FLEET MANAGEMENT SYSTEMS



Paul Moore reviews trends in the FMS space, both surface and underground, with some updates from key players both big and small

leet management systems in mining, often referred to in the industry simply as FMS, are the backbone of surface mines, where they optimise the comings and goings of production equipment maintaining the highest productivity and efficiency. But today they offer a lot more than dispatching including incorporating elements of tyre monitoring, fuel management, machine guidance, collision avoidance, fatigue monitoring and predictive maintenance - all areas that have traditionally been supplied as standalone technologies but today are often factored into the overall FMS offering as part of a package, though are often still supplied by the same specialists as part of partnership agreements and joint interfaces, or in some cases these companies have been acquired - a good example being Hexagon acquiring collision avoidance company SAFEmine whose technology was then embedded into the Hexagon FMS solution. Added to that, of course today FMS offerings are having to interface with autonomous haulage systems (AHS), both from mining equipment OEMs but also OEM-agnostic players. This is a whole other topic in itself, especially when it comes to how interoperable the platforms are.

Today, the FMS market in mining includes a diverse set of players, including three owned by major mining equipment OEMs (Caterpillar's MineStar, Komatsu-owned Modular Mining, Hitachi-owned Wenco) plus OEM independent companies including iVolve based in Australia, Zyfra Mining (former VIST Group) with a strong position in Russia but also growing globally, and Hexagon Mining. But there are a lot of new players coming into the market today, nimble companies offering in some cases more flexible, more cost competitive options. Also, in the underground space, true FMS is still not really being used in the sense it is used on the surface due to the different type of working environment, with most underground mines using forms of advanced tracking together with production optimisation software. But here progress is also being made, as rather than trying to adapt surface FMS to underground, new solutions are being put in place that have been designed for underground.

# Performance assurance at the next level

Looking in-depth at how **Modular Mining's** FMS solutions are applied in a tailored approach for each mine, in March of 2015, the company introduced the Performance Assurance (PA) program, a nextlevel support initiative designed to ensure that each customer receives maximum sustained value over the life of their Modular Mining technologies. With each PA engagement, a dedicated team of experts collaborates with a cross section of mine personnel to develop tailored, flexible, and proactive solutions to address each operation's specific challenges.

The company says participating mines have seen numerous benefits, including enhanced truck productivity,

shorter queue times, reduced equipment maintenance costs, and more. A longstanding Modular Mining customer recently expressed concerns about diminished production

volumes from its truck and shovel fleets. Any of the events that mines experience on a regular basis, including changes in personnel, fleet A dispatch room with the Modular Mining DISPATCH Central application running in the foreground

composition, pit design, or mine plan, can cause production levels to fluctuate. As such, the mine enlisted PA for help in pinpointing the underlying reason, rectifying the issue, and getting production back on track.

With a focus on helping the mine maintain its performance standards amid dynamic conditions, the PA team worked with mine personnel to compare the 2018 production records to those from 2019, and conduct a thorough review of the mine's DISPATCH<sup>®</sup> Fleet Management System (FMS) configuration. Over a series of visits, the PA team updated relevant system parameters and provided dispatcher training to improve optimisation of the automated truck/shovel assignments and minimise truck queue and shovel hang times. After the PA team recalibrated the DISPATCH system's settings, the mine achieved sustained



A PTX device running Modular Mining's DISPATCH Mobile application

improvements in fleet utilisation and marked increases in production rates. Most significant was the 29% uptick in ton miles per hour (TMPH), which increased the average from 958 to 1,238 from May to December 2019, as shown in the attached graph.



After the PA team recalibrated the DISPATCH system's settings, the mine achieved sustained improvements in fleet utilisation and marked increases in production rate

# Hexagon - short interval control and the art of smart

A proven fleet management system can bring many tangible benefits to a mine, including better and faster data to make real changes. But Hexagon adds that by integrating FMS with a dynamic scheduling solution means the dividends can be even more impressive. "Finding the best FMS for your mine, either through large-scale dynamic assignments fleet management, tabletbased fleet management, or just using secondary data collected by telematics or collision avoidance systems is critical. Finding a partner that can guide you through that journey is equally important."

Hexagon told IM it created its Mining division to provide customers with a smarter, more holistic view of their mine. Underground or at the surface, that means bridging the gaps between a strategic plan, a tactical plan, and execution of the tasks involved in moving material.

In other words, short-interval control. "Greater control at a sub-shift level delivers even greater insights and aligns company strategy with execution," says Mining division CTO, Rob Daw. "Hexagon's customers are seeing great benefits in this area from the integration of our MinePlan scheduling solutions, Activity Scheduler (MPAS) and Schedule Optimizer (MPSO), and our fleetmanagement solution, MineOperate UG Pro and OP Pro. The data produced by that connection can pay huge dividends when it comes to

productivity."

MPAS allows for direct access and feedback from actual production data in near realtime to compare and allow adjustments to the planned schedule and reconcile with real life. "Feed your



short-term plan directly into the task management system and automatically update your short-term plan based on actual task progress. Delays are identified and the schedule can be updated immediately to account for the uncertainty. In both open pit and underground design and scheduling, we can connect with real-time data through short interval control."

By reducing the variance between plan and actual, Hexagon says customers are capturing greater project value. "A copper mine in Mexico, for example, had struggled to reconcile plans prepared with different software tools. The customer's mine plan called for a high profile of run-of-mine leach and total material movement. A solution was required that would allow engineers to evaluate other planning alternatives to optimize the material routing in the schedule and reduce the mining rate."

Hexagon's MinePlan Activity Scheduler allows for direct access and feedback from actual production data in near real-time to compare and allow adjustments to the planned schedule and reconcile with real life

The mine migrated to MPSO to produce optimum yet practical mine plans for long, medium and short-range planning, all in one tool. At the core of the mine planning process, MPSO is used to generate practical short- to long-term project schedules.

By also using MineOperate OP Pro, the mine applied field data (eg speed table and cycle times) to accurately model the equipment requirements associated with a mine plan and specific material movement project. The integration between the two solutions dramatically improved performance, reducing the variance between plan and actual.

Elsewhere, similar integration at an

# **Congratulations to** our customers for OPTIMIZING



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Paul Moore spoke to Benjamin Gow, CR Digital Sales & Product Strategy Manager, about its highly successful Titan 3330™ Load Haul Optimization system. CR Digital is the division of CQMS Razer that specialises in the development of mining digital technology

# Q What can a user expect when operating a Titan 3330<sup>™</sup> Load Haul Optimization system for the first time?

A The Titan 3330<sup>™</sup> Load Haul Optimization system is mining tested, proven and ready to be installed at the mine site. The system provides real-time payload monitoring that increases average payloads while reducing overloads to deliver improved production across entire haul fleets. For example, one customer experienced a 15.5% increase in instantaneous productivity after installing and utilising the Titan 3330™ by reducing their major overloads by 1.2% and underloads by 23%. We aim to tailor our product to the mine site requirements and optimise a customer's operation to peak performance. The Titan 3330<sup>™</sup> can also be fitted to any hydraulic excavator or shovel as it lies independently of all OEMs.

# Q How does the Titan 3330<sup>™</sup> Load Haul Optimization system add value to information already being submitted by the shovel as part of the mine-wide fleet management system?

A The main issue the Titan 3330<sup>™</sup> combats is the underloading and overloading of trucks by using real-time data that is not available with traditional weighing systems when the truck is stationary at the loading unit. By calculating the payload in real-time on the excavator with the Titan 3330<sup>™</sup>, the operator is provided both realtime data alongside the truck target information. With this information, the operator can load the truck accurately every time with minimal overloads. Users of the Titan 3330<sup>™</sup> see payload spreads of less than 5% from the target for entire shifts. Together with real-time data, the system also collects information about the hydraulic circuits on the excavator that are not captured by the OEM.

## Q Can you give some insight on how the concept was developed initially?

A The solution was originally developed from technology designed to monitor structural fatigue on dragline buckets. The technology was then adapted to hydraulic machines and later the payload algorithm was applied which has accelerated the solution to be the leading excavator payload system in the market today with CR Digital technology fitted to more than 200 machines around the world.

# Q Has it yet been used on any shovels loading autonomous truck fleets and will it still add value in these applications?

A Yes, the system is supporting several

autonomous truck fleets in Australia. Accurate loading is even more important in an autonomous truck fleet as the truck algorithms are not flexible, and an overloaded truck can disrupt an entire load haul circuit creating significant production losses. We've witnessed an inclination for operators to underload those fleets, but with Titan 3330 installed, operator confidence is increased, and tighter load spreads enable higher payload targets to be achieved - without overloading the AHS trucks.

# Q You recently brought out a new version of the Titan 3330<sup>™</sup> Load Haul Optimization system, can you describe what new functionalities it has?

A The new generation Titan 3330<sup>™</sup> Load Haul Optimization system combines six years of learnings, built with the latest generation edge computing, security and performance to provide a more robust solution for our customers. Our engineering team achieved a 58% reduced hardware footprint for improved installation flexibility, a tough construction (IEC and ISO certified) and the new platform offers total protection against dust and high-pressure water, extreme operating temperatures, shock and machine vibration.

### Q Does it have a screen in the operator cab as well as in the mine dispatch centre?

A The operator can view the information via a rugged 10 in screen fitted in the cab, while the mine dispatch centre can utilise the reporting and Short Interval Control dashboards via the web interface. The Titan system does not require any site-based servers or infrastructure allowing rapid deployment of the systems to mine sites globally.

Q Is it currently mainly used in Australia or now going global; is there a recent case study that highlights its effect on productivity that you can describe?

A The Titan 3330<sup>™</sup> Load Haul Optimization system has grown from its Australian origins to be fitted in machines around the world including Chile, Colombia and Peru, with a new fleet being deployed at a copper mine in Arizona during May 2020. We have personnel employed in Australia, USA and South America as well as an established dealer network in Canada and LATAM.

## **Q** Can you give a case example that highlights the system's upside for a mining operation?

A An Australian mining operation saw a 26% increase in instantaneous productivity and a 19 t increase in the median truck payload (8% increase on base period) when using the Titan 3330<sup>™</sup> Load Haul Optimization system. The challenge was placed to CR Digital to ensure that this new asset was promptly producing as much value as possible. The customer could not rely on the under-shovel weights provided by truck payload systems to guarantee optimised truck loading efficiency. Due to the design of truck payload systems, the feedback can be unreliable. CR Digital's experienced field technicians worked with the miner to install the Titan 3330™ Load Haul Optimization system on a Hitachi EX5600-6 backhoe. The production optimisation system is specifically designed to maximise the productivity of surface dig units by providing accurate, real-time, pass-by-pass feedback to operators on truck payload, production rates, truck fill times, and a suite of other production metrics. Sensors fitted on the excavator identify and track trucks filled, aiding in overall site productivity.

# Q Are you mainly being asked to fit the system to older shovels or is it also being deployed on new machines? What software and hardware comes with a Titan 3330<sup>™</sup> package?

A The short answer is both, the system can be retrofitted to any hydraulic excavator or shovel. For most of our customers Titan 3330<sup>™</sup> Load

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hydraulic excavator or shovel and is completely OEM agnostic

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Haul Optimization system has also become part of the standard fitment of new machines and is often installed during the machine build right alongside the OEM commissioning team. The Titan 3330<sup>™</sup> system is comprised of several sensors that measure the machines movements and our purpose-built Data Acquisition module uses the latest edge computing technology to provide the operator with the required information instantly right onboard the machine. The Titan 3330™ system is available with multiple reporting and integration options. Due to customer demand, we recently released a new 'on demand' Advanced Analytics and Short Interval Control platform. The ORION Data Analytics reporting platform delivers productivity and machine health insights directly to operational teams from our suite of digital products. It enables miners to drill down into a range of operational metrics, including dig unit productivity, truck payload compliance, machine attachment duty and operator performance. Insights are delivered via web or mobile platforms, via secure databases and simple-to-use interfaces. Additionally, we believe empowering operational best practice comes from integrated solutions, so we have an open third-party interface protocol that can integrate Titan 3330<sup>™</sup> and our other products, with FMS and operational execution software platforms.

# **Q** What is next for CR Digital in terms of solution development?

A We have several products due to be released in 2020 including a new generation of GET Toothloss detection for hydraulic excavators, rope shovels and wheel loaders. We are also putting the finishing touches on the expansion of the Titan 3330™ Load Haul Optimization system to include wheel loaders. In January, we announced the acquisition of Seattle based Thunderbird Mining Systems, a strategic move that further expands CR Digital's product offering, IP, sales/marketing and technical support activities into the blasthole and drilling markets. Integrating our portfolio of technologies together will see rapid growth in real time operational analytics, from drilling and rock strata, through to load haul of that same block, we will be able to help operations hone in on maximised recovery and high cost per tonne efficiency, now from drill to mill.

underground gold mine in Brazil saw an 11% increase in fleet production within four months of deployment of MineOperate UG Pro. "Not only does UG Pro integrate with Hexagon's safety, scheduling and data visualisation tools, it also synchronises with data from third-party vendors."

For Daw, such integration is part of what makes a mine smart. "There's a huge opportunity within mining operations to develop these technologies," says Daw. "When it comes to smart devices and smart connected devices, a recurring theme among the clients I talk to is, how do we get access to more of this data so we can look at it, analyse it, and make more proactive decisions? IoT devices are what will allow us to pull all of the data from all of these different areas of an organisation and start to look at trends using artificial intelligence. Once that ecosystem is established within our operations, we can make better, more proactive decisions."

#### Wenco resets the bar again with 6.1

In 2018, **Wenco Mining Systems** reset the bar for mine productivity, intelligence, and technical interoperability with the release of its latest fleet management system – Wenco System 6. The sixth version of what it calls "the leading open FMS for mines" added new usability, data handling and analytics features that drive users to extract even more unrealised value. In late 2019, Wenco took the next step forward with the release of System 6.1 with which it says it has advanced the performance and scalability of System 6 with a more powerful architecture, improved data filters, and enhanced system integration.

The biggest update in System 6.1 involves Wencomine's new 64-bit architecture. Under the hood, this update enables the FMS to support more equipment units and larger operations than ever before. Each background service now has more memory allocation, which allows the Wenco Core Service, the Wenco User Service, and other essential processes to run with greater performance.

"The transition to 64-bit also comes with support for ActiveMQ – a more modern, robust, and reliable way of sending messages between Wenco software components. Along with the more powerful architecture, this enhanced messaging service enables support for remote operations. Mines can now monitor and control multiple mines across multiple networks all from one centralised location – a growing trend as mining gets more and more digitised."

"Usability has always stood as a hallmark of Wenco solutions and the updates in System 6.1 take it even further. New filtering options throughout the system's monitoring and control application, Fleet Control, let dispatchers quickly and easily focus on the exact units, locations, or status categories they need to observe more closely." The Production Planning panel of Fleet Control previously displayed all information available to aid dispatchers in plotting out their shift. With the updates in System 6.1, users can now filter that information to concentrate on particular units and their performance – a feature especially useful for sites with multiple dispatchers looking after different areas of the mine. Filtering by loading unit, dispatch group, or status category allows mines to clearly understand relationships between shovels, trucks, and essential performance metrics – like projected production rates and average cycle times.

Route Management has also added filters. Users can now refine displayed routes by equipment status categories, reducing screen clutter by hiding options for loading units that are down or idle. When those shovels or loaders come back online, Fleet Control automatically refreshes the route list to keep dispatchers up to date. Playbacks now have filters as well. When creating playbacks of shift activity, dispatchers can filter by haul cycle, allowing them to link dig and dump points to the route travelled for each cycle. This feature makes it easy to trace material as it moved from dig point to dump, providing answers about any loads delivered to the wrong location.

The new updates to System 6 also bring deeper integration between Wencomine and the Wenco Drill machine guidance system. Mines using Wenco Drill are now able to run the FMS's onboard application, MDT, in tandem with it on their touchscreens. This integration offers three big advantages: improved situational awareness in the pit; stronger data handling in the head office; and one less monitor in the already crowded drill cab.

"By integrating Wencomine and Wenco Drill, drill operators can pay attention to a single monitor for all of their shift activities. Autoswitching between drill operation screens and the MDT on a single monitor reduces the distraction possible with an abundance of onboard systems. Plus, there's no longer a need for an additional monitor to run the Wenco Drill application, freeing space in the cab."

Integrating the two systems gives even further process enhancements, says Wenco. "In System 6.1, drill operators can badge-in through the onboard touchscreen and easily access pre-start checklists, text messaging with other operators and dispatchers, and options for receiving status change updates from Fleet Control. Drill KPIs show on the MDT screen too, for at-a-glance views of hole counts, average rates of penetration, and other important indicators. Dispatchers can view drills in Fleet Control, staying aware of drilling progress and communicating with drills as needed."

"These updates join a host of other enhancements in System 6.1, all working to

# FLEET MANAGEMENT SYSTEMS

advance Wenco's vision – a fully interoperable pit-to-port mining experience, grounded in openness and partnership with other leading solution providers."

# iVolve Mine4D & ensuring data consistency

Australia's **iVolve** says its Mine4D FMS solution is installed on thousands of mining vehicles worldwide. CEO Kim Parascos says the company is focused



on helping mining companies recognise the importance of data and the potential value it can bring to the table. Parascos emphasises that mining companies can get excellent benefits out of high-quality data. "One of iVolve's strengths is our ability to build and maintain OEM agnostic interfaces to a plethora of vehicles. If the data is not consistent across

iVolve Display showing truck loading data

the fleet, it can lead to poor recommendations when used in analytics. With almost two decades of experience in gathering and presenting data from mine sites, customers can use the iVolve system to bring more value to their mining operations. In today's environment we see our customers really focused on mitigating risks and seeking to achieve improved productivity, all while keeping an eye on the bottom line. You need solid data to make that happen."

Since its inception, the company says it has worked with the majority of vehicle types used in this sector. On encountering a new vehicle type, iVolve works closely with the equipment manufacturer to create the necessary interface to track on-board data. "iVolve Mine4D sets itself apart with its simplicity and familiarity with mixed fleets while being flexible enough to meet specific customer requirements."

iVolve says it benefits customers by improving the quality and accessibility of their data, which provides them with the information they need to support quick decisions. An example of the benefits seen by one European mining company focuses on iVolve's process of accessing and analysing production data in real time during the excavator loading operation. iVolve Mine4D's Production functionality enabled excavator operators to load trucks optimally and dispelled the previously held fears of the overloading-related dismissal of vehicle warranty claims. By utilising operational load data feedback mechanisms, the company observed productivity gains of 10-12% within six to eight weeks, translating to \$10,000 per day.

iVolve says its focus on turning a complex problem into a simple solution is reflected in the user experience of their FMS solution. "In understanding that user engagement is critical to a successful technology deployment, it was essential for personnel across the site to easily see value for themselves. iVolve took an innovative approach to UI design in this space by working closely with the end users directly in a complete redesign of the software. The result is users at all levels, operators, maintenance and office personnel, through to senior management, are presented the right data exactly when it is needed by a system that is simple and intuitive to use."

Not only is the user interface intuitive, the iVolve online reporting engine, iReport, provides a simple tool for scheduling and distributing reports. iReport enables automatically generated and distributed tailored reports, delivering immediate insight allowing any corrective actions to be taken early.

"The tag line 'let us worry about the complexity so you can focus on your own tasks' is illustrated perfectly by iReport. All authorised personnel are armed with up-to-the-moment production and vehicle health data, sent directly to their smartphone, tablet, or PC."

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Because mining operations are located in some of the world's most remote regions with few reliable means of communication, iVolve's hardware is also equipped with in-built mesh networking that allows for the dynamic extension of networks. The company's equipment uses IoT to remain interconnected without requiring access to a central server to help administer the network.

iVolve says its independence from OEMs underlies its focus on supporting a wide range of vehicles and having the ability to add new interfaces on a regular basis. "This ensures sites that roll out an iVolve solution have the flexibility to support new machines as they are added to the fleet. iVolve works differently from its competitors in that the R&D team are agile and available to develop customisations specific to a given application or site's needs. For every project, iVolve works closely with customers and partners to provide regular direct feedback into the development roadmap."

# Zyfra FMS solutions from Peru to Russia

Finnish-Russian company Zyfra Mining says it has recently implemented, together with CT Power, a fleet management and monitoring system in the mining section at Chinese-owned iron ore operation Shougang Hierro Peru, for COSAPI. This system will allow full monitoring of operations by increasing productivity and safety at Shougang mine thanks to the following features: real-time equipment monitoring, automatic truck assignment using intelligent ad-hoc algorithms, high precision selectivity in loading different types of materials, high precision drilling guidance and operator assistance.

Also included in the platform delivery are road quality monitoring, tyre management and machinery diagnosis, among others. "The joint project with COSAPI is an opportunity for us to demonstrate the advantages and competitiveness of our technologies to mining companies in Latin America," said Zyfra Mining Managing Director, Pavel Rastopshin. The news comes after recent success in India for Zyfra, where in December 2019, Thriveni Earthmovers Private Ltd, which through its joint venture TSMPL operates India's largest energy conglomerate NTPC's flagship Pakri Barwadih Coal Mining Project (PBCMP) in Jharkhand, awarded Zyfra the contract to implement its Intelligent Mine solution at the mine

Elsewhere, productivity at Russian Coal's Stepnoy Pit has increased by over 5% following tthe installation of a VG Karier dispatching system (now known as Zyfra OpenMine) from Zyfra Mining for the mine's BELAZ dump trucks. This is the first phase of the system's deployment. "Thanks to the rapid installation of the system and successful integration into our production process, we have

been able to get the dispatching system up and running just two months after the project launch. We have updated the mine's existing software by automating its information transmission processes. We are now modernising the GSM network, which will enable us to launch the new optimisation module for an additional productivity improvement," said Sergey Sekletsov, Head of IT at the Chernogorsk Branch of Russian Coal. Up-to-date statistical information on



Fleet management and monitoring system control room in the minina section at Chineseowned iron ore operation Shougang Hierro Peru

transportation volumes and downtime, as well as more efficient to import data, view results and dump truck distances and loads are now being transmitted to the 1C system installed at the mine. "The deployment in Stepnoy Pit is a unique project for us. We've managed to integrate our systems very quickly with no significant additional software optimisation. Phase 2 of the project will boost productivity even further by increasing the networks' throughput capacity," commented

The estimated effects after the full deployment of Zyfra OpenMine are up to 15% increase of productivity of shovels and dump trucks, up to 8% reduction of equipment operating costs, 5-10% fuel saving, up to 80% reduction of nontechnological downtime. The system is deployed in 80 open pits with such companies as Severstal, SUEK, Stoilensky GOK, Polymetal and others.

Aleksandr Bondarenko, Director at Zyfra Mining.

Stepnoy Pit is an asset of the Russian Coal federal holding company. Located in Khakassia, it produces D grade coal from the Chernogorsk deposit in the Minusinsk basin. The mine comprises seven coal seams and uses 130 and 55 t BELAZ dump trucks as process vehicles. The pit has a capacity of 4.5 Mt of coal per year.

### **RPMGlobal unveils TALPAC-3D**

RPMGlobal has unveiled a new addition to its suite of mining simulation solutions, launching TALPAC-3D to, it says, help miners unlock greater potential value from operations. After detailed consultation with the global user base of TALPAC, RPMGlobal released TALPAC-3D to offer an enhanced user experience, increased functionality and a "stepping stone towards RPMGlobal's other simulation products for those looking for more sophisticated simulation demands", the company said.

TALPAC-3D harnesses the functionality of RPMGlobal's Truck and Loader Productivity and Cost calculator - TALPAC - with a gaming-inspired 3D user interface (UI). This makes it easier and

make changes to models, and in doing so, enhances the ability for users to optimise haulage routes and equipment selection, according to RPMGlobal. "TALPAC has been trusted by the mining

industry for more than four decades for its accuracy and equipment manufacturer independence, delivering best practice simulation for miners, original equipment manufacturer (OEMs), contractors and consultants," the company said. "Originally developed as a tool to support truck and loader haul route calculations, TALPAC is now used all over the globe with thousands of users."

TALPAC-3D builds on the extensive history and smarts of TALPAC and applies a brand-new graphical UI, according to the company. RPMGlobal's strategy has been to provide a much richer user experience across all products with a focus on the UI. This has translated into an upgrade for TALPAC-3D, bringing it in line with the **RPMGlobal Intelligent Simulation suite including** HAULSIM, the Discrete Event Simulation (DES) solution.

HAULSIM was introduced to the market over six years ago and RPMGlobal has invested significant resources into ensuring the UI focuses on ease of use and intuitive controls across the entire simulation suite, the company said.

RPMGlobal Chief Executive Officer, Richard Mathews, said: "The solution is reflective of the company's commitment to taking on board client feedback and addressing the industry's evolving needs.

"While TALPAC has been the de-facto standard for the industry's simulation needs for more than 40 years, we remain dedicated to introducing new solutions tailored to the requirements of the industry."

He added: "We realised there was a need for an innovative simulation solution providing the

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reliable engine of TALPAC but encompassing a fresh, modern UI that was scalable."

TALPAC-3D also offers a "seamless upgrade path" with integration to HAULSIM, according to RPMGlobal. As users become more sophisticated in their simulation requirements and need more functionality through a DES tool, they can easily upgrade to HAULSIM. This isn't offered by any competitors in the industry, according to RPM Global. The 3D UI of TALPAC-3D delivers several new features such as a fleet planner and a cycle time analysis tool that work across the network.

Mathews said: "The industry's adoption of TALPAC had continued to grow and it was used by miners all over the globe to help them calculate the ideal size of their fleet and understand which machines and sizes of equipment are most compatible.

"As a modern software package, TALPAC-3D makes that work easier than ever before, enabling end-users to rapidly achieve the next level of productivity. The world's biggest miners are consistently looking for ways to unlock greater value from operations. Using TALPAC-3D, mining companies are able to investigate multiple fleet options to optimise productivity."

RPMGlobal Simulation Product Manager Adam Price told *IM*: "TALPAC-3D doesn't compete with Fleet Management Systems (FMS) but it can be very complementary for a FMS. TALPAC-3D now has a 3D-network inside it so which means that customers are able to build a model of the haulage network on their site with multiple different types of loading units and types of trucks."

He says the reason why this is complementary to a FMS, and is a good tool for say a dispatch room, is that the dispatchers can use TALPAC-3D to calculate ahead of time what the cycle time is going to be on a new haul that hasn't been covered yet in the FMS. "This is a major gamechanger as FMS traditionally only know about how long a haul is taking after it happened – there isn't a tool in there to create a new road that hasn't ever been driven on yet and model what that's going to be and that's what TALPAC-3D does."

There is also a tool in TALPAC-3D called the Fleet Planner which enables operations to look at expected productivity for a combination of loading unit, truck and material type across a particular haul. They can look at productivity in real time as well.

"One of the key issues RPMGlobal is addressing is getting data from the FMS to inform our models of how the truck should operate. We are starting to see some movement in that area where we can take data from a FMS that shows us what the trucks are actually capable off then compare that to models of the trucks to understand how close our model is with reality. We're becoming able to calibrate those models a lot more easily now because we now have a haulage service that we can use to run those calculations programmatically."

Another important tool in this conversation is MinVu, RPMGlobal's data integration and validation solution. "One of the benefits of MinVu is that we basically isolate parts of the whole to make that calibration piece easy. This is achieved as we isolate part of the haul where the truck is travelling full and the truck is travelling empty which is the stuff we want to compare against our travel time calculation engine. So, when we're modelling the truck, we are not interested to model it at a truck sign or queuing at the loading unit. The calculations that we do are based on the truck moving from a source to a destination and back from the destination to the source. In this way the MinVu data intelligence platform makes it easier to get that data which can otherwise be difficult if you're relying on the FMS by itself."

He concludes: "It's important to note that FMS are used to manage what is happening now. However, RPMGlobal's software solutions can take data from the FMS and use that data to plan in advance. The calibration that we are doing is to help with modelling what is happening today, but the same calculations are also in our medium and long term planning systems so we can start to close the gap between the horizons."

# A new era for Cat MineStar underground

In 2018, Caterpillar and Minetec, a wholly owned subsidiary of Codan Ltd, announced an agreement for the development and delivery of technologies targeting underground hard rock mining challenges. The collaborative work would deliver best-in-class site solutions for mining customers, and the integrated solutions would be offered as part of Cat<sup>®</sup> MineStar.<sup>™</sup> Caterpillar said it expected the integrated solutions "to focus on applications of underground mobile equipment and to enable expansion of MineStar capabilities through the use of improved high precision tracking and wireless communications, task management technology and proximity detection." Caterpillar has also stated: "Recognising that underground mines would benefit from the same technologies that surface mines have been enjoying for many years, Caterpillar recently enhanced its technology portfolio to offer new and expanded capabilities that fully integrate underground mining operations."

Grant Wilson, Minetec GM told *IM*: "The growth of technology through the Minetec-Caterpillar partnership enabled the release of the latest MineStar for underground offerings that includes Detect, Fleet and Command. The technology enables whole of mine visualisation and tracking for underground mining integrated into a solution that can be provided as a system or in modules to provides solutions in communication, tracking, proximity detection, fleet management and short interval control. The system can be provided in multiple configurations that will suit different methods of underground mining such as stope mining or mass caving operations on any brand of machine. The key in the technology is not just in a communication system, data collection system or in a high accurate tracking system. It is the neat way the system simply works for underground mines and how the system integrates to present and optimise the right information to enable a more productive, safer mine."

Wilson also responded to the question on what FMS means in an underground context versus surface mining where it is almost ubiquitous: "The underground is a challenging environment to gain accurate data, especially over the whole operational mining chain in a manner that is useful. The issues are beyond communication systems and extend to the operational complexity and environment of underground mines. The concept of a digital tracking solutions is considered the first step in the FMS solution establishing the basic understanding of where the equipment is and was around the mine. The digital tracking of equipment is the first phase in establishing a basic fleet management system similar to GPS fleet tracking solutions on the surface many years ago."

Back when the deal was announced, Caterpillar and Minetec said that Newmont Mining Corporation would host the first trial of this technology at their Tanami Operations in Northern Territory, Australia. Newmont Goldcorp's Tanami gold mine in Australia has implemented MineStar Fleet for underground, which provides real-time visibility to cycle time, payload and other key operational parameters. Thanks to a proprietary high-precision positioning technology, mines can also accurately track personnel and assets to submetre accuracy.

Aaron Nankivell, Mining Operations Manager at Tanami Operations said in 2019: "Last year I was asked if Tanami Operations wanted to participate in the trial for the MineStar for underground technology. I jumped at the chance, not just because we'd be first in the field but it was our opportunity to influence the direction that it took. A technology that gives us the ability to be able to see what's going on and where things are at, and to be able to intervene and make decisions in a timely manner is a big opportunity for us, and every mine in fact. This is a game changer in that it removes hope and restores control. The status quo is sitting down at the start of the shift, coming up with what you think is the best plan, putting it in motion and hoping it goes to plan. MineStar for underground gives us the opportunity to work right until the very last minute and recommence

work after blasting as soon as possible."

Nankivell gave some specific examples of the difference the system makes: "A good example is with our stope bogging. We don't have a clear picture of the productivity of those loaders other than what they report at the end of the shift. MineStar for underground gives us a real time view of the productivity at the drawpoint, to identify those areas where we can change the design, we can change the deployment, and make sure we are maximising that activity. Another fantastic element of MineStar for underground is the way that it integrates with our planning process. Your whole front end mine planning schedule is already built into the software, so this isn't just a tool that captures what's happening, this is a tool that's actually integrated in what should be happening. The real benefit for Cat MineStar for underground is the way that is captures and presents data. Any system can capture a lot of data but if that means someone has to go an interrogate that data days or weeks later, you've lost the opportunity to intervene and use it in a useful way. MineStar for underground presents the data immediately, its capturing it in real time and there's an interface there that supervisors can use straight away to intervene and make decisions."

# Actionable insights based on advanced analytics

Another up and coming player in this space is Essen, Germany-based **talpasolutions** whose mantra is "delivering transparent and actionable insights for the heavy industry by making data accessible and understandable" and was founded in 2016. It told *IM* it enables mining companies to utilise operative data, collected from sensors embedded in assets, planning software, ERP and other contextual data sources. "Our digitalisation experts offer their customers holistic solutions, starting with the acquisition, processing, analysis and visualisation of the data, through to the derivation of recommendations for action and automation." Its customers and partners to date have included quarrying operations, underground salt and oil shale mines, wellestablished equipment OEMs like GHH, and fellow high-tech mining solutions company indurad.

While delivering automation solutions in some

empowering people by utilising benefits of digital

applications and leveraging synergies between

As an example, talpasolutions equipped 11

operated by VKG with talpacortex. This state of the

processes and transmits all machine data in high

quality. The customer infrastructure allowed the

(talpasolutions' operating system) which was then

analysed and the results were made available

online to the customer continuously. Optimised

task management and operator feedback then

efficiency by 13%. Operations became more

their effective working time."

increased productivity sharply. "Our system led to

a statistically proven increase in overall equipment

productive with less operational expenditures by

utilising assets more efficiently and increasing

On FMS specifically, Mirko Liebetrau, Chief

Sales Officer states: "Fleet management systems

of established companies have been utilised for

functionalities provided have not kept up with the

functionalities can be provided, especially when

decades now. The technology applied and

development of IT. Nowadays, many more

manufacturers in an Estonian oil shale mine

art processing unit collects, records, pre-

pushing of the data into talpaplatform

projects, talpasolutions says it believes in

machine and operator more efficiently.

underground machines from various



talpasolutions aims to deliver transparent and actionable insights for the heavy industry by making data accessible and understandable

accessing additional data sources like the machines themselves or other data silos." Liebetrau argues that even if big mining companies have a super sophisticated main control room and have spent millions of dollars on it, the information flow is not optimal. "As an example - there is a super advanced control room where all data and information runs together and is assessed. Still, the company most of the time looks at single data silos and isolated analysis. And if some information is identified to be crucial for operations or needs immediate attention, the responsible person is called or contacted via a separate communication channel. Why not provide the information on-site colleagues are lacking directly to them?" He adds that mining was and is challenged by the complexity of operations. "It makes this business hard to manage. Our applications provide a comprehensive and unbiased overview on productivity, events and performance. Any mine manager can improve his efficiency and economics by having a better overview as well as detailed information. The challenge for most fleet management systems remains the fact that information and task dispatching is good, but actionable insights are better. To provide those you will need

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comprehensive historic data sets and know processes in detail. This can only be done with big data and state of the art analytics. Applying such technologies can make decisions faster and better, even when it comes to dispatch systems. The future dispatch system will allocate the operational resources of a mine by itself and might only need input for prioritisation, when machine-external information from operators or strategic decisions by the management cannot be sourced and processed automatically."

## Underground FMS – a technology partnership

GroundHog Apps is one of a new breed of companies offering what it calls connected miner software to the mining industry. To illustrate its type of solution, it cited to IM an unnamed customer, one of the largest gold mining companies in the world, whose leadership team decided to launch a digital transformation initiative. The overarching objective was to reduce all-in sustaining costs (AISC) by giving team members the enhanced in-shift decision-making capabilities required to consistently meet production goals and significantly reduce variance to plan in every shift. The group decided to implement a combination of a Short Interval Control System, a Fleet Management System and a Real-Time Location Tracking System.

The customer chose GroundHog as a technology partner for its key operations. GroundHog worked with the customer to build a digital SIC system, which included configuration and customisations of the system. Several years before implementing GroundHog, the customer had deployed a fleet management system that was typically deployed in open pit operations to help manage its underground operations. The main challenges the customer faced according to GroundHog included special purpose hardware that could only be bought from the vendor plus the system also relied on local compact flash storage cards that were discontinued. Very poor online/offline capabilities which resulted in data loss that also led to unreliable reports. Data needed to frequently be reviewed and updated by dispatch and supervisors. Poor customer support since the system was installed required a technician to visit the site to perform any service activity. Plus significant amounts of custom development was needed to integrate with other system to generate reports for management.

Reporting of shift tasks was paper-based and required multiple manual steps, such as data entry and aggregation in Excel. As a result, the accuracy, completeness, and timeliness of the data were often compromised. The old system also required operators to be within network range to update shift activities. However, because of connectivity limitations in underground mines, operators typically stayed outside of the range for long periods. As a result, some data entered was not captured and required re-entry. "The old system did not provide a holistic view of mine operations, such as realtime data related to personnel, equipment, and material movements. As a result, management was limited in its ability to drive optimum production, causing frequent and significant deviations from operating plans."

To help the customer achieve its goals of reducing AISC and improving operational efficiency by at least 20% without adding staff or equipment, GroundHog says it was chosen as the key technology partner for two reasons. "First, GroundHog is a cutting-edge mining production control platform built from the ground up and designed to be run on standard off-the-shelf iOS and Android hardware, and it offered the critical functionality that the customer sought. Second, GroundHog had earned a reputation for extreme speed, responsiveness, and exceptional customer support in the industry."

The solution met a number of customer-specific requirements including the ability to display tasks in a dynamic Gantt chart format by shift, activity, and location. GroundHog works with existing planning and scheduling software, which shows task progress and expected completion times in a Gantt chart that is updated in real-time. This format provides a visual representation of dependencies and their impact on production timelines. "Real-time updates allow you to visualise the downstream consequences of any event at a granular level (individual operator and location), enabling the customer to take immediate corrective action."

Its system also automatically assigns tasks to equipment and operators. GroundHog's scheduling system imports long-range schedules and "tunable parameters" from the customer's production plan or even a passdown sheet created using Excel. A capability matrix identifies skill and effectiveness index, matches operator to equipment, and creates shift task lists for supervisors to review and dispatch. Key performance indicators (KPIs) and reports allow supervisors, operations managers and management to derive insights and facilitate optimisation as required.

They also wanted to be able to communicate detailed task information, including all updates, in real-time to each operator. "GroundHog SIC simplifies the user experience for every operator type and optimises the clicks (or taps) required to perform an action or reach a goal. After operators log into groundHog SIC on their machine, they see their schedule for the shift or the day. Operators



During a shift, GroundHog captures production data from each individual operator working on a piece of equipment at every location in the mine

use the app to follow the schedule and update progress."

GroundHog's solutions also allows tracking of locations of equipment and workers in real-time via 3D maps and tracking production manually and automatically by operator, equipment, and location (heading) within the mine. During a shift, GroundHog captures production data from each individual operator working on a piece of equipment at every location in the mine. As the shift progresses, each operator uses a tablet to manually update progress. "For activities that require only time data and not counts, such as buckets or truckloads, the tablets track progress automatically. The system updates progress instantly for all operators whose tablets are connected to WiFi. For those who are not connected, the tablet stores data onboard and submits it automatically when wifi returns. For mines that choose to deploy GroundHog Peer-to-Peer (P2), the data can also be transferred through the P2P network without requiring additional hardware."

The solutions also allows the user to open APIs that enable GroundHog to connect with various 3rd party software such as SAP, OSI Pi, Data Lakes on Amazon Web Services and Azure, and other mining software. "GroundHog captures data on mobile devices, such as smartphones and tablets, enabling quick operational assessments from the command centre, while streamlining health and safety inspections and maximising compliance with environmental impact regulations. The outputs produced from equipment and infrastructure are integrated to deliver insights."

GroundHog told *IM* that the customer achieved an increase in 36% more tonnes to surface relative to the original goal of 20%. Face utilisation, equipment utilisation and personnel utilisation also significantly increased. The customer also uses a combination of GroundHog's inbuilt reports and PowerBI reports to monitor performance in near real time.