up fleet availability.

Underground mining operations involving a lot of mobile machines, such as LHDs, dump trucks, drilling and auxiliary equipment, often become a closed silo of information. Once underground, the machine is hardly visible – both to the OEM that delivered it and to the central services of the mining company responsible for planning its maintenance and supplying relevant spare parts.

To address this issue, **TALPA** has implemented a system in partnership with a major mining company and a leading OEM, allowing for a reduction of equipment service costs of more than 35%/y, it claims.

The system, which has been implemented in stages, began with the optimisation of service scheduling based on the information about the engine hours of the machines recorded in near real time automatic mode by the system. This was later complemented by displaying full sets of error codes and signals generated by the integrated machines. The virtual advisory to the service personnel was made available at the third stage, allowing all parties to understand issues registered at each unit and plan fit-for-purpose actions in a timely manner. Furthermore, the system provides an interface to the central procurement system and provides equal information to the OEM, allowing for a timely supply of required spare parts and major stock optimisation opportunities.

TALPA enabled the mine operator to track and manage all its machines in a single system, allowing employees previously occupied with time-consuming tasks such as fault finding and service scheduling to focus on critical processes such as fleet availability for production. The customer leveraged TALPA's monitoring and analytics system's deep capabilities to reduce costs and boost its productivity. The list of benefits included:

- Improved service scheduling by understanding the exact time to service a fleet of over 150 machines based on permanently available knowledge of engine hours left until the next service, the recent workload of particular machines and registered errors;
- Timely reactions to critical warnings and trends in the intervals between scheduled services in order to prevent damage to the machines requiring major overhauls;
- Precise preparations for the service events, knowing the exact technical conditions of the machines and allowing for the timely delivery of spare parts and components;
- Reduced downtime of machines, as the system allows for early detection of potential issues and prompt maintenance; and
- Increased equipment availability, as the system allows for better planning.

TALPA has implemented a system in partnership with a major mining company and a leading OEM that allows for a reduction of equipment service costs of more than 35% /y, it claims

TALPA's Industrial AI Platform solves industry-specific problems and delivers fast time to value, the company says.

"Using TALPA's maintenance dashboard allows for improving key processes throughout the workflow, delivering a clear understanding of the technical state of the fleet based on OEM standards as well as real technical conditions, and allowing optimisation of after-sales services for OEMs and technical operations for the end-user," TALPA said. "Delivered to the full extent as a service, TALPA´s platform allows for cost-efficient and worry-free implementation regardless of the fleet size and location of the operations."

Hexagon's Mining division and Phoenix Drill Control are in the advanced stages of commercialising a semi-autonomous drilling solution

occurring across the software space, Batkin looked to integration and plan compliance in the operations side of each mine "planning horizon".

"Using longer-term plans to guide the operational space in each planning horizon, and then validating the progress back to those plans, has provided huge benefits for the organisations that have invested in technology," he explained.

Such developments have been witnessed by not just RPM but the wider software sector in the decarbonisation space, with Batkin noting increased demand for the simulation of alternative trucking fleets through such solutions as RPM's HAULSIM.

"As more operations look to replace their diesel fleets with a more sustainable alternative, we are seeing them turn to discrete event simulation as a way of testing and quantifying what that looks like for their individual operation without any financial outlay," he said. "Many organisations are in a position where they need to retire fleets in the next five years, but the traditional diesel replacement won't achieve the sustainability goals that the company has set."

Being able to simulate different options then schedule and cost those options to a "zero-based budget" is proving to be critically important to satisfy many stakeholders, according to Batkin.

It is this simulation capability that also showcases RPM's openness to collaboration across the mining technology space, with the company having one of the largest adaptor libraries to third-party systems in the industry, along with predefined APIs available for hundreds of systems.

Batkin added: "We have been working with the likes of SAP, Accenture, Komatsu, Hitachi, CAT, Wenco and Modular for many years to provide integrated and data-driven solutions for our combined customers."

Centralised vs decentralised

Derek Cooper, Managing Director USA/Canada at **Hexagon**'s Mining division, is expecting the mining software and technology space to buck the recent trend of declining premiums in the wider technology M&A space, thanks to robust demand and a lack of supply options for mining customers.

"Mining technology is a bit of a different story to the rest of the financial markets: our customers are large, producing mines and commodities have been fairly resilient, especially for companies supporting the 'electrification' push," he told ***IM***. "Quite simply, although capital may be harder to find, many of the technology acquisitions in our space are profitable businesses selling productivity and/or safety solutions to big profitable companies."

Requiring very specific knowledge, very specific products and a certain level of product maturity from its customer base prior to deployment, the software sector is not a space just any company can enter successfully.

"That's difficult for new entrants to overcome, so, honestly, acquisitions are – and likely will continue to be – a viable option for many in our space," Cooper said.

For the acquirer, M&A is a way to expand product offerings without incurring years of R&D effort, according to Cooper, who acknowledges Hexagon's own transaction history in the mining technology space.

"There are also advantages for the acquired company as well: Hexagon has brand recognition and a large pool of resources we can leverage in terms of technical product development, and we also have economies of scale that allow us to secure raw materials (computer chips) in quantities that might be impossible for smaller players," he said.

In terms of the mining company demand dynamic, Cooper has witnessed a huge change in the way companies collect, analyse and act on

The process of removing a broken shovel or jammed bucket tooth from a crusher is risky, costly and time consuming, often involving the use of an excavator to dig out all the other material in the crusher and a boilermaker using a torch to heat and cut the tooth to loosen it. This process can be especially dangerous as the heat can cause the metal to expand, creating even more pressure and potentially causing the heavy tooth to be launched out of the crusher at high speed.

To prevent these dangerous and costly crusher jams, mine operations can invest in safeguards like **Motion Metrics®'** ShovelMetrics™ Gen 3 and LoaderMetrics™ Gen 2 missing tooth detection systems. These systems, which operate without interrupting routine workflow, use ruggedised AI-enabled cameras that continuously monitor each bucket tooth and alert the operator, as well as operation staff, when a missing tooth event is detected. These high-priority notifications can be used to divert contaminated payloads away from the crusher, avoiding potentially catastrophic crusher downtime.

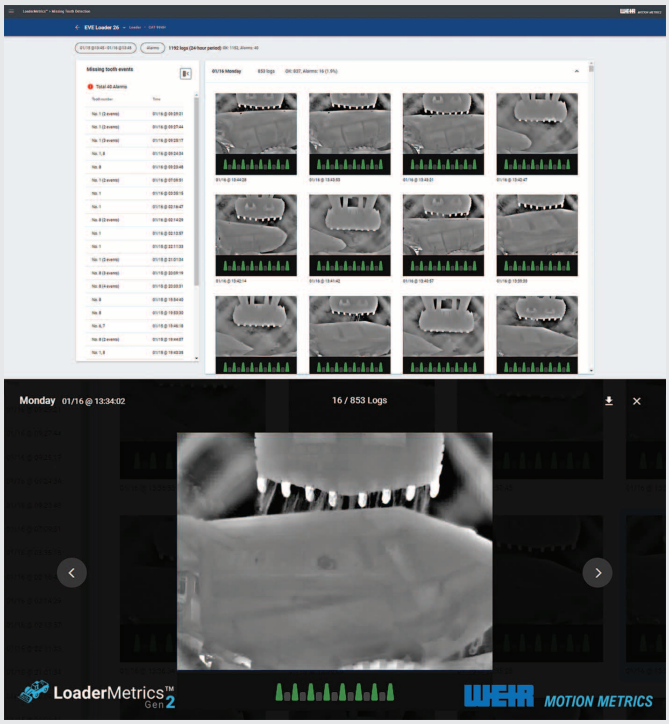
"Motion Metrics technology works together to build a more complete minute-by-minute picture of mining efficiency by increasing operational awareness across the entire comminution circuit," Ryan Hewitt, Marketing Manager, Weir Motion Metrics, said. "Integrating military-grade, smart cameras into a mine's infrastructure without disrupting normal workflow, Weir Motion Metrics products can detect missing or broken ground engaging tool (GET) components, measure particle size distribution (PSD) and identify oversized material such as boulders, as well as provide insight into other relevant variables critical to a healthy mining operation."

This includes:

- Reducing energy consumption: by measuring crusher/grinder input and output PSD, mechanical settings can be autonomously adjusted to achieve optimal closed-loop performance; and
- Reducing unplanned maintenance: by actively measuring the length and wear rate of each bucket tooth, maintenance staff can plan tooth change outs with new-found awareness.

These improvements will result in many important environmental and economic benefits, according to the company.

Since power generation in many regions relies on fossil fuels, reducing electrical consumption indirectly reduces air pollution and carbon emissions. Eliminating oversized material and foreign objects from the processing stream means mines will also be able to process less ore more efficiently without affecting yield, leading to a reduction in fresh process water consumption and increasing operational sustainability.



To prevent dangerous and costly crusher jams, mine operations can invest in safeguards like Motion Metrics' ShovelMetrics Gen 3 and LoaderMetrics Gen 2 (screenshot pictured) missing tooth detection systems

All data collected, including productivity metrics and incident logs, are seamlessly uploaded to MetricsManager™ Pro, a secure cloud-based data management platform from which authorised personnel can review incident logs and generate custom reports for each connected system.

Hewitt concluded: "By implementing these types of safeguards, mines can help prevent tragic incidents, improve productivity and keep their operations running smoothly around the clock."

data at a site and corporate level.

"Today, value has been placed on transparency, auditability and redundancy," he said. "We aim to get the right information to the right person at the right time; sometimes the right person is at the site, sometimes at corporate office, and often it's both at the same time."

The latest developments to the company's HxGN MinePlan product portfolio are a reflection of this change, with Hexagon's Mining division adding its "block model service" to the platform for full transparency and audibility across simultaneous user accounts.

"This is going to help bridge the site-to-corporate information silo," Cooper remarked.

Looking to democratise the data dynamic, Hexagon's Mining division is offering a hybrid method of cloud- and edge-based computing to customers.

"For safety and mission-critical systems, a robust edge solution might be the preference for a mining company's core functions, but the final reporting/storage and final computations might be better suited in the cloud," Cooper explained. "This hybrid method is in use for most of our operational technologies."

The company is also doing its bit to tailor its offering to solve both the need to improve the industry's ESG performance and cope with the ongoing labour issues being experienced across the sector.

"On the ESG front, Hexagon has a whole suite of products that improve operational safety, productivity, efficiency and/or reduce waste from operations," Cooper said. "We have products that help mines blast better and reduce dilution; this combination supports productivity and reduces processing effort measurables in terms of energy, water, emissions, etc."

It is also involved in specialised projects with clients to demonstrate and quantify how electrification (trolley assist, for example) will impact the mine schedule, mining rates, pit reserves and mine life.

Hexagon's Mining division's automation ambitions have also risen to the top of late, with partnerships with Mineral Resources Ltd – to automate long haul road trains in Australia – and Phoenix Drill Control – to propel autonomous drilling – established.

On the latter, the companies are in the advanced stages of commercialising a semi-autonomous drilling solution. Cooper explained: "Transitioning a repetitive, multi-variable process from a human to a computer, leads to productivity and efficiency gains – not to mention the safety aspect of a human engaged in a repetitive task many hours into their second night shift."

A strategic software differentiator

acQuire, a company focused on providing geoscientific information management software, has also been collaborating with industry to solve customer challenges by ensuring clients

get as much functionality as possible out of products like GIM Suite and EnviroSys.

This is exemplified by its Nova Network, designed to give acQuire customers access to a qualified talent pool of geoscientific information management experts across its product range.

Alison Atkins, CEO of acQuire, called this a "strategic differentiator", providing customers with more choice.

"We align with independent consultants and external organisations who become our Nova Network Partners," she explained. "Nova Network Partners are an excellent resource to supplement time-poor teams and can help customers explore and adopt new functionality available in software releases."

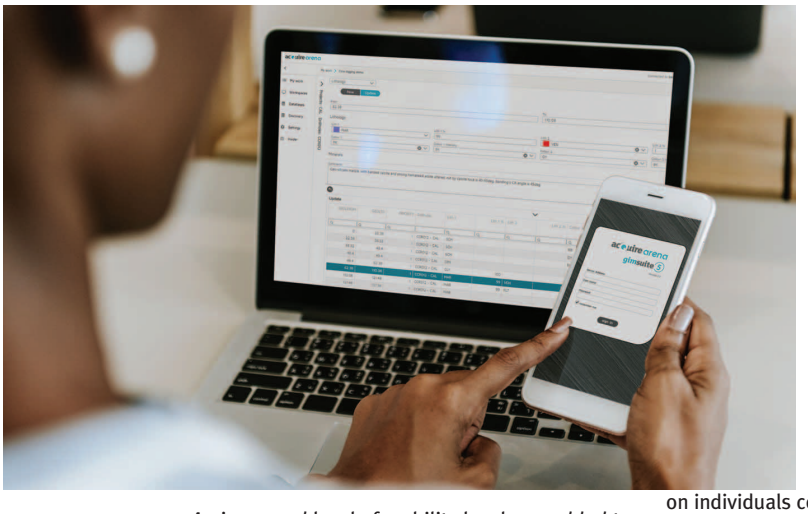
acQuire has 32 practitioners globally within this network who assist the company and its customers, while providing feedback that may influence acQuire's product roadmap.

It is this customer feedback that is leading to acQuire working with third-party vendors its customers are also using for specific functionality.

Atkins explained: "We're partnering with technology organisations where we see there's mutual benefit; or, I should say, tri-party benefit between the customer and both vendors – ourselves and whoever we're partnering with."

APIs are one way of enabling acQuire's customers to interoperate between these systems.

"APIs are driven by us based on feedback from customers and third parties," Atkins said. "If we look predominantly at GIM Suite, our core solution, we have a very well-known global brand and reputation, with a great customer base that stretches to 500 sites over 220 organisations globally. We service multi-commodity, multi-domain, geographically-dispersed customers. Third parties tend to come to us, but we have also engaged with third parties that make strategic sense for us based on customer needs."



An increased level of mobility has been added to acQuire's newest geological data management solution, GIM Suite 5

What has also made strategic sense for the company is adding an increased level of mobility to its newest geological data management solution, GIM Suite 5.

"There's an expectation to have mobile devices in the field for data collection and reporting observations," Atkins said. "Our clear product roadmap is continuing to transition our desktop functionality into web and mobile capabilities. As we've evolved our technology, we're building things more fit-for-purpose for how customers are working now."

More automated and remote automated functions are the key areas where acQuire is seeing the most focus and return from a development perspective, providing employees in the mining industry with the ability to work remotely.

"We predominantly focus on information management from an observational perspective and ensuring compliance of the collection of data – how it's stored and how the data is used," Atkins said. "There's a staggering amount of sensor data and miners are less reliant on individuals collecting information as more tools and systems generate and collect data."

All of this results in more complexity, with observations and measurements becoming more digital.

Atkins said: "One of the first questions we ask organisations that go down the route of collecting a lot of this newly generated sensor data is: 'why?' And, secondly, 'what are you doing with it?' The continual evolution of data types being collected in the field is an area we focus on with GIM Suite and EnviroSys."

The use of AI is just one avenue the company is exploring for future solutions, which comes back to the volume of data the average mine site is generating and looking to leverage.

"There are no standard products out there in the AI field, so we're continually researching technology changes and assessing if this is something we adopt as part of our product strategy," Atkins said.

Helping automate decision making

Eclipse Mining Technologies, the mining technology provider led by Fred Banfield, Mintec's former Chairman and Founder, and Susan Wick, Mintec's former Chief Operating

"By making it easier for different departments and experts to access and share data across the organisation, SourceOne EKPS can help improve communication and collaboration within the organisation," Eclipse's Susan Wick says

Officer, has opened its own software solution to the industry and third parties to enable collaboration across all parts of the mining ecosystem.

It's SourceOne™ Enterprise Knowledge Performance System (EKPS) is intended to help mining companies manage the large volume of data and software applications that they use in their operations.

Providing this solution – a place to manage their data and software – can help mining companies improve efficiency and make more informed decisions, according to Wick, who mentions automation as one key functionality to have grown in demand recently.

"This is not the automation of equipment that most people envisage when discussing autonomous operations but automation of decisions, which is equally important," she told ***IM***. "It represents how humans will interact with advanced technologies, such as AI, to optimise decision making."

SourceOne EKPS has much to offer the industry here, storing the workflow previously used and offering users the chance to automate it, "which can then be accessed and run by anyone, anywhere in the world, with no possibility of introducing human errors".

It is this type of simplistic and intuitive functionality mining companies are continually requesting and SourceOne EKPS can already offer, according to Wick.

SourceOne EKPS is not only bringing value to mining customers today; it is also designed for the transformation of tomorrow's workflows.

"Mining organisations have embarked on initiatives involving advanced data analytics, AI, machine learning, etc to extract more value from the plethora of data they collect," Wick explained. "To accelerate digital transformation even more, the industry will need to better integrate their current technologies across their organisations. The ability to share data from the many disparate systems and devices at operations would increase the rate of transformation.

"Better linking of operations, departments, ICT layers, software technologies and devices would not only increase the acceleration of digital transformation but would lead to greater operational optimisation and remote collaboration."

This is where SourceOne EKPS, as a centralised, secure system for the storage, handling, processing, and analysis of an organisation's data, can help.

"By making it easier for different departments and experts to access and share data across the organisation, SourceOne EKPS can help improve communication and collaboration within the organisation. This can help to ensure all relevant parties have access to the information they need, when they need it, in order to make informed decisions, and it can also help to improve the timeliness and accuracy of the data being used." IM