

SOLL GROUND

A MAGAZINE FROM SANDVIK MINING

#2.2014

Safety's future

Functional standards
in lockstep with
technology

◆ Regis Resources
and Sandvik
Mining partner to
build a lean
crushing site.

AUSTRALIA: ROSEMONT MINE

PLOT OF GOLD

A complete crushing and
screening plant in the desert

Sandvik DD422i:
**One brainy
drill**

Intelligence:
**Mining in the
21st century**

Mexico:
**On-site
service**

SANDVIK

Dear reader,

THIS IS THE FIRST opportunity I have had to contribute to *Solid Ground* since taking up the role of President, Sandvik Mining, several months ago.

MY PASSION LIES with the mining industry, and I have a clear commitment, having previously spent more than 10 years working directly within it, along with wide-ranging experience in the automotive sector. That experience has led me to believe that many of the challenges we face within mining today are not unique to our industry: intensifying competition, the reestablishment of the importance of cost and the technological evolution, to name but a few.

WHAT IS IMPORTANT is what we are doing to help our customers address those challenges. In this issue of *Solid Ground* you'll find just a few of the many examples, including features on both a Western Australia gold operation and a Mexican zinc mine, where Sandvik service technicians keep the mobile equipment fleet moving. The magazine also contains product articles about Sandvik DD422i, the first of our Next Generation underground hard rock drills, and Sandvik DR461i, our latest rotary blasthole drill.

YOU'LL ALSO LEARN about a scientific finding that could have potential applications in mineral exploration. Plus, discover how the complexity of mining automation technology and the speed of its development have made safety regulations difficult to standardize.

I AM DELIGHTED to have joined Sandvik Mining at such an exciting point in our ongoing journey, where we are committed to building on our existing achievements and becoming even better at serving you, our customer, and helping you address both existing and future challenges within our industry. This is not only my personal aim, but the aim of all of us who work within Sandvik Mining.

SCOT SMITH
PRESIDENT
SANDVIK MINING



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Correspondence and enquiries regarding the magazine are welcome. Contact: *Solid Ground*, Spoon Publishing AB, Rosenlundsgatan 40, SE-118 53 Stockholm, Sweden. Phone: +46 (0)8 442 96 20. Email: solidground@sandvik.com. Distribution enquiries email: solidground@spoon.se Internet: www.minestories.com.

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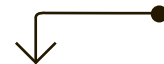
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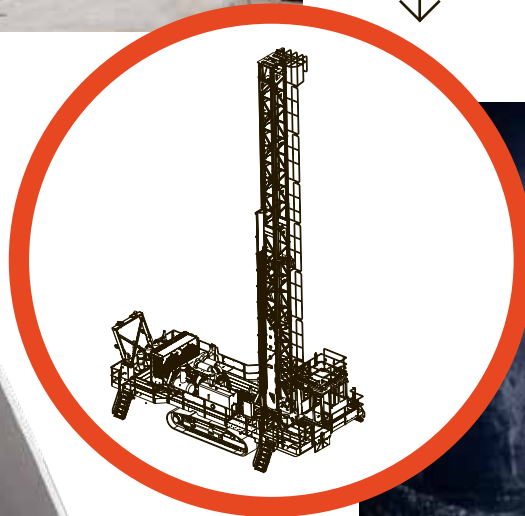
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It pays to recycle

● It's no secret that there is a global shortage of raw materials. Sandvik Mining recognizes this, which is why it's the only mining company that recycles steel and carbide. Recycling cemented carbide not only helps balance the supply chain, but also makes sense for a sustainable business and the environment. The Sandvik recycling process significantly reduces energy consumption, lowers carbon and nitrous oxide emissions, and produces less waste.

Sandvik Mining offers a cemented carbide recycling service to all of its customers worldwide. Suppliers will be paid a fair price for scrap or dull bits, taking into account market conditions, net weight, location and service costs. Ask your local representative for terms and conditions.



'Lite' bulks up

● Sandvik will launch its fleet automation solution for surface topammer (DPI Range) and DTH (Pantera) drill rigs in the final quarter of 2014. Currently available as AutoMine Lite for single rig remote control, this AutoMine Fleet launch will enable up to three rigs to be controlled simultaneously by one operator while sitting in a control room environment. AutoMine Fleet for surface drills will be available as an option on all new drill rig orders or can be retrofitted to newer DPI and Pantera rigs that are already working in the field.

THE QUOTE

“This award symbolizes our creativity, hard work and innovative spirit.”



- Jan Petzold, vice president of UG Drilling at Sandvik Mining. Pantera DI6400, the new down-the-hole percussive drill platform from Sandvik Mining, won the prestigious 2014 Red Dot Award for outstanding product design.

Made for tight spots

● Developed initially for the fast-growing Chinese market in close collaboration with Sandvik Mining R&D teams in Finland and China, the compact and manoeuvrable Sandvik LH204 delivers class-leading safety and productivity in a cost-effective solution. With a capacity of four tonnes, the new LHD addresses challenging loading, hauling and dumping conditions of narrow-vein ore bodies. “Sandvik LH204 operates productively and profitably in confined applications while still handling larger payloads than

similar-sized competitor units,” said Mika Pöyri, Sandvik Mining product manager. “The increased four-tonne payload capacity results in a productivity increase of at least 13 percent compared with other LHDs in this size class.”



+ Sandvik LH204 is built for confined spaces.



International recognition

+ **Hard work and dedication earned inductions to the IM Technology Hall of Fame for these four Sandvik colleagues.**

● Four Sandvik employees - Riku Pulli, Timo Soikkeli, Brett Cook and Janne Kallio - have been honoured by the International Mining Technology Hall of Fame for their efforts in developing Sandvik AutoMine. This award recognizes some of the greatest technical innovations from the world of mining.

Much of the research for AutoMine was done at the production site in Tampere, Finland. But taking the ideas from the test lab to the mine was possible thanks

to the cooperation of customers such as De Beers, Codelco, Rio Tinto, LKAB and Boliden, to name but a few, who were eager to automate their operations. Today, AutoMine has evolved into a complete automation offering for surface and underground mines, making them safer, more productive and efficient.

“It was a real journey,” says Timo Soikkeli, mining applications director for Sandvik Mining China. “Now we feel like we’ve finally taken the lid off underground mining.”



New R&D centre in India

• Sandvik is taking its research and development (R&D) activities in India to a new level with a planned new Group R&D centre to be based in Pune. The western Indian city is already an important site for production, R&D, design and engineering for Sandvik. The new R&D centre will enable Sandvik to maintain close relations with customers in India and to adapt innovative technical solutions for the local market. In

addition, the centre will carry out strategic research aimed at developing future business opportunities for the company, complementing existing R&D units for materials and process engineering. There is already an R&D team of modelling and simulation experts in place in Pune. This will be scaled up by 2017 to around 100 employees who will be housed in an energy-efficient, certified 'green building.'

Drill rig simulators: Real-life training

• To train staff how to use equipment in a safe yet "real-life" environment, Sandvik Mining has introduced several custom-built training simulators for its new Pantera surface mining drill rigs. These Pantera simulators are a perfect replication of the actual drill rigs used in real mines: the cabin layout and control system including down-the-hole (DTH) and topammer configurations are the same. A screen at the front window in the simulator gives the trainees the feeling of being in a real mine. It is a low-risk

and damage-free alternative to in-the-field drill rig training.

The simulators can be easily moved into a training room where mine staff, such as drill operators and maintenance technicians, can practise before operating Pantera in a mine. The simulator provides them with all the skills they will need to operate the equipment, while the trainers and mine management can get feedback to identify improvement areas or to certify staff.



Drill rig simulators offer low-risk, damage-free training.

2.9

Radius in metres in which the new Sandvik DD2710 single-boom electro-hydraulic jumbo can operate.

Major order for Sandvik in Australia

• Sandvik has been awarded a major materials handling contract in Australia worth more than 50 million euros. The order for the project includes engineering, procurement and the construction of two bucket-wheel stacker/reclaimers for coal handling with a stacking capacity of 8,600 tonnes per hour and reclaiming capacity of 7,250 tonnes per hour. "The importance, size and complexity of the project - and the impressive performance data - demonstrate our capability to provide high-tech solutions in the area of mobile materials handling machines," says Scot Smith, president of Sandvik Mining.

Drilling solutions for oil and gas

• Sandvik has acquired Varel International Energy Services Inc., a global supplier of drill bits and downhole products for well construction and well completion to the oil and gas industry, as well as to some mining and construction companies. Varel is headquartered in Texas, USA, and has around 1,300 employees. It has manufacturing sites in the USA, Mexico, Scotland, France and Russia. Varel will form a new product area within the Sandvik Venture business area, providing a platform to enable Sandvik to enter into drilling solutions in the oil and gas sector.



Q & A

UNEARTHING TALENT

WITH MORE THAN 25 years of experience in the mining industry, Mark Roderick, general manager at Australia-based Downer Mining, knows how important it is to find talented colleagues who share his commitment to customers.

Q WHAT DID YOU DO BEFORE WORKING AT DOWNER MINING?

I joined Downer Mining in my current position in January 2012. Before that, I spent 25 years in the mining industry, working with various mining contractors and also for a few mine owners. This has mainly been in hard rock underground metalliferous mines, although I did do a short stint in the coal sector.

Q WHAT ARE YOUR TASKS AS GENERAL MANAGER?

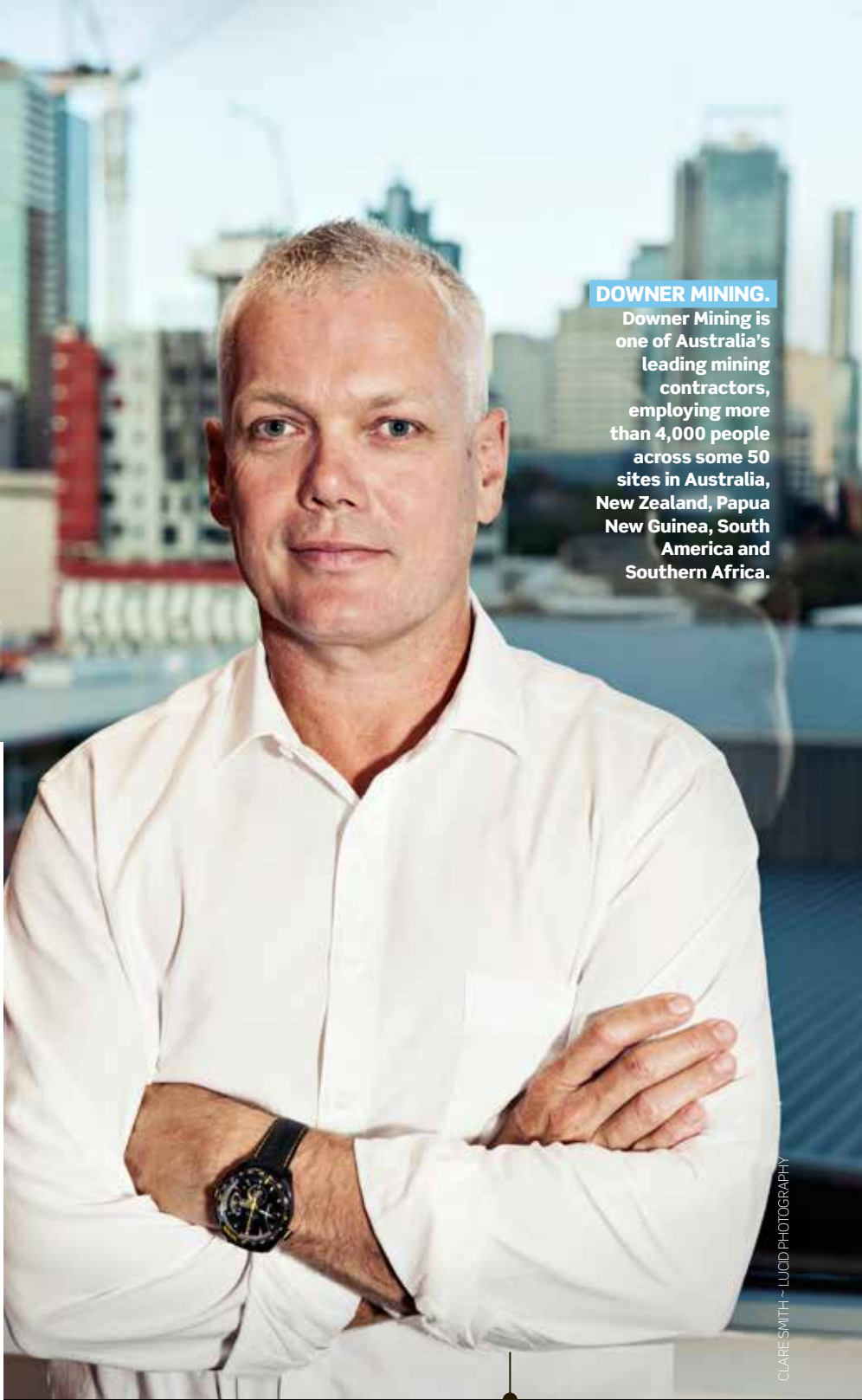
I'm responsible for the growth and financial performance of our underground mining and exploration drilling business. I've spent the past couple of years actively building a team of experienced, like-minded professionals who share Downer Mining's commitment to its clients and its values-driven, collaborative approach to doing business.

Q WHAT KIND OF PARTNERSHIP DO YOU HAVE WITH SANDVIK?

Sandvik is extremely responsive to our strategic needs and has proven to be a reliable and versatile business partner whose values align with our own. The synergies of our partnership bring value for our customers and definitely make our brand stand out in the marketplace. Our vision is to be the only underground mining contractor in Australia using a single equipment manufacturer for our mining fleet.

Q WHAT ARE THE CHALLENGES IN YOUR WORK?

The mining sector itself is definitely a challenge at the moment, but it also presents an opportunity for us. Becoming recognized as a Tier 1 underground mining contractor and understanding mine owners' needs have kept us busy for the past two years in



CLARE SMITH - LIQUID PHOTOGRAPHY

DOWNER MINING.

Downer Mining is one of Australia's leading mining contractors, employing more than 4,000 people across some 50 sites in Australia, New Zealand, Papua New Guinea, South America and Southern Africa.

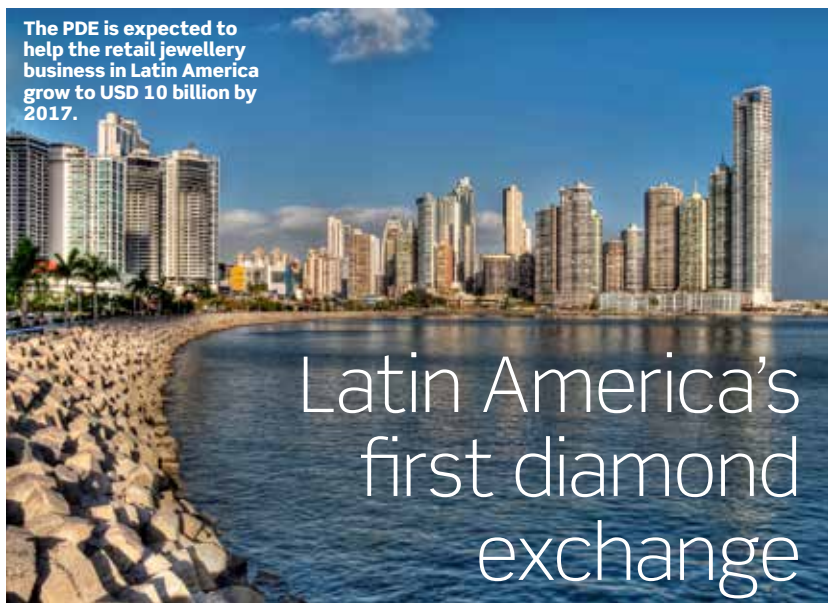
trying times. We're now seeing great results, with new business opportunities being presented to us.

Q WHAT IS THE MOST INTERESTING ASPECT OF YOUR WORK?

Having the ability to grow a business as diverse as ours is always exciting. One day it's a suit and tie; the next I could be on a helicopter in Papua New Guinea or underground at one of our sites in Australia. Seeing my team grow in their careers while maintaining a happy work-life balance with plenty of quality time with their families is personally very fulfilling.

ABOUT MARK RODERICK

TITLE: General manager underground and exploration drilling
COMPANY: Downer Mining, Brisbane
AGE: 49
LIVES: Brisbane, Australia
FAMILY: Wife Caroline and four boys, ages 2, 4, 5 and 10



The PDE is expected to help the retail jewellery business in Latin America grow to USD 10 billion by 2017.

Latin America's first diamond exchange

● In March 2014, Panama launched its USD 200 million Panama Gem & Jewelry Center. The facility will also house the Panama Diamond Exchange (PDE), which is expected to help Latin America's jewellery retail business grow to more than USD 10 billion by 2017. The idea is that the PDE will become a hub for the region, which is considered the world's most untapped jewellery market. Panama was chosen as the base for the exchange due to its strategic location as home to one of the world's major shipping lanes. This is the 29th such market worldwide but the first in Latin America, a region that produces many precious gems, such as emeralds from Colombia. In the past, Latin American buyers have had to travel to the United States or Europe or buy expensive second-hand gems locally, as there was no diamond exchange in the region. Now, diamonds will be flown in from places like New York, Antwerp and Dubai.

THE QUOTE

“This ground-breaking facility allows us to focus on optimizing mineral processing across a broad range of sites, anywhere in the world.”

John McGagh Rio Tinto's head of innovation.

Rio Tinto recently opened a new state-of-the-art Processing Excellence Centre (PEC) in Brisbane, Australia. The PEC team will enhance operational performance by examining processing data in real time from seven Rio Tinto operations.



Tesla's battery cell plans are expected to increase global lithium demand over the next four years.

Tesla gives lithium a boost

● Tesla Motors recently announced that it would build the world's largest battery factory, in anticipation of strong demand over the next three years for its third-generation electric vehicle, which retails at just USD 35,000. This vehicle runs on lithium-ion cells, thus increasing demand for lithium batteries. Tesla already plans to buy around

1.8 billion lithium-ion cells over the next four years from Panasonic, but this may still not be enough. Tesla's news is expected to increase global demand for lithium, pushing up the price and benefiting the world's three major lithium producers - Sociedad Quimica y Minera, FMC Lithium and Rockwood.

Miners are happy and productive

● A recent study by Oxford-based iOpener Institute for People and Performance found that miners across the globe are not only some of the most productive employees, but also rank among the happiest.

The happiest employees were found in food service, retail, health care, education and consulting, with mining employees ranked sixth, well ahead of other industries such as telecom, automotive, civil

engineering and advertising. The study analyzed responses from more than 45,000 professionals in a wide variety of industries. Workers in the mining industry scored a higher-than-average rate of 62.1 percent in the category "time on task"

— the total hours workers actively produce output that makes a tangible contribution to their organization.



Fabergé egg dodges the scrap heap

● A lucky scrap metal dealer in the US Midwest literally struck gold when he purchased a small 8.2-centimetre gold egg, on the brink of being melted down for scrap, for just USD 13,000. Suspecting the egg was worth more, he found it was one of 50 original Fabergé eggs produced by Peter Carl Fabergé for the Russian tsars from 1885 to 1916. This one, said to be an Easter present from Tsar Alexander III to his wife, is worth around USD 33 million. This egg sits on top of a gold stand, and a diamond acts as an opening mechanism to reveal a Vacheron Constantin watch inside.



Africa's Billion Dollar Map

● A World Bank initiative aims to compile Africa's mineral maps into a single, public database: the Billion Dollar Map. The goal is to give African nations as much information as possible about their natural resources so that they can earn a fair price for the minerals they sell. The groundwork for the initiative has evolved over the past 10 years, with the World Bank investing more than USD 200 million in geological data in Africa. The initiative is still going through the funding and preparation stage, but reactions from governments and the industry have been positive.

EU conflict minerals law

● A new EU scheme hopes to make it more difficult for armed groups to finance their activities by selling conflict minerals. The draft regulation wants to make it easier for companies to source tin, tantalum, tungsten and gold through conflict-free sources. The measures include an EU system of self-certification for importers "who choose to import responsibly into the EU and avoid causing harm on the ground." The organization will also publish an annual list of EU and global "responsible smelters and refiners." Other proposals include tighter cooperation with the countries where these products are extracted.



The Saudi Arabia of lithium

● A recently unearthed 2007 study by the US Geological Survey appears to have discovered nearly USD 1 trillion in mineral deposits - iron, copper, cobalt, gold and important industrial metals such as lithium - in Afghanistan. An internal Pentagon memo states that Afghanistan could become the "Saudi Arabia of lithium," a key raw material in the manufacture of batteries for laptops and smartphones. The deposits are supposedly so large that the find could transform war-ravaged Afghanistan into one of the most important mining centres in the world.

However, the many obstacles to development include investment and security risks, lack of infrastructure, rampant corruption, the presence of the Taliban and conflicts among tribal leaders.

According to the memo, a Pentagon task force is trying to help the Afghans set up a system to deal with mineral development with a view to start seeking bids on mineral rights before the end of 2014.

36.1 million

Tonnes of iron ore shipped from Australia's Port Hedland in May, a record, as mining companies boosted output. Shipments to China were a record 29.9 million tonnes in May compared with 28.9 million tonnes in April and 23.3 million tonnes a year earlier.

First mining venture for Oman

● Oman recently kicked off its first mining venture. Earlier this year, Oman Oil Company (OOC), the state's investment arm in the energy sector, signed a memorandum of understanding with Mawarid Mining and Oman Mining Company to develop the Yanqul copper project. The project is located in the northern part of Oman, close to the city of Ibri. When the feasibility study is successfully completed, the project will

be split between OOC with a 41 percent stake, Mawarid Mining with 49 percent and the rest belonging to Oman Mining Company.

The Yanqul project is important for the country as its development would support metal-based industrial projects in Oman and further support OOC's diversification strategy to boost long-term investment opportunities in the infrastructure, power and mining sectors.





Zeppelins to move equipment in Siberia



COPPER COUNTRY:

The board game

● Currently under development, Copper Country is a new board game for mining fans. It brings players back to the year 1840 when America's first mining boom is about to change the country forever. Each player takes on the role of a mining company competing for copper. There are six mines, and players have to hire miners, build company houses and increase the efficiency and safety of their workforce. Just as in real life, disasters must be overcome. As the industry grows, so do the communities surrounding the mines. In the end, the winner is the player who has produced the most copper.

The idea for the game comes from David Lankton, who was inspired by hours spent playing board games at Christmastime with friends and family, including his father, a historian at Michigan Technological University, who spent many years researching the history of Copper Country.

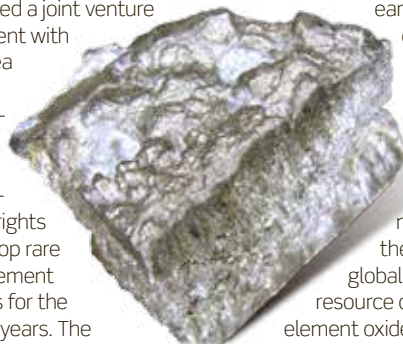
● Amur Minerals Corporation, a copper and nickel explorer in Russia's Far East, plans to fly equipment to its Siberian operation by Zeppelin to bypass snow-clogged roads in a region where temperatures can dip to minus 60 degrees Celsius. As road and rail transport can often be hampered by these wintry conditions, mining companies are forced to look for other cost-effective transport solutions.

Amur plans to use two airships from Worldwide Aeros Corp that can carry loads of up to 250 tonnes. This kind of airship is suitable for use in rough terrain because it can take off and land vertically. In addition, airship fuel costs are around a third of those for a cargo plane. For Amur, their use will reduce the estimated USD 140 million expense of building a 320-kilometre (200-mile) road to the nearest rail station, as well as cut freight costs.

Largest known rare earth deposit discovered

● SRE Minerals has discovered what is believed to be the largest deposit of rare earth elements on the planet in North Korea. The private equity company has signed a joint venture agreement with the Korea Natural Resources Trading Corporation for rights to develop rare earth element deposits for the next 25 years. The

discovery of rare earth elements at this site is believed to be one of the largest deposits in the world, with initial estimates of 216.2 million tonnes of valuable rare earth elements. Worth trillions of dollars, this deposit would nearly triple the current global known resource of rare earth element oxides.



The Expert

THE IOPENER INSTITUTE for People and Performance is an international consultancy that helps organizations achieve their strategic and commercial goals by maximizing the performance, productivity and happiness of its employees. Joint CEO of iOpener Jessica Pryce-Jones discusses some results of the iOpener People and Performance Questionnaire (IP PQ) with *Solid Ground*.

Q: Why do you think miners rank so high on the IPPQ's Happiness at Work scale?

A: Miners often work in small groups, and they are highly reliant on each other for personal safety, which means they have high levels of trust. They often work in close physical proximity to each other, too. And that breaks down barriers and further increases trust. Our research shows that employees who forge very strong personal relationships are often happier at work and as a result stay longer in their jobs.

Q: Miners also scored higher than average in the "time on task" category. Why do you think that is?

A: The work they do is very easy to measure, so it's quite straightforward for them to quantify their time on task. Above all, however, when you have happy employees they are just on task most of the time; the two are highly correlated.

Q: Why is it important to be a happy employee?

A: Our empirical data has found that a happy worker is a high-performing one.

And for an employer, the cost of unhappy employees is huge. Employees who are really unhappy at work spend only 40 percent of their time on task. That's two days a week. In effect an organization is losing about 100 days' work - or about 3.5 months - for every really unhappy employee.



Check out minestories.com for more on the iOpener Institute and their IPPQ.

Text: CHI AN GRAMFORS ENGLUND Photo: ADAM LACH

SPARKLING SUCCESS

■ **DUKETON, AUSTRALIA.** Out in the middle of the red sand desert of Western Australia, Regis Resources extracts gold at the Rosemont mine. A complete crushing and screening plant supplied by Sandvik helps to meet the mine's production goals.



Bernie Cleary, Regis Resources general manager at Rosemont, thinks the safety performance at the plant has been excellent.

THE FLIES ARE everywhere – in your face, on your boots and all over your clothes. They try to crawl into your nose, mouth and eyes. It’s sunny and hot out here in the middle of the Western Australian desert. But it’s autumn and approaching winter in this region, so the temperature is lower than a few months ago.

“This is nothing compared to summertime,” says Kenny Weller, construction supervisor at Regis Resources. “Then we have temperatures over 40 degrees Celsius, and there are many more flies everywhere.”

The Sandvik-supplied crushing and screening plant at the Rosemont gold mine in the middle of the red-coloured Western Australian bush lands is an integral part of Regis Resources’ efficient gold production. Think of mining as a tripod consisting of three equally important legs: extracting (exploration, drilling and excavation), haulage (loading and hauling) and comminution (crushing, screening and milling). Without support from all three legs, the mining tripod would collapse.

To make sure that the third leg at Rosemont was reliable and strong, Regis Resources chose Sandvik as its supplier for the crushing and screening plant at the site.

“The Sandvik crushing plant is an integral part of the gold mine,” says Mick Evans, project manager, Regis



▶ Resources. “It’s the first stage of the gold processing plant, and as such it’s very important for the whole mine that it has good reliability and performance. The main reason we chose the Sandvik solution is that it’s a tested design. We’ve used Sandvik equipment in our other operations in the past. I like the equipment – it’s good robust equipment, and I was confident that Sandvik would be able to deliver.”

WELLER EXPLAINS THAT 100 tonnes of ore will yield between 100 and 200 grams of gold. It’s an enormous undertaking to make the bullion that

comes out of the mine.

Bernie Cleary, Regis Resources’ general manager at Rosemont gold mine, has overall responsibility for the mining project, from the pit to the processing plant and through the production of the bullion. He has been in the mining industry for 12 years and has worked at the Rosemont plant from the start.

“The process plant team and maintenance team commissioned the circuit over a period of around a week, and then the circuit was at full capacity,” Cleary says. “The plant was designed for 1.5 million tonnes per annum, and following a month of commissioning the plant was achieving almost 1.7 million tonnes per annum.”

Running the plant doesn’t require many people. One reason is that the crushing circuit is operated from the plant control room. The operator has a complete overview of the process thanks to the automation and control systems in place, including the Automatic Setting Regulation (ASRi) system on the cone crushers, the feed level sensors and the CCTV cameras. With the ASRi, the actual crushing load inside the crusher is continuously monitored. It also keeps track of liner wear. This makes it easy to plan liner

2.3
tonnes (over 80,000 ounces) of gold per year are produced at the Rosemont mine.

changes and minimize interruptions in production.

Joel Marland is the maintenance supervisor at Rosemont. His tasks are to organize and supervise the maintenance staff for the general day-to-day servicing, maintenance and planned shutdowns.

“I’m just making sure the mine site is ticking along nicely,” Marland says. “I might need to change an oil filter or a breather. You just do that as quickly as ▶

Worker safety was paramount during the plant’s design phase.





REGIS
RESOURCES LTD

Regis Resources project manager Mick Evans loves the robust equipment Sandvik provided.

“The Sandvik crushing plant is an integral part of the gold mine.”

The process plant is already exceeding expectations, achieving almost 1.7 million tonnes per annum.



“There have been no serious incidents since commissioning the process plant.”



SANDVIK FLEET AT ROSEMONT

- One Sandvik CH660 cone crusher
- One Sandvik CH420 cone crusher
- One Sandvik CJ615 jaw crusher
- One Sandvik LF2448D screen
- One stockpile conveyor
- One plant automation control room and electrical equipment
- Additional Sandvik conveyors, dust encapsulation, bins and feeders

possible and in a safe manner, and get the plant back up and running. It’s been running really smoothly.”

The operator and maintenance teams work in two 12-hour shifts to keep the plant going 24 hours a day, seven days a week. The personnel are away from home for weeks at a time, but the feeling on-site is friendly with genuine camaraderie.

“Life’s pretty good out here,” Marland says. “You are really looked after, so you have almost everything you would ever want, but being away from your wife and family makes it hard sometimes.”

REGIS FORMED THE partnership with Sandvik four and a half years ago, starting with a Sandvik CH420 cone crusher delivered to the Moolart Well plant within the mining project area. Next, two Sandvik CH660 cone crushers,

secondary and tertiary applications, were supplied at the Garden Well plant. Sandvik product support manager Marcus Benn has been along for the whole ride.

“After these deliveries we were contacted by Regis and asked if we were able to supply a complete modular crushing and screening plant,” he says. “We have efficaciously concluded that agreement at Rosemont, and it’s been a great success for both Regis and Sandvik.”

Together with Sandvik, Regis has erected an extremely lean crushing site. The whole workplace at Rosemont is neat and tidy.

“The process and maintenance teams do a terrific job at keeping the process plant tidy and orderly, so it’s always easy to make sure there are no issues

19

tonnes of contained gold sit in Rosemont’s ore reserve.

developing at the plant,” Cleary says. “Also, the safety performance is excellent. There have been no serious incidents since commissioning the process plant.”

Part of that achievement is that Sandvik paid a lot of attention to safe handling of the crushers when designing the products. They are made to be as easy to operate and maintain as possible. All service and inspection is carried out from above, which makes the work easier and reduces the maintenance costs.

Evans agrees that the safety features are convenient for the team’s daily work and help support their well-being.

“From a safety aspect, I find that the Sandvik equipment fits in very well with Regis’s philosophies,” he says. “The maintenance accesses are good, and there are some really good innovations,

▶ such as access into the screen deck with a removable feed chute that rolls away and drop-in platforms that prevent any chance of falling. Overall, I'm happy with the thought that has gone into the safety and the maintenance aspects of the plant."

The job for the plant is to size the material to the mill. After going through the mill, the gold ore is transported with pipelines, in a slurry form, back to the Garden Well processing facility 10 kilometres away.

It's been helpful for Regis that, in addition to the high capacity, Sandvik CH crushers are compact, which makes them easy to move and install.

"I decided to look for the Sandvik option for this processing plant in order to cut the initial capital costs and also the installation costs," Evans says. "One of the issues we have on these mine sites is that they're very isolated. There are also transport problems, and for the structural erection we have to have people on site and accommodate them. All those issues pointed me towards a modular-type plant."

Benn describes the partnership between Regis and Sandvik as a smooth process that has brought valuable experience to both companies about what a plant like the one at Rosemont can offer.

"It's been a very pleasant experience for both Sandvik and Regis," he says. "The project has run very smoothly, and we're all happy with the results."

The surroundings here are breathtaking, with wildlife around every corner. To commission a gold mine in the natural setting of Western Australia, a mining company needs to go through a highly detailed process. The enhanced environment, health and safety aspects of the Sandvik crushers have helped make it possible to meet the standards.

"The environmental protocols need to be adhered to strictly, and to date it's been completed successfully," Cleary says.

Evans, who has been with Regis since 2009, thinks the environmental aspects play a big role when deciding what equipment to choose.



The operator in the control room has a complete overview of the process control systems.



See videos about Rosemont at minestories.com

"One of the things I like, in terms of the environmental aspect of the Sandvik plant, is that it fits within a very small footprint," he says.

It's true that the Rosemont plant is very compact. It's also robust and reliable, which makes it a stable leg for Regis to rely on for the efficiency of the gold mine. ■



SANDVIK SOLUTION ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦

CRUSHED IT!

● The plant was designed, manufactured and supplied by Sandvik over a period of 12 months following the signing of the contract. Thirty-five weeks were devoted to design and supply, and the rest of the time was dedicated to installation.

The plant from Sandvik includes a primary station (bin, apron feeder and a jaw crusher), a secondary crushing circuit (Sandvik CH660 cone crusher and screen) for the first round of sizing the ore, and a pebble crushing station (a Sandvik CH420 cone crusher). Sandvik also supplied all accompanying feeders and conveyors. A key feature of the cone crushers is their automated control system.



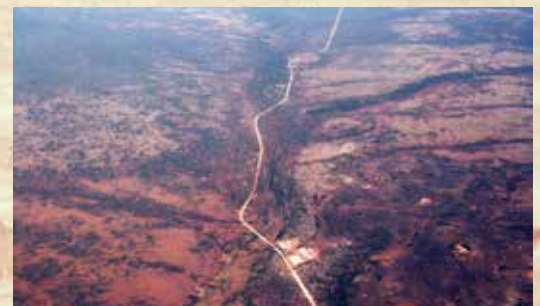
“The project has run smoothly, and we’re all happy with the results.”

Standing with Bernie Cleary, Sandvik product support manager Marcus Benn (above right) has supported Regis for more than four years.



About Rosemont gold mine

● Rosemont was discovered in the 1980s and was partially mined as a shallow oxide open pit. Regis took ownership in 2006, and the updated ore reserve at Rosemont stands at 19 tonnes (664,000 ounces) of contained gold. Regis Resources Limited is a Perth-based gold production and exploration company. The company is a purely Australian gold miner, with operations at the Duketon Gold Project in the North Eastern Goldfields of Western Australia and the McPhillamys Gold Project in the Central West region of New South Wales.





SANDVIK DD422i

Sandvik DD422i can be integrated with the AutoMine Drilling system for autonomous drilling operations, reducing risk to personnel and providing better accuracy and higher productivity.

Text: TURKKA KULMALA Photo: MÅNS BERG

INTELLIGENT DESIGNS

■ Sandvik Mining has **launched Sandvik DD422i**, the first of its Next Generation underground hard rock drill rigs, with a strong emphasis on the human-machine interface. The completely redesigned drill offers top-level performance in safety and ergonomics for operators, increased productivity at a lower cost and wide-ranging automation options to carry the mining operation far into the future.



Development drilling is the key to unlocking an underground mine's ore, and the new Sandvik DD422i drill rig offers a wide range of new features to improve excavation of these tunnels in hard rock mines.

Sandvik DD422i is the first release in the company's upcoming generation of advanced underground drill rigs. These Next Generation jumbos respond to future trends in mining: operators must comply with increasingly challenging safety and environmental requirements, while mine managers need more efficient cost control and must be able to provide new operators with advanced

on-board drilling assistance in typically remote mining locations.

"These super-trends were the main drivers for our Next Generation drill programme," says Alain Comorge, Sandvik product line manager, face drills, bolters and low profile underground drills. "We want to be there for our customers and, as an original equipment manufacturer, to help them face these challenges."

FOUR KEY ELEMENTS make Sandvik DD422i a unique new rig that will raise the industry standard to a new level: a new drilling and boom control system, better cabin ergonomics, an improved carrier, and wide-ranging drilling assistance and automation options.

The rig's drilling and boom control system for the first time introduces torque-based drilling control in the Sandvik mining jumbo fleet. According to test results, the optimized torque control significantly reduces jamming of the drilling tools and helps operators not only to gain better service life for their tools but also to reduce the throughput time in face drilling. The improved control system also helps to increase the speed and accuracy of the boom movements.

Another key feature of Sandvik DD422i is the modern ergonomic cabin. The entirely new design improves visibility during both drilling and tramming, thanks to lower and wider boom support and larger

"Customers truly love this feature."



Alain Comorge, Sandvik product line manager, face drills, bolters and low profile underground drills

windows. The windows and the steel structures of the cabin frame include special acoustic materials that significantly reduce noise levels. Dust levels have also been optimized through careful design and comprehensive simulations. All the controls for drilling and tramming are ergonomically located and freely adjustable by operators according to personal preferences.

"The entire cabin is more open and spacious, and we truly believe that this is the most comfortable underground working environment in the whole industry," Comorge says.

THE THIRD MAJOR feature of Sandvik DD422i is the improved carrier based on the latest available technology.

Smart drilling for future mines

SANDVIK DD422I boasts powerful automation capabilities for the planning, measuring and follow-up of drilling operations based on the Sandvik Intelligent Control Architecture (SICA), which provides commonality with other Sandvik equipment.

The rig is compliant with teleremote control and can be integrated with the AutoMine Drilling system for autonomous drilling operations and thus reduced risk to personnel, better accuracy and higher productivity.

AutoMine Monitoring offers real-time data collection for efficient fleet management and predictive maintenance, while AutoMine Process Management keeps shift supervisors up to date on rig availability, utilization, condition and output and enables optimization of the mining operations. Furthermore, the Iredes v1.0 interface provides compatibility with third-party mine planning systems.





Sandvik DD422i is the first release in the company's upcoming generation of advanced underground drill rigs.

TECH SPECS

Power pack	2 x 75 kW IE3
Diesel engine	Cummins QSB4.5, 119 kW, Tier 3 (optionally Tier 4 F)
Transmission	Hydrostatic
Cabin	FOPS and ROPS
Drilling coverage	10,270 x 6,590 mm
Hole diameter	43–63 mm
Hole length	Max. 5,270 mm
Rock drill	Sandvik RD525
Height	3,145 mm
Width	2,310 mm
Turning radius	7,000 mm (out), 4,050 mm (in) with 12' feed
Operating weight	26 tonnes
Control System	Sandvik Intelligent Control Architecture (SICA)
Automation levels	Silver/Gold/Platinum



► These new solutions include a Tier 4 F engine option for reduced emissions, hydrostatic transmission for better tramping control as well as comprehensive diagnostics, service points accessible at ground level, and light yet durable covers to make the maintenance as easy as possible. The multi-voltage electric system is a novelty that allows relocation of the drill rig from one electrical system to another with minimal changes. A special current reducer unit is an option that can decrease the current draw by up to 20 percent.

In addition, Sandvik DD422i offers an exceptionally wide range of drilling assistance and automation levels to

26
tonnes is the
operating weight
of Sandvik DD422i.

improve productivity and lower costs as well as reduce the training load. The Silver level features the basic measurements of rock drilling, including drilling depth and feed angle. The Gold level has additional capabilities for on-board visualization of the drill plan as well as the market-leading iSure planning, reporting and optimization software. The Platinum level maximizes the automatic face drilling capabilities of the rig.

Platinum, the highest automation level, also includes a new, semiautomatic feature combining both manual and automatic drilling functions.

“Based on feedback from our tests, customers truly love this feature as it’s specially designed to more efficiently

interlink these two ways of operating the rig,” Comorge says. “We already had a strong and reliable drill rig to begin with. Now the advanced automation adds a brain to it.”

The project progressed smoothly, and the first prototype drill rig was unveiled in front of customers in September 2013. From the very beginning, the goal was to build a drill rig that could help mining companies respond to requirements emerging in both the medium and long term.


“Our new Sandvik DD422i development jumbo provides a clear direction to the future of mining, incorporating a host of new features for more efficient drilling,” Comorge says. ■

Text: DALE QUINN Photo: JOSHUA DRAKE

ZEROING IN ON ZINC

■ **VELARDEÑA, MEXICO:** Among arid, sparsely populated hills sits Mexico's most productive zinc mine. Every day, 6,000 tonnes of rock are hauled out of the mine, the bulk of them on 40-tonne Sandvik Mining trucks. Those trucks, and other equipment maintained around the clock by an on-site Sandvik Mining team, keep the mine moving.





IN THE ROCKY hills of northern Mexico, thickly covered with prickly desert brush, an area rich with minerals and mining history is meeting modern technology. Mexican mining company Industrias Peñoles acquired the Velardeña mine in 2005 and is now breathing new life into the region, having discovered a 30-million-tonne zinc deposit there.

To meet ambitious production goals for the Velardeña mine, Peñoles uses six Sandvik Mining trucks to haul thousands of tonnes of zinc out of a section of the underground mine that stretches across two kilometres and descends 200 metres into the earth. The company also uses 15 Sandvik underground loaders, seven mining

jumbos to drill through rock and three rock support drill rigs to support the mine as it is excavated. On top of the equipment, Sandvik has a service and maintenance agreement with Peñoles to ensure all the machinery is constantly running efficiently. The relationship has proven valuable.

“Having the maintenance done by Sandvik, with its own mechanics, gives us an assurance of proficiency, and we don’t have to worry about the upkeep of the equipment,” says Hugo Alberto Palacios Martinez, general manager at Peñoles. Palacios Martinez oversees all operations at the Velardeña mine, and he believes the service programme is a big part of the mine’s successful operation.



About Industrias Peñoles:

● Peñoles, a Mexican mining and chemicals group owned by the business conglomerate Grupo Balcón, is the world's largest producer of refined silver and metallic bismuth. It's also a major producer of zinc and sodium sulphate and a leading regional producer of gold and silver.

Its operations include nine underground mines, two open pit mines and the refining complex Met-Mex Peñoles in the Mexican state of Coahuila. The Mexico City-based company was founded in 1887. It started operations at the Velardeña mine in May 2013, and the site has quickly become the country's leading producer of zinc.



Hugo Alberto Palacios Martínez, general manager at Peñoles, believes the service programme is a big part of the mine's success.

“Having the maintenance done by Sandvik, with its own mechanics, gives us an assurance of proficiency.”



The crew of Sandvik employees on site help the mine, and its equipment, run smoothly.



▶ With its fleet of six Sandvik TH540 trucks, Velardeña is the first Peñoles mine to use the low-profile trucks.

“For us it’s something new,” Palacios Martinez says. “We’re the first Peñoles mine in Mexico using this type of vehicle. Normally traditional 20- to 30-tonne trucks are used.”

Because Sandvik technicians are on hand around the clock, the 40-tonne capacity trucks are always ready to haul zinc out of the mine faster, requiring fewer trips to meet the mine’s high production demands.

Upon entering the modern Velardeña mine site, the company’s commitment to safety and efficiency becomes readily apparent. Productivity is evident immediately as truck engines hum constantly and crushed rock pours continuously into a massive dome that helps reduce dust at the site as minerals are pulverized before making the trip to the company’s refining complex in Torreón.

Some 200 metres below the earth, on the mine’s seventh level, Sandvik has a

workshop where workers provide preventive and corrective maintenance. In contrast to some of the darker tunnels, the workshop is a brightly lit underground oasis, with even some potted houseplants adding a bit of green to the atmosphere.

“As part of the service agreement, Sandvik has three groups of about 10 technicians who take shifts working in the mine,” says Daniel Calderon, Sandvik contract supervisor at Velardeña.

Given that the mine is in constant operation, Sandvik employees are key to making sure that downtime doesn’t hold up productivity.

“We provide support service to the equipment all the time to maintain it and ensure that it’s always available,” Calderon says.

That aspect is crucial for Peñoles.

“One of the challenges for the mine is maintaining its production goal of 6,000 tonnes every day,” says mine supervisor Gabriel Duran Lopez, who manages Velardeña’s underground operations.

30
million tonnes
of zinc were
discovered at the
Velardeña mine.

Not only do Sandvik trucks haul heavier loads than traditional ones, they also fit better and manoeuvre more effectively in the underground caverns.

Because it takes fewer trucks to carry material out of the mine to be pulverized up in the massive dome, that means fewer vehicles are spewing emissions into an enclosed space. Also, with the Sandvik crew helping to keep them running safely and efficiently, drivers have more confidence when handling the equipment.

“My crew doesn’t necessarily have the expertise to provide all the needed

SANDVIK EQUIPMENT AT VELARDEÑA

- 11 Sandvik LH410 underground loaders
- Six Sandvik TH540 underground trucks
- Six Sandvik DD311 mining jumbos
- Three Sandvik LH517 underground loaders
- Two Sandvik DS310 rock support drill rigs
- One Sandvik LH307 underground loader
- One Sandvik DS311 rock support drill rig
- One Sandvik DD310 mining jumbo



“For us it’s something new.”

▶ maintenance to Sandvik equipment, and for that reason it’s beneficial to have the Sandvik team on hand to tune up their own equipment,” says Luis Sifuentes Diosdado, head of maintenance, Peñoles.

That service is of utmost importance for someone like Maria Isabel Avila Torres, who drives one of the trucks hauling minerals out of the mine. “Driving a vehicle of that size was challenging at first,” she says. “And while it’s still not necessarily easy, I’m able to live up to the task with the training I’ve received.”

Safe driving in the tight confines of the mine is crucial, and knowing that the Sandvik team has provided complete service adds to her confidence.

Avila Torres’s hometown is Velardeña, the village that sits directly beside the mine, and she says Peñoles has played an important role in the community, giving people job opportunities that otherwise wouldn’t exist.

“It’s very important because right now there’s no other employment,” she says.

On a global level, Mexico is among the world’s top 10 producers of zinc. Last year, before Velardeña completed its first year of production, Mexico was the

world’s seventh-largest zinc producer, according to the US Geological Survey’s Mineral Commodity Summaries 2014. Ultimately, that zinc will become a key component in providing corrosion protection for galvanized steel or an important ingredient in many nutritional supplements, as the mineral is necessary for the healthy growth of humans, animals and plants.

Mining isn’t new in Velardeña, an area with deposits of lead, copper and gold, and the small village there is largely dependent on the mining economy.

“It’s been more than 400 years since the discovery of ore here, and it has been worked on in different eras, from the Spanish colonial era to the present,” Palacios Martinez says.

The mine is situated in an arid, sparsely populated, geologically diverse area in the Mexican state of Durango, just across the state line from Coahuila where the Peñoles refining complex is located.

Peñoles and Sandvik both work hard at Velardeña to use the latest technology to extract valuable materials from the earth in a cost-effective manner, but an essential component is people. While providing hundreds of jobs for locals who otherwise might not have one, the



One of the challenges for the mine is maintaining its production goal of 6,000 tonnes every day.




See videos about the Velardeña zinc mine at minestories.com

mine aims to create a safe working environment for those workers and reduce the environmental impact on the area.

These values are carried throughout the work of Industrias Peñoles and Sandvik, and they are clearly evident at Velardeña. ■



Technological transformation



■ Faced with an industry-wide slowdown, mining companies are abandoning their traditional business models and embracing new technologies and ways of working.

Text: **ALANNAH EAMES** Illustration: **BORG.NU**

A **NEW SURVEY BY** Accenture confirms what is commonly known; the mining industry has increased its investments in digital and automated solutions in recent years. The global management consulting company predicts this trend will continue as companies invest in new technology to improve their operations and maintain a competitive edge.

Accenture based its findings on a survey of executives at 40 metals and mining companies in the US and Canada. The results clearly show that, despite the economic downturn, 25 percent of mining companies have doubled their technology investments since 2010. Almost all the companies (93 percent) said they were satisfied with the payback on their digital investments. Only 5 percent said they would not increase their technology investments over the next three years. Ninety percent of the survey's participants believed that adding technology to their operations adds value and revolutionizes their business.

The majority of these investments are in equipment automation and in integrating software and equipment to

improve safety, security and surveillance. According to the survey, the next wave of investment will be in integrating all the different systems used in the mine.

Jose J. Suarez, Accenture's managing director mining (North America), led the survey. He is also responsible for all of Accenture's mining capital projects globally.

"I grew up in the mining business," he says. "I've been around crushers, mills and mines all my life."

Suarez studied civil and mechanical engineering, later becoming an officer in the US Navy before returning to his roots in mining.

"I've seen a lot of mines around the world during my career, and I've always seen technology as a way to help us make better decisions," he says. "I am very excited about this trend toward digitalization."

Digitalization and automation of the mining industry is not a new phenomenon, but it is picking up speed. Suarez refers to a recent presentation by Mark Cutifani, the CEO of mining group Anglo American, who made headlines when he said what many others have thought for years: that mining has been

25

percent of mining companies have doubled their technology investments since 2010.

slow to react to new technological developments compared with the oil and gas industry, for example.

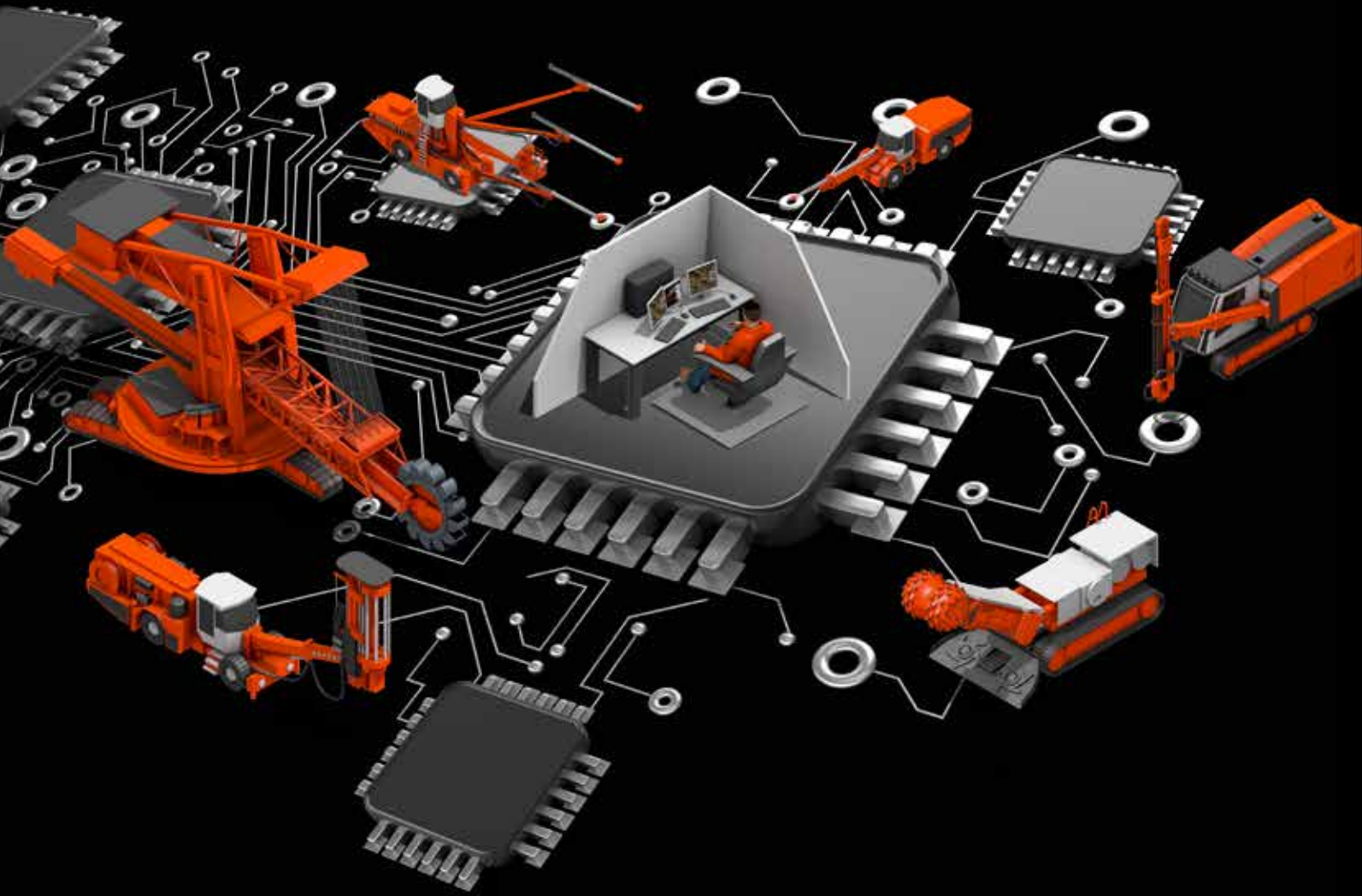
"Mining has been doing things the same way for the past half century, but we need to move forward," Suarez says.

MINING COMPANIES ARE open to change, he believes, but technology must be implemented one step at a time.

"You need time and training to make changes," he says. "For example, using mobile devices to diagnose the condition of equipment is a fantastic idea, but some personnel will adapt to this technology quicker than others. And, as mining operations become more technical, miners will need to be trained to adapt to changing industry needs."

Suarez believes that besides the cost and productivity improvements that come from the automation and

"I'm very excited about this trend toward digitalization."



digitalization of mining operations, safety is a key concern.

“Most mining companies I meet have a tremendous care for safety, not because of their bottom line but because they have a corporate responsibility,” he says. “They want to be a good contributor to the community so that people can return home safely every night.”

THERE'S ANOTHER HUMAN aspect to the need to turn to automation and digital solutions.

“Mining has an ageing workforce, so finding replacements for people retiring will be a challenge,” Suarez says. “That means the industry has to look at what automation can do to optimize human resources for operations.”

Even though this survey focused mainly on North American and Canadian players, the trends and findings are influencing the industry worldwide.

“For example, in Australia’s mining

industry, they typically have high labour costs and an issue with finding qualified staff, so they need to adopt automation a lot quicker,” he says. “The motivation in other regions may be a little less. Right now, I believe North American companies are at the forefront.”

Suarez says Accenture is currently expanding the survey to the other regions. He believes the technological developments in mining are unavoidable.

“Five to 10 years from now, you will see mines being operated remotely with a much higher level of safety performance,” he says. “Availability of data will make it easier to make decisions on which mines to operate and which to throttle down. The markets will have even more confidence in mining industry performance. But companies need to embrace technology sooner rather than later. If they don’t, they risk facing extinction.” ■

Sandvik comments:

Riku Pulli, vice president mine automation

● “Sandvik Mining has been pioneering and promoting mining automation and digitalization for more than 15 years, so it is really easy for me to agree with the report’s findings. Today, our customers report significant benefits that have been achieved with our AutoMine products – no lost time injuries, a significant increase in fleet utilization rates, real-time control and visibility of their mining process. These benefits have made the workplace much more attractive and produced more tonnes with lower costs.

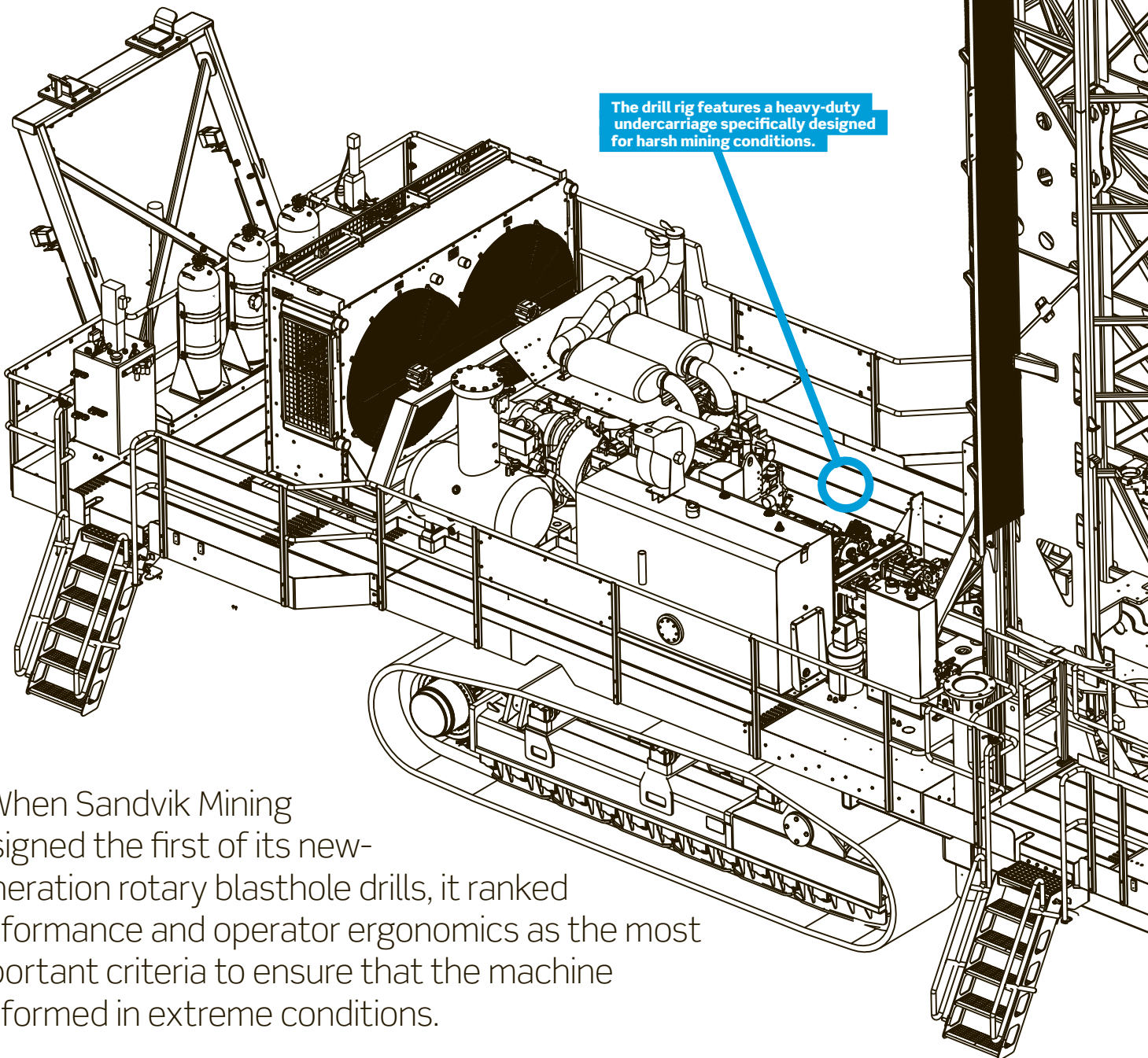
“Our products are continuously being developed to become smarter – not only to make the operators’ jobs easier, but to enable seamless integration and communication with the rest of the mining process. This provides our customers with a solid platform to boost overall safety and productivity. Revolutionizing mining, however, starts with the people. This means interacting closely with our customers and providing smart services that allow them to optimally design their production processes, offering support throughout the life cycle of the mine.”



Riku Pulli, vice president mine automation

AN EXTRAORDINARY DESIGN FOR

EXTREME CONDITIONS

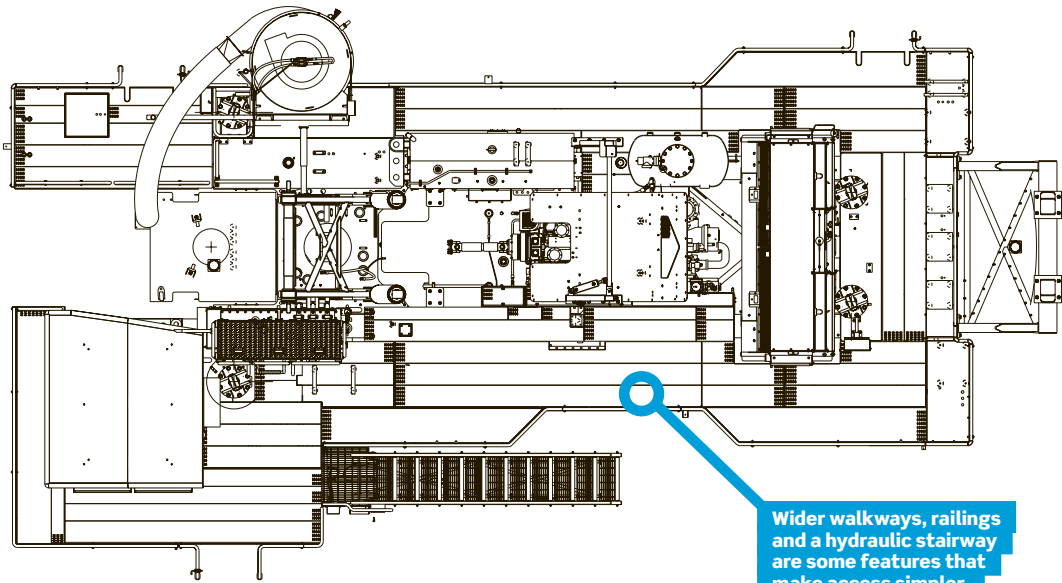


The drill rig features a heavy-duty undercarriage specifically designed for harsh mining conditions.

■ When Sandvik Mining designed the first of its new-generation rotary blasthole drills, it ranked performance and operator ergonomics as the most important criteria to ensure that the machine performed in extreme conditions.

Text: **TURKKA KULMALA**

TOP VIEW



The rotary drill rig uses a CAN-bus hydraulic system, including a particle counter that monitors contamination in the hydraulics.

Wider walkways, railings and a hydraulic stairway are some features that make access simpler.

The new ergonomically-designed cab includes controls on the armrests, touchscreens, angled windows to reduce glare and a 'safari roof,' which keeps the cab cooler.

THE GIGANTIC man-made holes known as open pit mines are as spectacular as they are extreme. Serious machinery is needed for the vast amount of earth moving that goes on in mines that operate around the clock, often in remote areas where the weather can be blisteringly hot or frigid cold. It is in these kinds of environments that much of the most advanced Sandvik Mining equipment, including its new DR461i rotary drill rig, finds a natural home.

Sandvik DR461i was developed from the current Sandvik DR460 drill rig that is produced in Alachua, Florida, in the US. Sandvik DR461i is a diesel-powered, self-propelled crawler-mounted blasthole drill for bulk mining operations. It is intended for use around the world, and is equally at home in mines from Africa to North America.

SANDVIK DR461I is equipped for drilling in rotary or DTH (down-the-hole) configuration for 229 to 270 millimetre (9 to 10-5/8 inch) diameter holes. Sandvik DR461i is a rugged design ideal for drilling in hard rock applications.

"Rugged though the new machine is, our concern has been to pay a lot of attention to operator ergonomics as well as create a layout that makes service and maintenance as safe and simple as possible," says Ken Stapylton, vice

president Surface Drilling. He notes that it took Sandvik design engineers some 18 months to design and build a prototype.

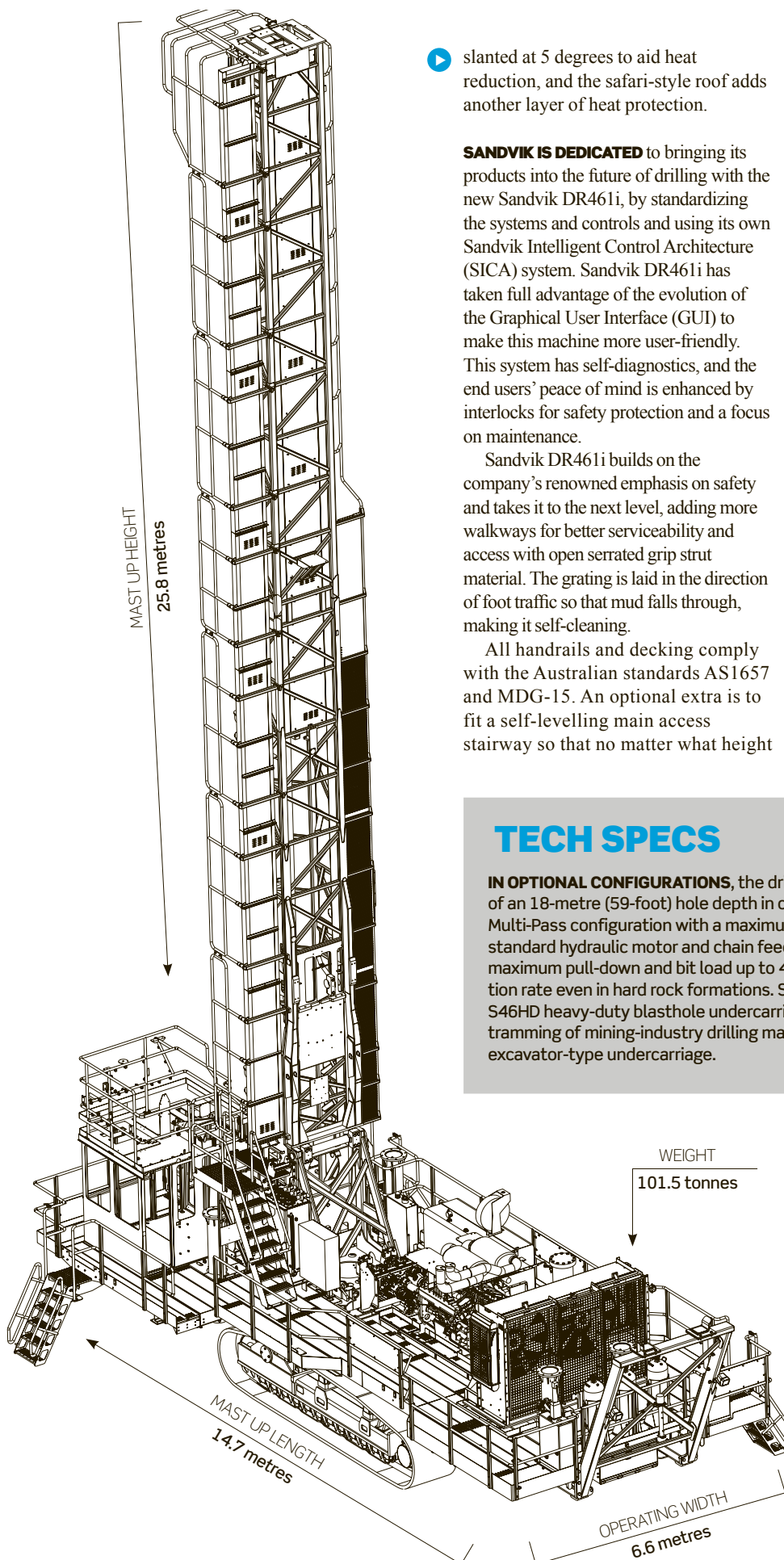
"Our ambition from the start was to deliver maximum peace of mind to the owner by ensuring they got a more energy-efficient machine that performed consistently over its operating life," Stapylton says.

Sandvik DR461i boasts the company's patented Compressor Management System (CMS) that matches the air supply to the required demand, but not as a mechanical function that generates significant amounts of heat. The CMS is an innovation that delivers up to 30 percent improvement in fuel efficiency as well as a longer working life as wear and tear is reduced.

ONE CLEAR COMPETITIVE advantage delivered by the new Sandvik DR461i over competing rotary drills is its ergonomically designed cab with "all in the seat" drilling and tramming controls that maximize operator comfort and productivity, day in and day out.

"Operators tend to work 12-hour shifts, so it is vital we make life as comfortable and easy as possible for them and thereby increase their efficiency," Stapylton says. Operators sit in a FOPS-certified (falling object protective structure) operator's cab. The cab is air-conditioned and pressurized, with sound insulation to 80 dB(A) or less. It boasts fully tinted windows

"Our ambition from the start was to deliver maximum peace of mind to the owner."



- ▶ slanted at 5 degrees to aid heat reduction, and the safari-style roof adds another layer of heat protection.

SANDVIK IS DEDICATED to bringing its products into the future of drilling with the new Sandvik DR461i, by standardizing the systems and controls and using its own Sandvik Intelligent Control Architecture (SICA) system. Sandvik DR461i has taken full advantage of the evolution of the Graphical User Interface (GUI) to make this machine more user-friendly. This system has self-diagnostics, and the end users' peace of mind is enhanced by interlocks for safety protection and a focus on maintenance.

Sandvik DR461i builds on the company's renowned emphasis on safety and takes it to the next level, adding more walkways for better serviceability and access with open serrated grip strut material. The grating is laid in the direction of foot traffic so that mud falls through, making it self-cleaning.

All handrails and decking comply with the Australian standards AS1657 and MDG-15. An optional extra is to fit a self-levelling main access stairway so that no matter what height

the machine is sitting at, the steps stay parallel to the ground.

Sandvik DR461i has been designed with various safety standards and best practices from around the world firmly in mind. These include MDG 15 and 41 (Guideline for Mobile and Transportable Equipment in Mines, New South Wales), EMESRT (Earth Moving Equipment Safety Round Table) and CE (Conformity Marking for products sold in the European Economic Area). A further benefit for owners and operators is that Sandvik DR461i shares components with the supplier's well-established existing underground drills, which will speed and ease service and maintenance.

"We realized operator comfort has the potential to deliver great dividends for our customers, and that's one reason our new machine enables closer interaction between operator and machine," Stapylton says. "Sandvik DR461i has proven technology that we're convinced will make it a natural first choice for any owner seeking improved machine and operator efficiency." ■

TECH SPECS

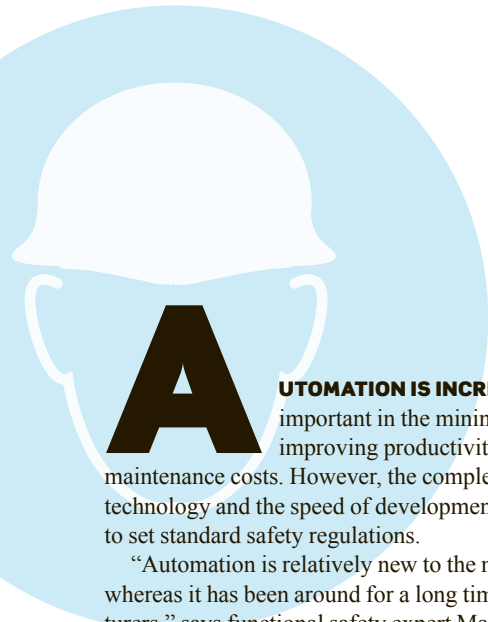
IN OPTIONAL CONFIGURATIONS, the drill comes as a Single Pass drill capable of an 18-metre (59-foot) hole depth in one pass. The drill is also offered in a Multi-Pass configuration with a maximum depth of 75 metres (246 feet). The standard hydraulic motor and chain feed delivers up to 356 kN (80,000 lbf) maximum pull-down and bit load up to 400 kN (90,000 lbf) for great penetration rate even in hard rock formations. Sandvik DR461i uses the new Sandvik S46HD heavy-duty blasthole undercarriage designed specifically for the tramming of mining-industry drilling machines, as opposed to the traditional excavator-type undercarriage.



On the safe side

- Automation is sweeping the mining industry, enabling ever more productive applications. But how can safety standards keep up?

Text: ANNE MARGRETHE MANNERFELT Photo: MINCO PHOTOGRAPHY



A

UTOMATION IS INCREASINGLY

important in the mining industry, improving productivity and reducing maintenance costs. However, the complexity of the technology and the speed of development make it difficult to set standard safety regulations.

“Automation is relatively new to the mining industry, whereas it has been around for a long time for car manufacturers,” says functional safety expert Marcus Punch.

Mining can be much more complex than other industries, Punch says. “Therefore, a generic approach is better suited to it,” he says. “There are different techniques for coal, copper and gold, for example. There are also cultural differences that come into play. A mining company needs to work out what works for each organization.”

Each application needs its own safety requirements, rather than a solution for all automation. Punch believes that the standards will evolve as mining automation technology becomes more developed.

As a functional safety expert, Punch works closely with a range of mining companies. “I guide system integrators and people using equipment through the terminology and the myriad requirements of the various machinery safety and functional safety standards,” he says.

FUNCTIONAL SAFETY DICTATES the process whereby hazards are identified and controls, which rely on an electronic system, are put in place. There are a number of standards, but Punch says none of them provide a stand-alone safety framework for every industrial application. For complex projects, automation in particular, a mix of standards may need to be applied.

Because of the increasing use of automation in mines in Western Australia and the lack of regulation around this relatively new technology, a working group has been formed, facilitated by the Western Australia Mines Department. In a report, the group says that since automation is not regulated, incidents have gone unreported through the process that governs normal equipment or mine-related incidents. To get better regulation, the group has collected these incidents in one place.



Marcus Punch,
functional safety
expert

Punch’s advice is to use frameworks while standard safety regulations are being developed. “Functional safety provides a framework in a risk-based manner,” he says. “Mining automation is still a fairly new technology, and there are also big differences between countries and individual mines. Therefore, it is easier to work with a framework, and



With new automation techniques, operators can remotely monitor a fleet of driverless mobile equipment, which increases safety.

“Functional safety provides a framework in a risk-based manner.”

each mine can work out the details. A general framework can be developed and then tweaked for each application.”

The main focus when safety regulations are developed is knowledge. “The project managers and engineers are very knowledgeable and know what needs to be in place,” Punch says. “However, that knowledge needs to be shared with senior management. Otherwise it is hard to get the right budget and order of priority. Important stuff will be neglected in the development process if the decision makers are not sure what is needed. You can’t create standards that don’t work for the people actually operating the automated systems.” ■





Automation in mining is relatively new, so each application needs its own safety requirement.



In pursuit of safety legislation

ENSURING SAFETY for all equipment users and for the environment is a top priority for Sandvik Mining. New automation techniques create challenges and demand work from several stakeholders. With the technology being so complex as well as developing at such a rapid pace, it makes it difficult for safety standards to keep up. At present there really are no current standards available for mining automation.

"Standards are normally generated based on what has come to be known and accepted as industry 'best practice,' and it takes time for the technology to mature, become widely used and be classed as proven technology within the mining industry," says Ashleigh Braddock, vice president development and safety, automation and technology, Sandvik Mining. "The rate of change of these technologies is normally much faster than what legislation can keep up with."

SANDVIK MINING IS determined and persistent in its efforts to do everything it can to improve safety around all processes and work environments. "A working group was formed in 2007 to generate an International Organization for Standardization (ISO) standard," Braddock says. "All of the major OEMs who provide autonomous equipment participate. However, this is still in progress and unlikely to result in a finalized standard before 2015."

IN THE ABSENCE of a standard, Sandvik Mining has used the functional safety standards IEC 61508, IEC 62061 and ISO 13849, which are used to fulfil both Australian and European legislation when designing programmable electronic safety-related systems. "Sandvik is unique in its offering of automation products because we design the safety-related parts of the system such as the Access Control System to this standard," Braddock says.

The Access Control System isolates the autonomous area from the safe area where people are located by using dual light barriers that are armed before the system can be started. If these are tripped during operation by either a machine or pedestrians, the machines in that area are stopped, preventing any possible contact between the autonomous machine and a human being.



Ashleigh Braddock, Sandvik vice president development and safety, automation and technology.

CSIRO at a glance

- The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia's national science agency. It has 11 research divisions, including earth science and resource engineering. Founded in 1926, it now has more than 50 sites and 6,600 employees across Australia and overseas. This study focused on eucalyptus and acacia trees in the mining-rich Kalgoorlie region of Western Australia and in sand dunes in the southern part of the country. CSIRO's findings were published in the journal Nature Communications. The research was partly sponsored by the Australian Mineral Institute Research Association.

Microscopic image of a gum leaf showing gold, copper and strontium.

GOLD LEAF, AU NATUREL

The Australian national science agency has published its discovery that eucalyptus trees absorb gold through their deep roots and excrete it through their leaves and bark.

Text: **ALANNAH EAMES**

AUSTRALIAN RESEARCHERS have found traces of gold in the country's eucalyptus trees, but don't expect a modern-day gold rush. First of all, the tree needs to sit atop a gold deposit. In addition, the amount of gold found in the leaves is minuscule – “nuggets” one-fifth the thickness of a human hair. This means it would take gold from 500 large eucalyptus trees growing directly over a gold deposit to produce enough gold for a wedding ring. A special detector, such as the high-tech Maia system used by Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), is also required to spot the gold. After all that, the exploration samples can be routinely measured in most analytical laboratories.

Even though miners won't get rich by tapping into these trees, the discovery could offer companies an alternative exploration method to drilling, since eucalyptus trees are so common across Australia.

“Analyzing the mineral content of leaves and bark could prove a more cost-effective and

environmentally friendly way of locating and assessing mineral deposits, particularly for smaller mining companies with less capital and equipment,” says Dr. Mel Lintern, who headed the research team.

Since the 1980s, CSIRO has been researching how trees – in particular, eucalyptus and acacia trees – absorb metals and minerals. Using samples from the leaves of eucalyptus trees can indicate the levels of gold ore in the ground beneath. It is a useful technique in areas with deep river sediments, sand dunes and weathered rock, where it is often difficult to see the minerals through the cover.

Some mining companies have already incorporated tree sampling into their exploration activities, Lintern says. Tree sampling is being used in thick forests in Canada and Russia, as well as in South America where bringing in drill rigs can be difficult. “The next step for us now is to merge our results into a robust technique that exploration companies can use, including for other metals like zinc and copper,” he says. ■

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ENVIRONMENT, HEALTH AND SAFETY (EHS)

Stay safe. Our objective is zero harm to people and the environment. EHS is a fundamental consideration in all Sandvik operations, especially product development. Our ambition is to provide the safest products on the market. From our emission-reducing Compressor Management System for surface drills to fire protection on a range of equipment, our products are designed to improve the environment and reduce health and safety risks in our customers' operations.



DRILL RIGS AND ROCK DRILLS

Know the drill. Sandvik rock drilling equipment is renowned for quality, reliability and productivity. Every machine we make is designed to give the lowest possible cost per metre drilled and a low life-cycle cost. To meet the needs of all customers, we offer a wide choice of machines, ranging from robust and simple drill rigs to semi-automated units that give extraordinary production rates and low total cost.



LOAD AND HAUL MACHINES

Reliable LHDs and trucks. Sandvik underground loaders and haul trucks are engineered for safety, productivity and reliability in the toughest of applications. Rugged, compact and highly manoeuvrable, the ergonomic products offer enormous capacity for their size and return a very low cost per tonne.



CONTINUOUS MINING AND TUNNELLING

Always advancing. Sandvik continuous mining and tunnelling equipment reflects the unique advantages of total in-house control over the machines and their cutting tools alike. Optimized cutting technology and machine design result in high productivity, long service life and low total costs.



CRUSHERS AND SCREENS

Maximum size reduction.

Sandvik crushing and screening equipment is engineered for productivity. We offer advanced solutions for any size-reduction challenge, stationary or mobile. We can upgrade existing plants, deliver complete solutions and effect turnkey installations. We also supply individual crushers and screens, as well as key components and a wide range of consumables.



CONVEYOR COMPONENTS

Ready to roll.

Our complete components offering supports modern conveying practices in mining and includes rollers and frames, idlers, pulleys and belt cleaners, condition monitoring and safety control devices and loading sections. With an emphasis on performance and reliability, products are easily available through the global Sandvik network both as original components and as replacements in existing systems.



BULK MATERIALS HANDLING EQUIPMENT

Total handling. Sandvik has the long-term experience to design, manufacture and install virtually any kind of bulk materials handling system. From mining systems on surface and underground to integrated stacking and reclaiming systems for mines, terminals and port facilities, we offer total solutions and turnkey installations. We also offer a wide range of conveying equipment and quality components for plants, as well as upgrading and modernization services.



SERVICES

Peace of mind. Our technicians are highly skilled in best practices to safely maintain and optimize your equipment, ensuring you get the most out of your capital investment. Our primary focus is to provide support and keep you operating and more productive. By signing up with Sandvik, you get the capabilities of a global industry and service leader delivered directly to your site, providing peace of mind and enabling you to focus on your core business.



MINE AUTOMATION

Complete control. The Sandvik AutoMine product family covers all aspects of automation, from single equipment to full fleet control. In the safety and comfort of a control room, operators can simultaneously control and monitor the movements of a fleet of driverless loaders, trucks or drill rigs. By adding remote monitoring and process management capabilities, supervisors are able to directly communicate with equipment and operators from wherever they are working.



ROCK TOOLS AND SYSTEMS

Deep impact. Sandvik offers the world's most comprehensive range of tools for exploration, rock drilling, raise boring, coal cutting, mineral mining, tunnelling, trenching, road grading and cold planing. As world leaders in steel and cemented carbide technology, our products have revolutionized the rock drilling industry, while our advanced tool systems for machines raise productivity sharply.





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LOW CONSUMPTION WAS YESTERDAY'S NEWS. READY FOR THE FUTURE? THIS WAY!

Sandvik drill rigs have been developed for maximum cost-efficiency for decades. Still living by the same rule when it comes to consumption, we developed a percussive drill platform that will elevate surface drilling to a whole new level. Built to meet the needs of tomorrow's mining industry as well as future requirements for automation, the new PANTERA™ is an intelligent, forceful and safe drill with variants for both down-the-hole and top hammer drilling. Designed for enhanced drilling efficiency, lower cost per metre and reduced environmental impact, it stands for utmost productivity.



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