

Paul Moore looks specifically at progress in the blasthole drilling sector, with all the key OEMs making major strides in new models, new market focus areas and of course, automation

Komatsu's new ZT44 drill is its first Tier 4 solution utilising a Cummins QSK19 with 800 hp

Of course there are still challenges. The drilling part of the smart mine is still managed like an island, with trucks and other areas of automation dealt with separately. If the industry can manage automation across fleets in a more unified way this will save customers and OEMs investment and time.

Working with ASI Mining, in which Epiroc now holds a significant stake, the two companies have had a lot of discussion about a true shared blueprint for interoperable autonomy across entire fleets including trucks, drills and light vehicles bringing value chain wins but also at a technical level streamlining everything and making the autonomous fleet more interactive. ASI's mine-wide Mobius command and control platform is at the heart of this, and some announcements on this type of approach are expected later this year.

Network market developments are also important, as more surface mines switch to LTE, Epiroc is making sure it is ready for that and already has drills running in LTE networks to take learnings into new business once it becomes more widespread.

Berens also said there is now increasing interest from big mining contractors in drill automation, as they now realise they have to find their space in autonomy (the same is true with trucks as well). Trials are already ongoing with Epiroc autonomous drills and contractors, helping increase understanding of how automated drills can be used effectively under a contractor business model. Part of this is looking at the automation options from more of an OPEX standpoint across the life of contract.

At SME's MineXchange Annual Conference in Phoenix in February 2020, Berens discussed optimisation in blasthole drilling from the specific standpoint of automation learnings. Questions like what are the reasons large, medium, and small mining houses are enabling drill automation? Where is the value found throughout the mining processes? How is data being used to drive these decisions? Optimisation insights no longer require human interaction – automated drills are now making a real impact in mine value chains. Epiroc customers are walking through structured models to properly develop and deploy automated drills into their operations with great success. But these change management blueprints also continue to mature into repeatable processes for each mine to capitalise on previous learnings. This is where the insights that automation brings really transitions into tangible results. The attached slides show a chart summarising how drill productivity and



Multipass potential

In the autonomous drilling market, **Epiroc** remains a market leader, with the most advanced platform and the most active sites. **IM** spoke to Automation Director, Surface Mining, Tyler Berens to get an insight on where things now stand and what is now possible. What is interesting about Epiroc's approach is that its automation journey with customers is dynamic. As a lot of data and analytics comes in from minesites, new lessons are learned which lead to the company sending out software updates for the AutoDrill 2 system, itself managed by the RCS 5 command and control system.

AutoDrill 2 was originally launched to detect the rock when the bit touches the ground and start air, dust suppression, rotation and feed to collar the hole. After the collared distance has been met, this control will adjust air, dust suppression, rotation and feed to a drilling setting. AutoDrill 2 will apply optimal pulldown and rotation to drill as fast as possible without stalling the rotation or getting stuck. Once the target depth has been reached, AutoDrill 2 will clean or flush the hole, shut off the air and dust suppression, and the return the bit to a tramming position. AutoDrill 2 provides the consistency of drilling to the correct hole depth, including water flow to maintain the hole so it does not collapse.

The most recent software update to AutoDrill 2 dealt with how the drill reacts to drilling on broken ground not just consolidated rock. This has actually led to productivity gains, 4% at one site and 6% at another which can make a

massive difference over an extended period of time. Epiroc can now use its technology to analyse different ground conditions across different areas of the same mine or different mines and commodities, and actively adapt the automation solution to each situation.

Looking at the market traditionally all the big gains and contracts for autonomous drilling have either been in iron ore with companies like BHP, Rio Tinto, FMG, Vale, IOC, Ferrexpo and others; as well as the big copper mines in Chile and Peru – Quellaveco the new Anglo operation will deploy an autonomous Epiroc fleet for example. Coal has traditionally used tethered multipass drills with a focus only on production and not a lot of interest in automation. However, this is changing – South Africa's Exxaro has a Pit Viper running autonomously now using RCS 5 with plans to expand the fleet, and in east coast Australian coal Epiroc also now has autonomous drills running.

In market trends, Berens says that for some years there was interest in taking a stepped approach, perhaps starting with line of sight and building autonomy from there, but today there is much more confidence from customers, backed up by years of data and analytics from existing auto fleets, to the point where they are happy to go from conventional straight to full autonomous in discussions. Berens estimated that as far as Epiroc is concerned over 75% of its automation projects consist of setting up remote operations centres and commissioning autonomous fleets.



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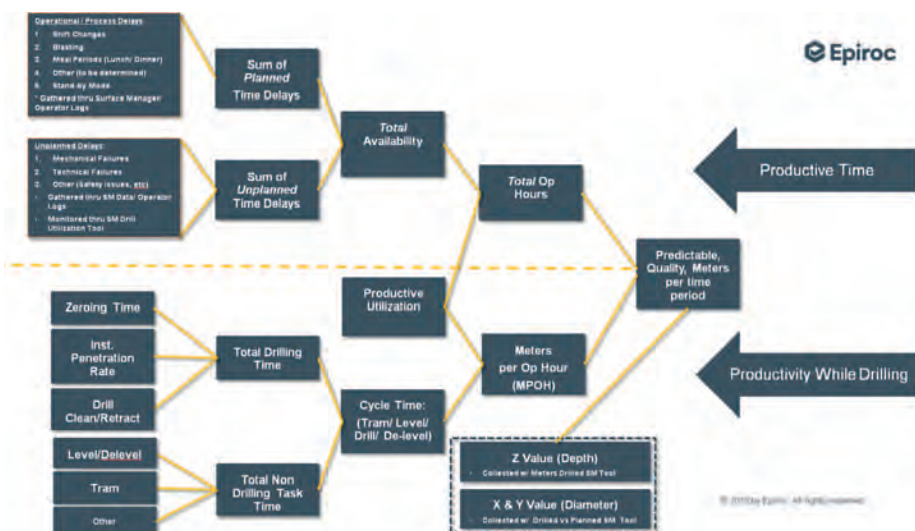
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productive time can be assessed; the other showing what has actually been achieved with autonomous drilling, which was very close to what the models predicted.

Looking at much less digitised drill models, at CONEXPO-CON/AGG, Epiroc showcased the DM30 II SP (Single Pass) rotary blasthole drill for quarrying and small mining operations. The crawler-mounted, hydraulic tophead-drive rig it says offers faster hole-to-hole drilling and a lower cost per tonne through single-pass capability. Interestingly, this is effectively another global launch of what is already one of the market leading drills in India, where Epiroc has been offering the DM30 II for a number of years (see *REL section including India market discussion*). It was launched originally in 2014 replacing the low pressure DM30 and has been manufactured in Nanjing, China. Aside from India it has also proved popular in Indonesia and Mongolia.

Built off the same reliable platform as the Epiroc DM45 and DML blasthole drill rigs, the DM30 II SP is suitable for a variety of single-pass rotary and down-the-hole (DTH) drilling applications. It can achieve a clean hole depth of 11 m (36 ft) for single-pass applications. The small footprint of the DM30 II makes it easy to manoeuvre on tight benches and simple to transport within the pit and over the road between pits.

“The DM30 II SP offers a low total cost of ownership, with a structure design life exceeding



45,000 hours. The single-pass capability allows for faster hole-to-hole drilling and decreases the cost per ton. Its design and layout grants quick and easy access to all major service points, simplifying maintenance.”

The DM30 II SP is designed to handle 4- to 6½-inch drill pipe with a hydraulic pulldown of up to 30,000 lbf (133.4 kN) and a hole diameter of 5½ to 7 7/8 inches (140-200 mm). A 36-foot single-pass tower option increases productivity for 29-to-36-foot drilling conditions by eliminating the need to add a second drill steel.

Customers can choose a low- or high-pressure compressor to create the right configuration for their drilling operation.

“Built off a proven platform and with the new single-pass capability, the DM30 II SP reduces the overall cost of production per tonne and improves transportability,” said Heino Hamman, Product Line Manager, Blasthole at Epiroc Drilling Solutions. “It offers high quality at an excellent value — and flexibility for the future.”

Outfitted with a number of enhancements to help keep operators safe on the job, the DM30 II SP features a FOPS (Falling Object Protective Structure) cab, ground-level isolation and an airend safety shutdown system for high-temperature situations. A

Above and right: Blasthole drill productivity – the autonomous upside from real results

300-gallon fuel tank allows the rig to continuously operate for more than 14 hours before refill.

For increased operator comfort, the DM30 II SP features an insulated, pressurised, heated and cooled cab with tinted glass, a suspension seat, 80 dBA noise level and excellent visibility. All operational functions are controlled from the driller’s console, and the ergonomic layout allows operators to instantly switch from drilling to tramping for increased productivity. In addition, the electric-over-hydraulic controls are common across the DM series, making operation easy for drillers with DM series experience.



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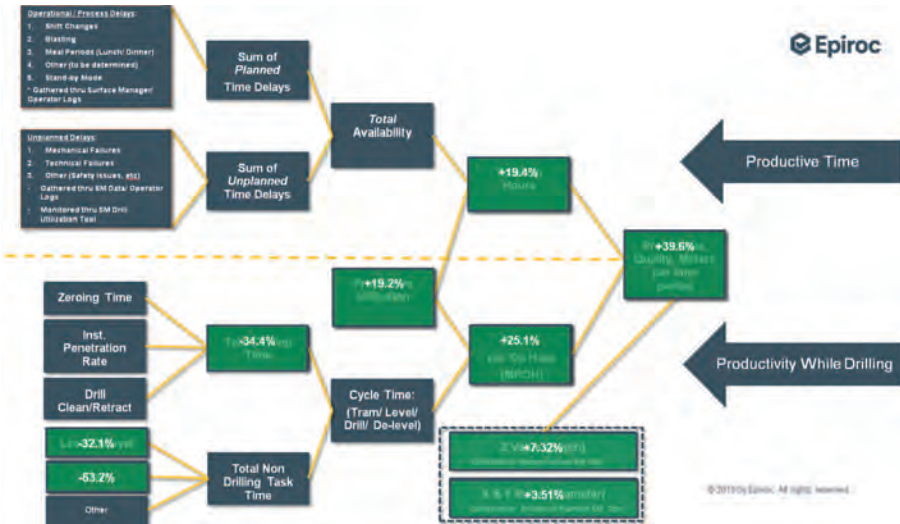
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Epiroc made a global launch of its DM30 II SP drill at CONEXPO



brand, “which has a strong reputation in the industry for quality, reliability, insights and partnerships, recognised by our customers globally. We’re focused on matching the strategy and innovation tied with our growing drill product offering.”

This was also Komatsu Drills’ first Tier 4 solution utilising a Cummins QSK19 with 800 hp. “The business has been very excited around the transformation. As track drills are engineered to be flexible in a variety of drilling applications, we recognised the need to match that machine versatility with an equally flexible business approach. Stocking these drills, ready for quick deployment, and delivered fully assembled to site now offers our customers an immediate turnaround for holes drilled.”

The 44XT was recently put to work in a US copper mine where the machine reportedly excelled. “Initially serving as the choice for presplit drilling doing 5-1/2” holes, the penetration rates and availability offered additional productivity that enabled flexibility to shift into production patterns doing 7-7/8” holes. The maximum hole range goes to 8-1/2” using 20 ft rods to hit a max depth of 140 ft. The drill uses an 800 hp drivetrain and a true mining-duty 85,000-pound footprint for durability for drilling in various application duties.”

Feedback from operators shows they have appreciated the machine’s ability to flex between

The DM 30 II SP is a simple machine scalable to automated features. The DM Series drill rig can be equipped with on-board technology capabilities with the optional Epiroc Rig Control System (RCS) Lite for added safety and productivity. “Built on the RCS 5 platform that comes standard on the Pit Viper series, RCS Lite offers a number of safety and interlock features. It also provides a convenient foundation to add more functionality and technology options in the future without a major rebuild of the machine. RCS Lite allows all Epiroc rotary drills to have the same onboard display and system for consistent operator

training and service. Epiroc has sold over 100 RCS Lite systems in 17 different countries around the world.”

Komatsu’s new drill family

Looking next at **Komatsu**, the most recent news for its surface drill line is its re-branding to Komatsu Drills. This was started with the introduction of the ZT44 (rebranded 44XT) at CONEXPO-CON/AGG in Las Vegas. (the “T” in ZT44 standing for track.) Komatsu told **IM** that this rebranding will provide a more unified and consistent customer experience with the Komatsu



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high pressure 1,160 cfm at 500 psi or low pressure 1,360 cfm at 350 psi drilling. “This gives the operator an ability to adjust with more breaking pressure for really hard rock, or alternatively for deeper drilling where more bailing air is necessary to lift out of the hole. Ultimately, this results in better performance and drilling outcomes. We have also heard great feedback from service technicians around easy accessibility with service walkways that provide unobstructed access into the house canopy where routine maintenance can be performed.”

The company also said that its surface drill line has experienced an increase in business as a result from integrating into the larger Komatsu family. “This has offered us further reach into an expanded customer base, providing drilling solutions. For example, we have achieved a nice milestone with manufacturing our 50th 320XPC drill for a customer on the Iron Range. The 320XPC fleet remains the choice drill for the most difficult drilling in the hardest rock. The 320XPC success has also carried us into new markets like Brazil through Komatsu Brazil Inc’s trusted relationship. Application of the 320XPC’s proven robust structural design of mitigating vibration combined with incoming power protection compensation for potential phase loss and phase rotation, offers improved performance.”

In addition to continued success with its existing products, Komatsu is also developing a new drill that will be showcased at MINExpo 2020 that continues the success demonstrated on the 77XR.

Supplementing the new products, the Komatsu surface product line is being supported through investment in training and certifying drill technicians with the new technology, which includes an emphasis on hands-on or on-the-job training. Another key piece is offering competitive Komatsu Finance packages for flexible options when mines are adding new Komatsu drills to their fleets.

Homing in on the 77XR, Komatsu says since the launch, it has continued to focus on technology and innovation. “One way is through designing core subsystems that improves drilling accuracy. We have heard positive operator feedback on the higher torque increase offered, enabling more efficient drilling. Additional feedback has been on vibration mitigation, where things like the mast increased torsional stiffness puts more energy into ground and not the structure, and the lower works, lower center of gravity with increased positioning, tractive effort, and turnability enable a smoother ride. We have also found that our levelling system has resulted in quicker cycles by keeping the deck close to the ground, enabling effective straight holes.”

Another way the 77XR development team has continued to improve technology is through



seamless integration and usage. “We have created a user interface that offers intuitive prompts for operator awareness – what went right/wrong and telling them why. The machine is set up to be an on-going lesson, continuously teaching the operator, while reducing the need to flip through many screens. Additionally, converting a sequence of procedures into one-touch button control for semi-autonomous operation aids in performance optimisation. We have also found that our supervisory control system (known as LINCS), significantly reduces complex troubleshooting. More importantly, the system logs all the data needed to optimise drilling performance. Pointing you to the fundamental source of data, pre-sorting the key indicators. Operationally, we know sites will have multiple operators running the drill, with different operational preferences. Data analytics on board and off board the drill enables ‘operator scorecards’ to identify best practices to offer tools to increase performance of the other less-experienced drillers. Examples include increasing rotational speed, or more pulldown, or setup time, or carriage speed, or too much water injection caving the hole – whatever is necessary to achieve best practices.”

The 77XR has already gone to work in several different applications, the most recent of which is coal mining in Australia. This is a dynamic application where multi-pass drilling at an angle calls for speed and precision. This is also a new market for Komatsu drills, which triggers things like change management for new products with new technology. Interestingly, Komatsu says it found that users commented that the 77XR was “really easy to learn.” Things like general ergonomics, such as joystick configuration with buttons in reach, using ISO symbols, screen placement, visibility, indicators, are all things that enable operators to become quickly proficient. “That combined with new features, like the Auto Bit Changer and easy accessibility to service points like the location of the machine’s hydraulic pumps, make for a nice design layout.”

Sandvik is now completing factory acceptance testing of an autonomous drill at its test quarry near Alachua. This shows monitoring of autotracking of a DR412i

Overall Komatsu has also continued its research and development with drill automation as a top development project, leveraging the larger Komatsu portfolio of technology businesses and products, along with dedicated data solutions experts that are integrated into the business. “We are committed to incremental technology releases that keep us on pace for a fully autonomous drill. The team has been working together with Modular and MineWare Phoenix drill control to use lessons learned and implement advanced sensor capabilities for best-in-class solutions.”

Sandvik’s SICA at the core

IM spoke to Demetre Harris, Sandvik Product Manager, Automation who is overseeing the company’s development of a fully autonomous drill offering. Currently full tele-remote functionality has been completed and the project is finalising areas such as auto-tramming, path planning, auto-pipe handling and other aspects of full autonomy. Harris said that Sandvik is preparing to move its full autonomous program to Site Acceptance Testing, and that demonstrations with customers have already taken place on their test rig located on proving grounds near the Sandvik mining drills factory in Alachua, Florida. For the next stage, Sandvik has several customers who are expressing interest in completing the assessment at their operations.

At the core of Sandvik’s automation solution is its Sandvik Intelligent Control System Architecture (SICA), effectively the company’s command/control platform. Unlike others on the market, SICA is being used across all automated product lines within the company including surface rotary and DTH drills to underground face drills and longhole/ITH drills. This gives it unique component to component communication and

extends functionality across entire fleets of drills for example. SICA also offers a high degree of interoperability.

Harris says: "Both SICA combined with the drill's design not only enable automation functionality; but are a core difference between our solution and the other solutions on the market. Software between solutions, with time, can be duplicated, transferred, or improved; but changes to the core architecture and machine design are a bit more permanent. Sandvik opted not to rush out a solution and instead has worked hard to get the architecture and design right; which are geared towards automation but also maintainability and performance."

On the main blasthole drill range, the latest model release from June 2019 was designed to improve efficiency and deliver dependable penetration in the world's harshest mining conditions especially in large copper and gold operations. The Sandvik DR416i delivers a single-pass capacity of 21 m, the longest single-pass mast in its class. Constructed for large diameter (406 mm rotary drilling, the Sandvik DR416i is automation-ready, scalable, and the company says supplies the highest rotational torques and pull-down forces at the lowest possible operating cost. It's also equipped with the patented Compressor Management System (CMS), designed to reduce the compressor load allowing the operator to manage air volumes and pressures

A team from contractor Basil Read on a visit to REL's manufacturing facility in Coimbatore, India

to maximise efficiency and reduce fuel burn thereby also reducing CO₂ footprint and extending engine and compressor life.

Revathi Equipment looks overseas again

India's leading manufacturer of mining blasthole drills is **Revathi Equipment Limited (REL)** based in Coimbatore, Tamil Nadu. The company reminded *IM* of its unique history, as it was founded in 1977 as Revathi CP Equipment Ltd (RECP) following support in the form of financial and technical collaboration from Chicago Pneumatic in the US. Atlas Copco then bought RECP in 1987. Then when Atlas Copco bought Ingersoll Rand in 2002, the Delhi, India-based Renaissance Group acquired REL. In 2004 the company began collaborating with Bucyrus, which ran to October 2010 and saw Bucyrus 33, 35 and 37 DTH drills made in India and sold worldwide with Caterpillar engines. Customers included Vale in Brazil, Kinross Gold, OCP in Morocco and several Australian miners.

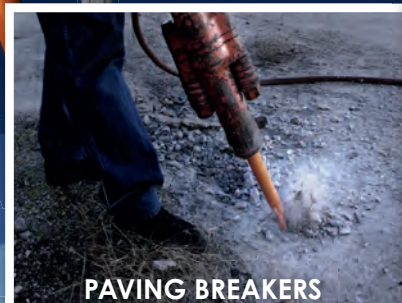


When Bucyrus bought Terex in 2010 the agreement was not extended because of conflicts of interest then Bucyrus itself was bought by Caterpillar.

The point is that under CP and Atlas Copco, then through the tie-up with Bucyrus, the company acquired a vast amount of design and

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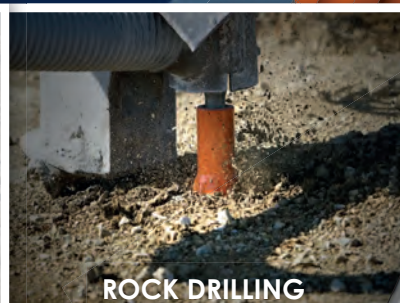
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technology experience. It was also using top quality components, and it has carried this forward to the business today. Some 70% of Revathi drill components are still imported from suppliers in the US including motors, pumps and some steel structures as well as Cat 18 and Cummins QSK series engines.

Moving on to the India market, it is very price sensitive – major users such as the largest coal mining company Coal India, NMDC and SCCL, (and major contractors they use like Thriveni) want highly robust models that can keep operating with a minimum of maintenance and be serviced easily using simple mechanical techniques. It is not yet a market with a lot of interest in digitalisation or automation due to the much higher prices involved and with TCO over the life of the mine not the major factor in tenders. Naveed Shaikh, REL Global Manager - Sales & Marketing, told *IM*: “REL drills are very robust, with the highest build quality, as well as being rugged and very long lasting but also with better lifecycle costs as well as being straightforward to maintain. Indian miners want the drills to drill, without complications or even any issues with auxiliary systems. And once you start putting sensors on a drill they can be affected by dust, dirt and water. There are many examples where sensors have failed on drills used in India and they have simply not been replaced. This is the reality of the market.” Semi-autonomous and line of sight drills have been used in India but have not caught on.

Currently Revathi has about a 50% market share in India and Epiroc about 50%. The big seller for Revathi is the C650 model, described as “a crawler mounted, multi pass, hydraulically operated, rugged” model supplied as both a rotary (159 to 228 mm diameter holes) or DTH drill (152-203 mm) and allowing holes of up to 54 m depth. This competes mainly against the Epiroc DM30 II and DM45 models, many of which are made in China, also for rotary or DTH drilling and for 140-200 mm holes. Other OEMs like Sandvik and Caterpillar currently only have very minor market shares in the country.

As the Indian market is quite saturated, REL has now started to look again at the overseas market. Its background here dates to 1991 during its control by Atlas Copco India when some drills were sold to Jordan Phosphate Mining Company. In the remainder of the 1990s some 168 drills were sold mainly to markets in the Americas under the Atlas Copco brand but built in India. Then came the mentioned tie-up with Bucyrus. Once that came to an end and REL went out alone, it made the decision to focus on the home market first. The drive to look globally once more started in 2017/2018. This includes other markets that appreciate simpler/robust and cost competitive machines but also those that want autonomous capability on these types of drills. There were



already REL drills in Indonesia, but the potential market is huge – Mongolia and other Central Asian countries, the Middle East, and many parts of Africa and Latin America. REL recently received its first order in Botswana for a 100% remotely operated C650 H autonomous model, which is being deployed at the huge De Beers Botswana Jwaneng diamond mine and operated from a control room at the top of the pit. The customer is the contractor Basil Read and if this unit performs well, the contract allows for another five.

REL's partner in automation is Indiana, USA-based **FLANDERS**, already globally well known for providing autonomous drill solutions, namely its ARDVARC system and umbrella FREEDOM for Drills solution used at a number of global mines like Iron Ore Company of Canada, Kolomela and Roy Hill on a number of different OEM machines (see *FLANDERS* section). The agreement will see FLANDERS apply its technology on both ex-factory REL drills as well as collaborating on R&D with REL going into the future.

One important aspect to REL's desire for its drills to remain robust is a decision to house automation sensors within the drill structure as opposed to being externally mounted. In addition, the sensors are transducer-based which is more user friendly.

Of course the company is still offering its traditional mechanised hydraulic drills to the overseas market. Contractors are a key potential market given that drills may be utilised for a number of years on different sites placing different demands on the machines. Africa's largest cement producer Dangote in Nigeria is one recent customer for the non-auto C650 H.

FLANDERS' automation drill recipe

Specialising in drill automation and retrofits for both hydraulic and electric drills, FLANDERS describes itself an expert in the development and

Drill Command Centre operator in Brazil simultaneously operating four multipass surface drills (two screens per drill) from two different OEMs equipped with FLANDERS ARDVARC

deployment of advanced control and automation technologies. Based out of the US, FLANDERS' flagship drill automation product, ARDVARC, is today deployed on over 100 drills, including 14 different drill models, across eight different countries.

The ARDVARC drill automation system is agnostic to any drill OEM, with an open architecture platform allowing for customisation to meet unique customer requirements. Three system levels, ranging from a base control platform to full drill automation, allows multiple solutions to fit specific site needs. As mines move from manual to automated processes, ARDVARC fully autonomous is trending as the most popular solution. This development began with semi-autonomous development that began in 2005 in southeastern Arizona. “Continuous development has occurred over the last 15 years by applying best practices learned from major multinational mining companies who have invested in FLANDERS technology. These improvements have taken place with the drills in production environments not in specialised optimal manufacturing conditions.”

The FLANDERS fully automated drill sequence includes auto level, auto tram, numerous way points, live refuelling and water in addition to multipass and angle drilling applications when needed both in rotary and hammer drilling configurations. FLANDERS automation reduces variability in operator performance, increases safety, promotes increased utilisation and productivity and ultimately optimises fragmentation. A recent case study shows the FLANDERS ARDVARC system outperforms the

manually operated drills by 8% in both hard rock and broken ground with overall productivity gains exceeding 20%. “FLANDERS drill recipes are significant to the success of the system. The drilling algorithm can be adapted for the ground condition, mirroring the operator functions, and is able to detect whether the hole is getting plugged and when to back off and raise the bit,” the company told *IM*.

With Western Australia leading the way in mining automation, the FLANDERS Western Australia Regional Service Centre has partnered with key players to allow customers to remotely control their machines from Perth, versus the actual mine site. “This system architecture allows the operator to be removed from the machine and placed in a safe location,” Mike Lane, GM of FLANDERS Western Australia told *IM*. “Current clients work on a one to five machine operating model, this is soon to be stretched to one to ten. Our flexibility to adapt the system, niche in the retrofit space, and ability to provide key continuous improvement and mine planning data makes us a leading choice in drill automation solutions.” FLANDERS currently has 25 ARDVARC systems deployed in Western Australia, with additional systems slated for 2020. In addition to Western Australia, FLANDERS has sold fully-autonomous kits globally with 22 in Brasil, 12 in South Africa, six in the US and two in Canada. “All told, 67 fully autonomous kits applicable to the major OEM models enables our clients to standardise to the ARDVARC control system at mines that operate mixed fleets.”

Cat® launches the MD6380

Designed for large bore hole production drilling, Caterpillar’s latest diesel-powered ultra-class drill, the MD6380, provides the optimal mix of on-board air, feed force, rotary torque and machine mobility. With a hole diameter range of 251 to 381 mm (9.875 to 15 in), single pass hole depth of 19.8 m

(65 ft) and multi-pass hole depth of 39.5 m (129 ft), the new drill is designed for large scale mining.

The MD6380 powertrain is designed to efficiently manage loads generated by the compressor and hydraulics, delivering superior fuel economy. The MD6380 compressor is configured with electronic regulation and variable volume air control, allowing the driller to perfectly match compressor output to drill tool and application needs. It also lowers stand-by pressures while the machine is in idle, further improving fuel efficiency. The MD6380 is capable of pulldown force of 49 895 kg (110,000 lb) and rotation torque of as much as 20 880 Nm (15,400 lbf).

“The MD6380 is controlled through proven Cat electronics. Integrated machine protective features and interlocks help keep operators safe and the machine up and running by preventing potential failures or misuse. With Cat Electronic Technician, troubleshooting is quick and easy. MD6380 electronics also provide a common platform for the integration of a number of future automation solutions.”

The machine offers a number of automated functions through Drill Assist, which includes auto level, auto retract jacks, auto raise and lower mast, and auto drill (single or multi pass). The drill depth monitoring system helps to reduce over- and under-drilling, which reduces the need for rework.


The MD6380 incorporates Cat Terrain for Drilling, which provides precise hole location, production reporting, and strata reporting. Terrain seamlessly connects to Cat Command, offering a path to autonomous drilling.

The drill’s best-in-class working envelope gives it superior maneuverability, allowing it to navigate quickly and efficiently. A Cat 374 excavator-style undercarriage offers durability as well as tractive effort for higher travel speeds. The drill is currently available in Africa and Middle East countries,



A graphic showing the new Cat MD6380 in a potential mining application

Australia, the CIS plus Central and South America.

In terms of autonomous drilling, Caterpillar is thought to have moved beyond field trials with fully autonomous drills, but no more information is currently available. Cat did say that interest in and deployment of semi-autonomous drills is greater in many mining areas as the semi-autonomous system allows remote operation/management and removing the operator from the rig provides safety and health benefits without full autonomy. It also enables a single operator to oversee several drills. 



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