Sustainable software

Mining software vendors and the companies using these solutions are realising major ESG benefits that the whole sector is now being judged on, Dan Gleeson reports

Trends in mining software ebb and flow with the cycles: one downturn, productivity and efficiency gains are highlighted in every release; the next upturn, throughput growth and data visibility are emphasised.

The great thing about software is that it requires updates, providing many opportunities for vendors to move with the times.

Today, there has never been as much data and data points for platforms to ingest and display, but the major trend all companies are looking to provide solutions for is the environmental, social and governance (ESG) wave.

Whether it is for forward-thinking internal reporting and studies, anticipated public announcements, or for local community consumption, ESG data is becoming increasingly valuable. This has led to many software companies pivoting in search of solutions that can fill this void.

Some companies have devised their own products, others have adapted an existing part of their offering, and a few have acquired entire businesses to gain exposure to the ESG software space.

IM spoke to groups in all three of these categories to get to the bottom of this evolving part of the market.

Sustainable and strategic M&A

This ESG market trend has been keenly observed in the software M&A space with several significant completed or planned transactions.

One of these came in December when **Sandvik Mining and Rock Solutions** announced plans to acquire **Deswik**, a provider of mine planning software, as part of a strategy to form a new Digital Mining Technologies division within the business area.

By acquiring Deswik, Sandvik says it would gain a top-tier supplier of integrated software platforms that support digitalisation throughout mine planning stages, with more than 10,000 current licences. Deswik would also represent one of three cornerstone assets in the newly created Digital Mining Technologies division, the other two being Sandvik Mining and Rock Solutions' automation solutions and the Newtrax telemetry and collision avoidance solutions.

Erik Anderson, Product Manager – Mine Planning, Hexagon says the ongoing integration between all technologies that touch a mine in the coming years will ensure all data can be used and analysed – from the mine to the boardroom – to keep a continuous live pulse on the entire operation. This data, he says, is vital in achieving ESG goals

This division was established to accelerate the execution of Sandvik's strategic priority to lead the industry development of underground sustainability and productivity solutions in electrification, automation, digitalisation and end-to-end optimisation.

This could see the mine planning expertise of Deswik being used to, for example, incorporate electrification at the mine planning stage.

Riku Pulli, President of the new Digital Mining Technologies division, told ***IM*** that this new division has a suite of digital solutions – mostly

Deswik's mine planning expertise could be used by Sandvik to design and build fully-electrified mines


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focused on the E and G of ESG – for the market.

"Sandvik software solutions help customers to run their operations more efficiently than before," he said. "As an example, the OptiMine software platform, and the new modules launched in recent years, provide a real-time view on what's going on in an underground mine, including tools like short interval scheduling and production tracking."

This transparency helps reduce mining risks, increase equipment use and improve safety in many parts of the mining operation, according to Pulli.

"By making operations more predictable and optimised, process waste is removed and this, obviously, has a positive impact on a mine's environmental footprint," he said.

Further optimisation – from mine planning to operations and back – is likely to be developed that will further improve the environmental footprint, while new software capabilities to develop digital twins of the mines will help customers identify and control potential hazards and risks before they materialise, Pulli predicted.

"One example is software that will help customers design and build fully-electrified mines," he said, referencing the incoming abilities of Deswik's software.

More broadly, he saw the growth of the company's wider offering – focused on automation, electrification and digitalisation – as having a "positive impact on both productivity and ESG".

Advancing sustainable software solutions

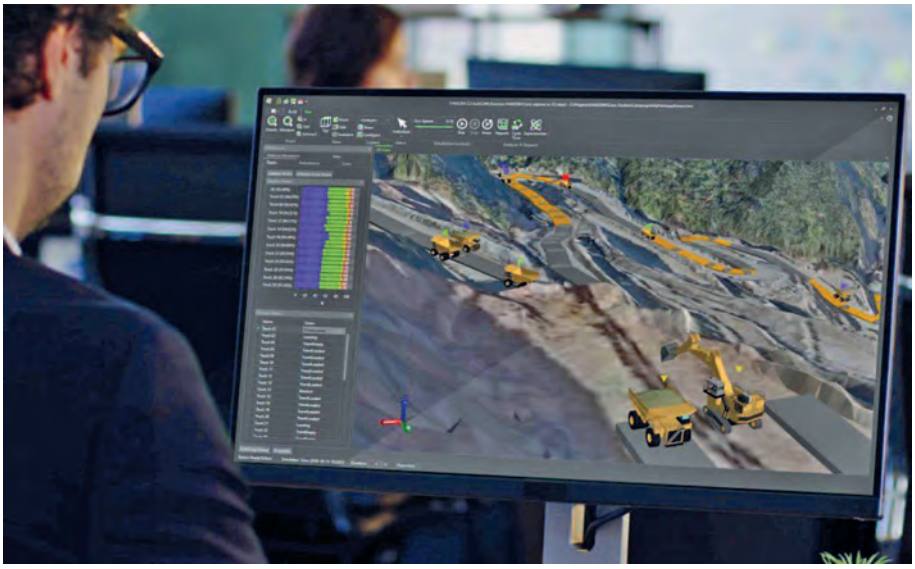
RPMGlobal is all too aware of the influence ESG issues are having on the mining software space, with many of its solutions factoring in all three elements.

The company sees almost every product in the mining space being developed to incorporate ESG objectives of its customers, noting that very few software areas do not link to an organisation's ESG goals.

In November, for example, the company further advanced its simulation platforms, HAULSIM and SIMULATE, to support hybrid vehicles that are powered by green hydrogen or hybrid diesel.

The hybrid vehicle functionality, developed in partnership with Tier-One miners and OEMs within the mining industry, enables users to simulate and test multiple scenarios including vehicles that use hydrogen or hybrid diesel, according to RPM. This is particularly useful for organisations looking to decarbonise their mining operations that are after a way to quantify potential options, the company said.

The hydrogen/hybrid diesel additions came on top of the company, earlier in 2021, bringing battery-electric and trolley-assist simulation into the HAULSIM and SIMULATE fold following two haulage electrification proof of concept studies for a major mining company in Australia and for a client in Indonesia.



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RPM's simulation solutions use a discrete event simulation engine specifically designed for the mining industry, contrasted with the base case simulation solutions the industry typically uses as a yardstick to measure any changes to the haulage network, road rules, mine layout or vehicles.

Richard Mathews, Chief Executive Officer of RPMGlobal, said the global decarbonisation effort has created demand for RPM's simulation solutions that can assist with "answering questions that you simply can't answer in a spreadsheet".

He added: "With mining companies across the world pledging to quantifiably improve their decarbonisation efforts towards net-zero targets, software solutions that can measure and quantify the potential benefits of using lower emission options that are available in the market are super important."

The latest software release also included several other developments such as interaction rules for autonomous vehicles, upgrades to electric vehicle infrastructure simulations, additional microservices to evaluate alternative options remotely (server or cloud) and more detailed reporting for electric vehicles.

RPM is facilitating industry adoption by offering usage of the software and training free of charge to Charge On Innovation Challenge participants. This challenge came about because of BHP, Rio Tinto, Vale and Austmine recognising the mining industry needs to be at the forefront of tackling climate change. It is aimed at encouraging innovative technology development that will support the mining industry's decarbonisation efforts.

RPM set about affecting change within the wider ESG mining sphere before this recent simulation addition.

In 2021 alone, the company acquired two ESG-focused consultancies – Nitro and Blueprint Environmental Strategies – in addition to bolting on environmental disturbance modelling and reporting functionality to its mine scheduling products, XPAC Solutions; and creating an Emissions Management Software solution with the Eden Suite deal.

The latter deal brought with it a proven technology platform for miners to track and forecast their carbon footprint from their mining activities, while the addition of Nitro to its offering resulted in the creation of a dedicated ESG division led by Ngaire Tranter, the former CEO and founder of Nitro.

Tranter told ***IM*** back in September that on top of new or acquired products, some of the company's existing solutions could be used to track core ESG metrics, referencing the potential of financial budgeting tools from XERAS Enterprise for future emissions budgeting and pit simulation tools for mine rehabilitation and closure studies.

Supporting 'sustainable innovation'

Dassault Systèmes and its **GEOVIA** brand are convinced the incorporation of simulation technology to test and validate scenarios in the virtual world will ensure mining companies are able to make prudent investments in their transition to the zero-carbon technology needed to achieve many of their environmental goals.

The good thing for miners is many of the building blocks required to hit such targets are already in place, Jeff Hamilton, GEOVIA WW

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Strategy and Alliances Senior Director, says.

"Overall, our tools aim to help customers model, simulate, optimise and monitor their operations," he told ***IM***. "While many of today's tools were not originally designed around sustainability, the processes and how they are applied can already add sustainable value."

He provides an example from the GEOVIA Strategic Mine Planning solution, a platform that can not only provide more efficient mine designs and optimised production plans over the long term, but also incorporate emission reduction and closure and rehabilitation plans to understand the mine's ecological impact and how best to minimise its footprint. This is all while still generating improved net present value for a mining company's investments.

"In addition, the GEOVIA MineSched solution enables miners to optimise the short-term operations and analyse multiple scenarios involving waste in order to reduce the impact of material handling from energy usage, emissions and cost perspectives," Hamilton said.

GEOVIA, itself, has built a "Sustainability solution referential" for mining by analysing mining processes and aligning them with mining company key performance indicators (KPIs) and global standards such as the UN Sustainable Development Goals, the International Council on Mining and Metals Mining Principles and the EU Taxonomy.

This "referential" represents four themes associated with sustainable mining KPIs that, GEOVIA says, are measurable and generate value for the planet, industry and community. It is these four themes – Energy & Emissions, Water Stewardship, Social Value and Futureproofing – that GEOVIA is specifically focused on.

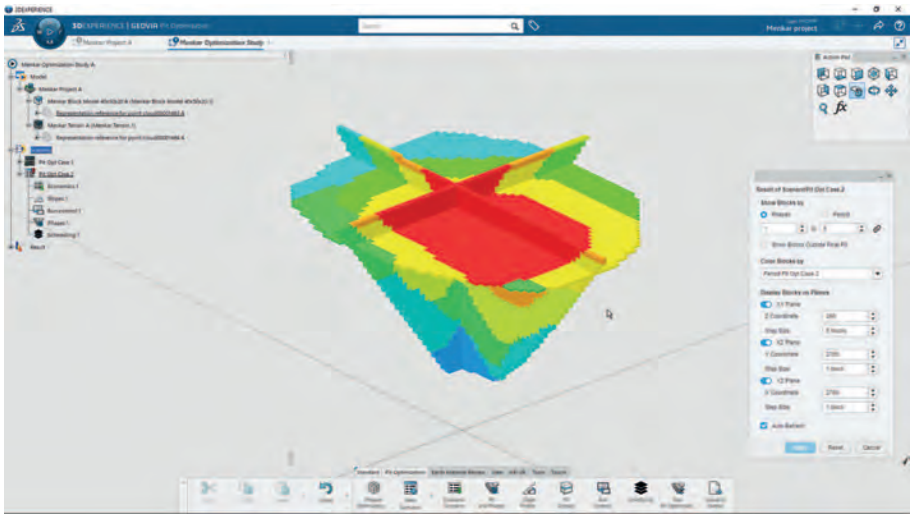
Within the wider Dassault Systèmes group's Sustainability targets, epitomised by its Sustainability Compass, the company is focused on not only providing the tools, but also the inspiration for its customers to "innovate sustainably".

"In addition to our Science-based and social targets, we have a company-wide portfolio target to have two-thirds of new licences sold from our solutions/processes with 'positive sustainability impact' by 2025," Hamilton said.

This ensures the group's goals aligns with that of its clients, providing a two-pronged incentive to develop sustainable solutions the industry can adopt.

Over the next three to five years, Hamilton expects GEOVIA and Dassault Systèmes to enhance its existing solutions to ensure they are accretive to its customers' sustainability and ESG goals. This is on top of creating new tools with inherent sustainability value to "enable our brand promise of Modelling the Sustainable Planet".

The group's ultimate ambition is to develop a "Virtual Twin Experience" of the Sustainable Planet where all solutions will include data intelligence capabilities to monitor key indicators, a governance and collaboration solution to enable essential transparency across stakeholders, mineral processing optimisation and several solutions to manage the circularity of mining operations that actively create value.



The GEOVIA MineSched solution enables miners to optimise the short-term operations and analyse multiple scenarios involving waste in order to reduce the impact of material handling from energy usage, emissions and cost perspectives, according to Jeff Hamilton

"And, when we talk about sustainability and ESG, we are also focused on Circular Economy – how do we get to zero waste, how do we generate solutions that help customers generate accretive value both to industry and the planet," Hamilton said. "For example, with water use – mining uses a lot of water – we don't want to waste water and, for the water that we do use, we want to ensure that after it's been used, it's of a better quality than before we used it and biologically accretive in the ecosystem."

Many of the group's current solutions are helping customers model, design, simulate, plan and execute their mining projects, and these same solutions, along with future developments, are expected to drive process innovation and even process disruption when it comes to "sustainable innovation" and increased value generation.

While the current ESG focus relies on reporting of ESG metrics for governance and public engagement purposes, Hamilton expects to see a move towards action and activities that drive sustainability/ESG results.

"And, so having the technology to both monitor and report on 'actuals' as well as drive the activities via modelling and simulation of future scenarios to ensure mining companies remain on track, will be extremely important," he said.

There will also be a need to "democratise" the data and simulation experiences, putting the data in the hands of decision makers rather than just technologists, according to Hamilton. This is where a platform like 3DEXPERIENCE helps, providing a real-time view of business activity and ecosystems to, the company says, connect people, ideas and data – all of which is customised to the chosen industry.

Hamilton added: "The main transformation caused by the ESG industry trend is the broadening of KPIs. Mining companies have always tried to reduce energy wastage, and over or under-designed energy systems and resource loss in their operations. Now, they are also looking at additional KPIs such as the percentage of green energy, the greenhouse gas emissions of the fleet or the plant and the value of waste, to name a few."

This new frontier is likely to see, for example, the resource/reserve estimation process no longer optimised solely on net present value, but also on other indicators such as the cost of closure, the liability cost, etc.

"Ultimately, we want to help our customers extract and process the same ounce of gold (for example) they had planned, but using less energy, less water and producing less waste," Hamilton concluded.

Earth, environment and energy challenges

The 2021 acquisition of **Seequent** put **Bentley Systems**, the infrastructure engineering software company, into new ESG-related territory too.

A leader in software for geological and geophysical modelling, geotechnical stability, and cloud services for geodata management, visibility and collaboration, Seequent argues well-structured and easily-accessible data is integral to driving real improvements in ESG performance.

"Mining produces waste that needs to be handled properly, as improper disposal can lead

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to air, soil and water pollution in the surrounding areas," the company said. "Waste rock and mine tailings all need to be processed, sorted and transported to disposal areas."

Efficient management of this material not only significantly reduces the risk of future liabilities for companies; it also protects communities and the environment. In this regard, it covers off the entire E, S and G acronym.

"However, if we can't measure, monitor and track that material with the help of data management, risk mitigation becomes nigh impossible," the company said.

Seequent's software solutions, it says, empower companies to make better and more sustainable decisions about their earth, environment and energy challenges.

"With the right blend of technology and tools, companies can ensure compliance with increasingly stringent regulations, set a new ESG gold standard, and deliver genuine and demonstrable sustainability efforts," Seequent said.

Seequent is continuously innovating technology alongside building out its software portfolio, with it and Bentley's above and below ground software capabilities, combined, paving the way for digital modelling and asset management that supports the entire mining lifecycle.

Just some of the technology Seequent is using to solve complex geoscience challenges that benefit people and the planet include MX Deposit, Leapfrog, Imago and Central.

MX Deposit is a cloud-based solution for collecting, managing, sharing and accessing drill hole and sample data, while Leapfrog Geo is a 3D modelling tool that enables rapid integration, communication and interpretation of geological data. Seequent's recently acquired Imago solution is a cloud-based platform for the capture, cataloguing, and review of drill core and chip images from any source, supporting every aspect of the geological process from exploration to grade control. Also cloud-based, Seequent Central is a data management system that brings teams and data together, helping them visualise, track, integrate and manage geoscience data from a centralised, auditable environment.

Even on the exploration side, Seequent's suite of solutions encourage collaboration and enable remote working, which helps customers directly reduce their carbon footprint.

"With data that's instantly made available, fewer geologists need to visit an exploration site, less often, and decisions can be made remotely to support an optimised drill program," it said.

At the same time, leveraging cloud technology and connected collaborative tools enables companies to make decisions faster and in real time, simplifying the exploration process and reducing the environmental impact caused by inefficient drilling or sampling practices.

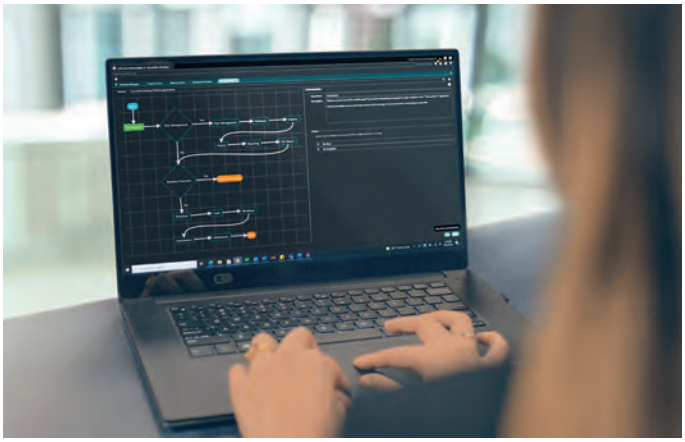
"The more holistic your conceptual geological models are the better-targeted drilling can be, helping to reduce costs and aid sustainability – which is what companies are looking for," Rob Ferguson, Segment Director, Exploration and Resource Management, Seequent, told ***IM***.

Data is proving key to achieving ambitious ESG targets, but some of the more advanced companies are becoming inundated with information they cannot use, leading to wasted efforts and investments, according to Thomas Krom, Segment Director Environment, Seequent.

"In addition, the data inevitably sits within different systems, architectures and platforms, and unlocking those silos and bringing down those barriers to collaboration becomes exceptionally challenging," he told ***IM***. "Technology companies can help not only collect information but to understand it and glean invaluable insights from it."

This is where digital technologies based on open systems can ease the burden, ensuing everyone gets access to data they need when they need it, "allowing them to get a far better insight when considering critical operational decisions that will impact ESG performance", he said.

Seequent believes it is well placed to deliver this, being focused on the development of technology that is open, connected and accessible.



Eclipse's Brett Marsh says SourceOne's system integration and knowledge platform core helps mining companies with their ESG efforts through defining and managing their overall processes

Data transparency

Eclipse Mining Technologies has followed a similar philosophy when developing its flagship SourceOne™ platform, which is able to connect data from different sources, while acting as a hub to store historical and contextual data. This renders it serviceable for analytics and for adoption of tools such as artificial intelligence and machine learning.

Brett Marsh, Eclipse's Director of Platform Development, said SourceOne's system integration and knowledge platform core helps mining companies with their ESG efforts through defining and managing their overall processes.

"Ensuring that all employees and business units are aware of, follow and digitally prove compliance to those processes is challenging," he said. The SourceOne EKP System helps companies address this challenge by digitalising – and to a large extent automating – the work processes that companies will be changing to manage their carbon and physical footprints.

"This will not only help with reporting to the certifying organisations, but it will also help the mining companies become more efficient overall," he said.

SourceOne's collaboration capabilities – like Seequent's – are reducing the need for workers to travel and be physically present on site as frequently as in the past.

"Recently, Eclipse has digitalised the planning processes across engineering, operations, maintenance, safety and procurement to eliminate significant reliance on wasteful and inefficient paper-based forms and communication methods," Marsh added.

Another key element of the SourceOne system is that it allows mining organisations to become more efficient across their entire value chain by integrating operational performance, planning, sensor and supply chain data so they can reduce energy usage by optimising operational cycle times and planning their procurement and product deliveries more effectively.

More directly, Eclipse's primary effort to help miners in the ESG space is to provide tangible tools that span the value chain and enable them to proactively manage the tasks associated with their ESG efforts and, in particular, governance.

"A primary development focus for SourceOne and a feature that is unique to mining and business, in general, is that all organisational processes and data stored within SourceOne are fully historised and auditable," Marsh said. "This provides companies with a clear understanding of how they are performing against their standards and helps continuously improve their operating standards.

"This auditability also enables rapid external disclosure, if required."

Such visibility, transparency and accountability will enable mining companies to ensure the ESG goals and messages driven from the top are

followed throughout the organisation, leading to them also complying with industry governance.

The 'why' behind your data

acQuire's focus has always been on geoscientific information management (GIM) solutions and, more and more, this software is coming into the ESG fold by allowing miners to use accurate data to mine complex deposits in a much smarter way.

These solutions, acQuire says, give miners the ability to develop resource models with greater precision, reducing waste and ensuring they are mining natural resources more efficiently.

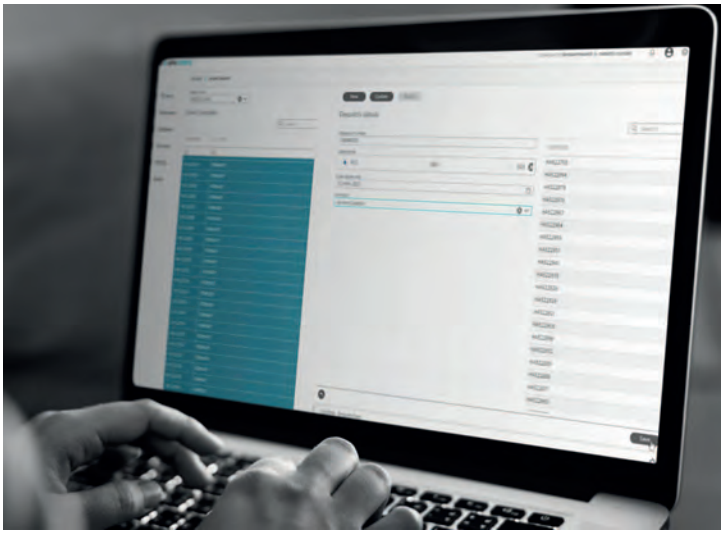
GIM Suite, the company's flagship geological data management solution, was complemented by the addition of new product EnviroSys in late 2020, a quality and compliance-focused environmental data management solution.

EnviroSys is designed so miners can manage environmental approvals and obligations to ensure they're fully compliant in real time while promoting transparency and data accessibility throughout the business, according to the company.

As the industry tackles ever-changing legislation and governance, the ability to confidently answer the question: "am I compliant right now?" is incredibly powerful, and that is what EnviroSys sets out to achieve.

"The importance of this cannot be overstated," the company told ***IM***. "It's not unusual for an environmental team to spend hours, days, or even weeks collating data from several different sources to answer this one question."

acQuire plans to launch a major release for EnviroSys this year, which will further augment the software's capabilities, delivering scalability improvements and updates across the interface for a more seamless experience of working with environmental data, according to the company.



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It is the 'E' (EnviroSys) and 'G' (EnviroSys and GIM Suite) where acQuire's software solutions mainly intersect with the ESG space and pending updates to EnviroSys and a recent upgrade of GIM Suite are only expected to strengthen this relationship.

"GIM Suite helps company's governance initiatives such as reporting to stock exchanges, investors, and regulatory bodies," acQuire explained. "EnviroSys helps companies ensure they are compliant by monitoring a range of environmental aspects and can deliver timely reports to regulatory bodies.

"Another area where GIM Suite excels is keeping historical records of data. This can be especially useful for decommissioned mines where being able to quickly access and report on historical data is crucial. But the primary area we intersect ESG is for environmental compliance with EnviroSys. It ensures nothing ever slips through the cracks, so you have a complete picture for the 'why' behind your data."

Improved transparency, control

Carlson Software's ability to carry out mine modelling, analysis and planning was recently given a boost with the launch of Carlson Mining 2022.

Focused on transparency and control for mine design and planning, its official release includes CAD-based mining software modules Carlson Geology, Carlson Surface Mining and Carlson Underground Mining.

The release includes new additions for drill hole labelling with complete control on formatting as well as improved Google Earth exporting, allowing engineers to easily share technical drill hole information across a universal interface. Carlson Mining 2022 also contains new routines for underground mine solid creation, viewing and editing; all of which integrate well with Carlson Laser Measurement Devices systems for precision mapping and measurement, the company said.

The Carlson Geology block model viewer now has improved loading speed, and the added inspector option allows users to reveal individual block attributes, according to the company. Another improvement is the ability to increase or decrease specific grade opacity for adjustable viewing, with the command Block Model Statistics able to report by grade parameter for more descriptive reports.

A new feature within Carlson Surface Mining is the ability to evaluate mine timing without the inclusion of non-key/waste material. This user-requested feature allows for accurate mine scheduling at operations when "spoil removal" is subcontracted, Carlson said. Non-key tonnage is now trackable through the entire scheduling workflow.

Carlson Underground Mining introduces updates to working with underground solids – the "Make Solid From Design" command now supports vertical alignments and outputs cross sections and template 3D polylines. When viewing solids, separate colours can be used to distinguish internal and external faces, Carlson added.

Carlson Mining 2022 includes new additions for drill hole labelling with complete control on formatting as well as improved Google Earth exporting

Tyler Faulkner, Carlson Sales and Support, said the development focus of the latest release was firmly on the end user.

"Carlson's relationship with our customers is the cornerstone of our culture and it always will be," he said.

The new release, which runs on both AutoCAD 2022 and IntelliCAD 10.1, is part of the overall Carlson 2022 Office Software release with additional modules like Survey, Civil, Hydrology, GIS, CADnet, Construction and Point Cloud.

ESG efficiency

Komatsu is also facilitating the reduction of travel to and from locations deep within a mine site through remote and autonomous operation of equipment – all of which is underwritten by software.

"When operators remotely work, their fuel consumption is decreased because they do not need to travel to and from locations deep within the mine site, and fuel per tonne is reduced due to minimisation of stoppage and diversions due to shift change," William Nassauer, Manager of Product Strategy, Autonomous Systems, told ***IM***.

Its FrontRunner Autonomous Haulage Systems (AHS) can also help mining operations move more material with the same amount of fuel, plus operate machines within the manufacturer's specifications, which can help improve machine longevity, the company said.

It does this by incorporating real-time situational analysis to affect system-driving patterns and behaviours that improve fuel efficiency.

"For example, the system anticipates the road condition ahead, like a ramp incline or decline, and will adjust its speed accordingly," Nassauer explained.

At the same time, FrontRunner's anti-rutting solution can see mine sites decrease fuel use and equipment wear.

"Autonomous trucks are coded to run the same route with intentional variation, so they do not cause deep ruts in mine roads," Nassauer said. "This helps maintain quality road conditions and can help reduce the need for road maintenance, inherently decreasing auxiliary equipment wear and fuel usage."

Komatsu's Intellimine Synergy open-technology platform is designed to partner with other technologies to rapidly innovate valuable solutions for customers, including for their ESG efforts, according to William Nassauer

Other software within the Komatsu ecosystem can also positively impact ESG efforts, the company said.

DISPATCH, for example, uses an optimisation algorithm with inputs to efficiently distribute haulage units in the pit. "This optimised routing leads to the most efficient fuel use for production routes, refuelling events, personnel breaks and maintenance," Nassauer said.

MineCare Health Monitoring System, meanwhile, identifies potential equipment issues while in operation and assists in proactive planning. "This planning includes tasking proper maintenance at the right time, which can help reduce downtime, assist in maximising equipment lifespan and reduce fuel consumption," Nassauer said.

In 2021, Komatsu announced the development of the new Intellimine Synergy open-technology platform, designed to collect, integrate and process data in real time. This will also play a role in improving ESG performance, according to Nassauer, offering customers a single source of actionable insights that brings together data from all relevant Komatsu, Modular Mining and third-party machines, mining processes, systems and technology applications to facilitate critical decision making.

"This same platform is designed to partner with other technologies to rapidly innovate valuable solutions for customers, including for their ESG efforts, and create a streamlined data process for interoperability," he said.

While Komatsu continues to work with customers on becoming more energy efficient, Nassauer acknowledged that energy use is no longer solely a monetary concern, with additional concerns about where that energy is coming from and how that is impacting the environment.

"To help our customers work toward reaching their alternative energy goals, our product development will include electric, trolley and teleoperations," he said. "We will continue developing advanced technologies that reduce energy use, to help lower the costs of operations and help our customers reach their sustainability targets."

Leaving no value behind

Providing interoperable and transparent solutions has allowed **Maptek** to provide customers with solutions that span the mining value chain, and it is this same customised offering that could end up providing the mining community with the tools needed to tackle its ESG challenges – but not at the expense of margins.

Eduardo Coloma, CEO, Maptek, said: "Optimisation is a big part of Maptek's mine planning and mine operation applications. Optimising processes such as stripping, sequencing and haulage allows operations to minimise rehandling of material, which, in turn, reduces haulage costs and emissions."

Some of the company's long-term strategic initiatives include efficient mine production, matching grades and blends to customer specifications to avoid waste and energy, and provide "climate-efficient processes".

Optimisation in the blasting space with its BlastLogic solution – which automates the design process and helps drill & blast engineers make intelligent choices for their plans – could lessen energy consumption at the crusher, for example.

On the haulage side – which can account for roughly 45% of operating costs – solutions such as Maptek Evolution can cut costs at the same time as reducing fuel burn.

Capable of producing short, medium, long term and strategic life of mine schedules alongside practical production plans, Evolution's capabilities go beyond haulage, with companies able to leverage it to achieve multiple objectives across the mining value chain using various tools, including in the environmental and governance side of the business.

It was recently, for example, adapted by Coeur Mining at the Wharf open-pit gold mine in South Dakota, USA, to schedule a heap leach operation where the pad footprints were re-used to minimise environmental impact and comply with the company's licence to operate.

The proposed solution uses existing tailings tracking to model the pad stacking portion of the process and models pad offload as a separate 'pit' model. The overlapping entities (pad stack and pad offload) are then sequenced via constraints and dependencies.

Prior to this solution, the client had to use separate planning tools to document all material movement, with most of the scheduling carried out in Excel spreadsheets that required many iterations.

"The single-setup solution streamlines the mine planning-scheduling interface with live links between Maptek Vulcan and Evolution," Coloma explained.

At the same time, Maptek's short-term planning solutions are providing the long-term visibility that mine sites need to keep 2030, 2040 or 2050 'net zero' goals on track.

"While it may seem unlikely at the time that short-term schedule decisions can impact longer-term performance, real-world scenarios involving resource sterilisation, geotechnical risk, energy use and processing plant performance have seen value left in the ground," Coloma said.

To ensure such value doesn't get 'left in the ground', Maptek has looked to collaborate with industry through sponsorship of not-for-profit bodies such as the Coalition for Eco Efficient Comminution (CEEC).

Sponsorship of CEEC is, Coloma said, aligned with the company's mission to provide integrated decision-support tools that enable operations to make better decisions for safer, more efficient mining.

"CEEC aims to drive efficiency, productivity and sustainability throughout the whole mining lifecycle and Maptek believes this is best achieved by considering these outcomes from the earliest stages of an operation," he said.

This is where a renewed focus on integrating advanced data reporting and analysis of many tools – including those from third-party providers – can ensure practical, real-world mining schedules are optimised against multiple objectives, either independently or simultaneously and in any combination, the company said.

Coloma concluded: "Maptek believes that a unified mine planning, scheduling and production environment will allow miners to take advantage of market conditions that maximise value while meeting ESG best practice."

Monitoring an operation's pulse

Like Coloma, Erik Anderson, Product Manager – Mine Planning, **Hexagon**, sees optimisation of schedules, use of equipment and a complete plan that aims to reduce unnecessary material movement all contributing to a lower mining footprint.

"Optimisation of mine plans will help determine the most economical way of extraction," he told ***IM***. "This reduces unnecessary stripping, which helps to minimise both carbon and physical footprints."

Here, he references a case in New Caledonia where Hexagon's MinePlan software helped a miner responsibly manage waste planning under the added oversight of UNESCO.

In 2008, UNESCO added the Lagoons of New Caledonia to the World Heritage Site list, meaning mines were subject to rigorous environmental standards and regulations. One example of these standards is in the restriction of disturbance limits, with the disturbance area confined to the ultimate pit limits, meaning all mining activity must stay in this area.

"This imposes a series of limitations and challenges, including a limitation on the space available for waste dumps," Hexagon explained.

Mines, in effect, must manage material efficiently and backfill the pit with previously mined waste material.

"However, opening the space on the pit floor to accommodate the waste can be tricky," the company said. "In the process of opening the pit floor for backfill, the management and availability of the multiple ore types and materials needs to be considered. This poses a significant challenge in the mine planning

Providing 'infinite capabilities'

Geovariances, the global provider of geostatistics-based software solutions, puts a significant part of its development efforts into the customisation capabilities of its flagship software product Isatis.neo.

Isatis.neo implements two powerful functionalities in that respect: recording a series of tasks and their parameters – the so-called batch capacity – and Python scripting for completing the data processing and interpretation workflow. This combination gives the software almost infinite capabilities, according to the company, permitting the user to go beyond the geostatistical calculations.

Such capabilities were recently highlighted during its last user meetings, held in January, in two case studies.

The first case study looked at the work completed for a multinational mining and metallurgy company.

This company called on Geovariances' expertise to establish a global processing workflow to update the resources of one of its projects: several deposits with similar geometrical, geological and spatial characteristics. A few month's work was required to define, test and validate the routine on one deposit; with another week used to run the routine on the other deposits and get the expected resource estimates. In addition to the considerable time the company's resource team saved, they also gained insight from the batch file processes that mirrored the expertise of Geovariances' consultants.

The second case study was about the work Geovariances completed for Alcoa S.A. The aim of this project was to rebuild the resource estimation workflows the company set up with Isatis, the Isatis.neo precursor, into Isatis.neo and make the update routines even easier for the user. The complex original workflow, developed by Alcoa's resource team, involved ordinary and indicator kriging and geostatistical simulation and resource classification. The batch files were prepared, incorporating Python coding for specific operations not yet available in the software and importing search and variogram parameters from csv files using the Pandas library. Alcoa ended up with a set of standard batch files that could be used for any deposit, but, at the same time, was customised according to its needs.

process; the excavation requires a very precise schedule to remove the different material types to maintain the grade balance at the mill, while minimising re-handling."

Using MinePlan 3D software, the engineers created the dump designs with a specific amount of volume or tonnage in mind. This allowed the engineers to design waste dumps to be re-handled at a specific time, strategically scheduling the start of the final waste dump areas.

"This kind of long-range planning tool helps the site verify that they can achieve their mining objectives and provides a schedule for the life of mine," the company said.

It factors in more than just the company's licence to operate, though, with the long-term plan allowing site engineers to simulate different mining scenarios when considering commodity prices and inflation by the input of economic information.

"Using all the tools at their disposal, the engineering group can optimise the schedule and evaluate many of the possibilities the mine may see," the company said.

Hexagon's recently launched Power of One solution can help provide such a holistic view, according to Anderson.

Connecting sensors and software, in-field apps and cloudware, the Power of One empowers digital transformation, according to the company.

"This ongoing integration between all technologies that touch a mine in the coming years will ensure that all data can be used and analysed – from the mine to the boardroom – to keep a continuous live pulse on the entire operation," Anderson said. "This data is vital in achieving ESG goals."

This "live pulse" will help minimise deviations from the mine plan, with Hexagon's Mining division continuing to partner with mining companies to develop the tools they need to execute industry initiatives. "For example, implementing the use of electric equipment in plan estimation or introducing additional solutions to better model reclamation," Anderson said.

He concluded: "Our customers are under immense pressure to prove their mines are as sustainable as they are safe and productive. By partnering with customers and putting their data to work, we are uniquely positioned to help them achieve ESG goals, reverse the trend of resource depletion and rise to the challenge of our age."

Keeping the ESG promises

Datamine, a company that has both consulting and software expertise across the mining value chain – from exploration and resource and reserve estimation to mine planning and operations, to supply chain optimisation – has continued to grow its capabilities over the years.

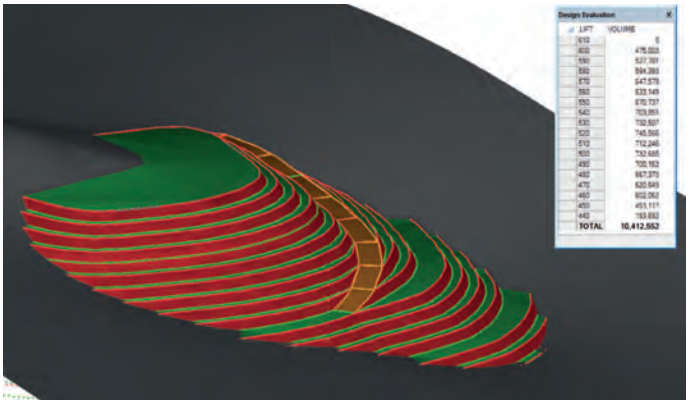
This growth has tracked the shift from using traditional mining practices to a highly automated and increasingly reduced carbon footprint future – "with autonomous equipment, robotics and automated software solutions being key components in realising this transition", it said.

With miners collecting and dealing with ever-increasing quantities of data and looking for ways to leverage it to make data-driven decisions that enhance risk management and increase profitability, integrated software solutions are – now, more than ever – essential in supporting continuous improvement, and maintaining data fidelity and data integrity across the entire mining value chain, according to the company.

Within this 'new normal', Datamine can leverage solutions such as Studio UG and Studio OP for the automated modelling of alternative open-pit and underground mine designs, and scheduling tools with advanced optimisation techniques such as Minemax Scheduler, NPV Scheduler and Studio UG.

More recently, the mining sector has seen a heightened focus on ESG and sustainability that many of the company's software products play a key role in confronting.

"A holistic view of operations is gained using Datamine solutions such as MineMarket, Centric and Reconcilor, which provide traceability and auditing for chain of custody and governance



Datamine can leverage solutions such as Studio UG and Studio OP (pictured) for the automated modelling of alternative open-pit and underground mine designs

purposes across the value chain from resource modelling to shipping and sales," the company said. "These connect to multiple data sources and systems linking Datamine's own operational solutions for surveying, grade control and blasting, etc."

In addition to acquiring the Optiro business (which has been merged with the Snowden business), GeoMineSoft, Database Systems LLP and Centric Mining Systems; and announcing partnerships with LAB3 and its SensorMine solution and autonomous drone major Emesent, the company, in 2021, set up a dedicated ESG business unit focused on the specific needs of the mining industry.

The new ESG business unit will bring together existing technologies and services within one group, with the unit able to call on products such as Discover GIS for geochemical, water, erosion and vegetation modelling and management; Qmed for workforce health management, COVID testing and vaccine administration; and Centric Mining Intelligence for real-time transparency and governance across multiple sites and systems, including key ESG performance indicator reporting.

Formed under the leadership of Chris Parry, the establishment of the ESG unit comes at the same time the mining sector is showing an increased interest in managing ESG and its component systems as part of a single scope, led by senior executives.

Parry said the newly formed business unit had got off to a fast start, already making progress with carbon modelling and tracking solutions to help customers achieve their ESG targets.

The newly established business unit has also seen the recent acquisition of Zyght – a leading health, safety and environment solution for high impact industries that specialises in environment, injury and risk management, safe work plans, document management, compliance and reporting.

"I'm excited to accelerate the growth of Datamine's ESG division by adding an established, well-respected team with a deep understanding of the mining industry" Dylan Webb, Datamine CEO, said.

Zyght, Datamine says, is highly complementary to Qmed, Datamine's existing solution for managing medical facilities, occupational health and COVID-19 screening, tracing and vaccinations.

By having a strong ESG data foundation in place, companies can make effective and timely decisions by incorporating critical ESG data into their planning and scheduling activities to meet customer demands while staying within the confines of their chosen ESG targets, according to the company.

"The importance of ESG is something that will need to be considered for most, if not every, decision in the future and having reliable and available information will be critical", Parry said.

"Whilst the industry will continue to see investment and innovation that drive operational efficiency and productivity, we will also see a strong ESG theme in these emerging technologies so that these solutions support both sustainable and socially responsible operations." IM