

SOLID

#2 2018

GROUND

A MAGAZINE FROM
SANDVIK MINING AND ROCK TECHNOLOGY

Iceland:
**Beyond
penetration rate**

OptiMine Analytics:
**Predictive
productivity**

Sustainability:
A friend in need

Canada: Hecla Casa Berardi

Update and automate

Dear reader,

INNOVATION IS ONE OF our Sandvik core values – as you’ll discover by reading the latest issue of *Solid Ground*. For example, we’re looking forward to the opening of our new Rock Drills Innovation Center in Tampere, Finland, bringing state-of-the-art production and testing facilities to further strengthen our extensive rock knowledge and drilling technology expertise.

For any technology to be fully accepted, it must be customer driven. We recognize your ever-increasing demand for improved safety and reduced costs, and we consider that with every new solution – for example, we used extensive customer feedback in the design of the new Sandvik LH517i loader, featuring ease of maintainability and good operator ergonomics.

One of our key focus areas is digitalization. A recent survey by BCG indicates that four types of innovation have grown in importance, all of which are related to digitalization:

- Big data analytics
- Fast adoption of new technologies
- Mobile products and capabilities
- Digital design.

It’s not enough to add intelligence to our mining equipment and rock tools – we need to help you make sense of the data it provides. The My Sandvik portal is designed to turn equipment data into easy-to-use knowledge. Once again we use customer input to help us in the ongoing development of the reports provided.

Customer focus is another of our Sandvik core values, and we encourage you to read about that from the perspective of mine operators around the world:

- How we’re supporting Hecla’s Casa Berardi gold mine on its automation journey
- How OptiMine Analytics is helping Petra Diamonds improve productivity
- How leading Russian coal producer SUEK is setting records with Sandvik bolter miners.

And in everything we do, **safety** is our No.1 priority. As summed up by one of our customers: “Our employees being able to go home safely to their families after every shift, that’s most important.”



LARS ENGSTRÖM
PRESIDENT, SANDVIK MINING
AND ROCK TECHNOLOGY

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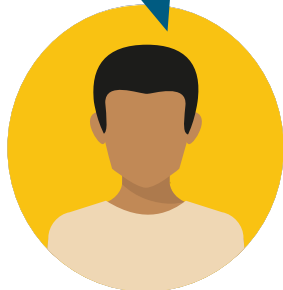
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Email and distribution enquiries email: solidground@sandvik.com
Internet: solidground.sandvik.com

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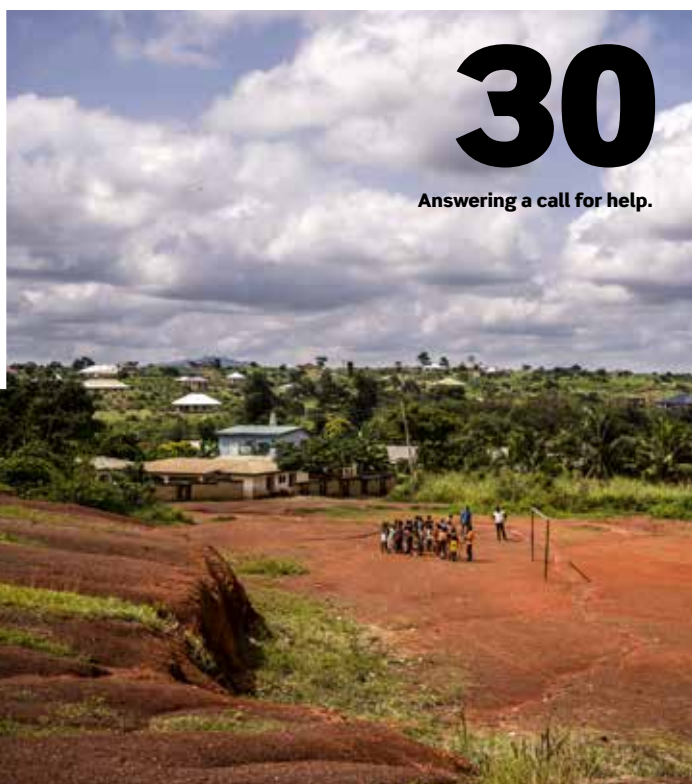
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Innovation station

▶ A new Rock Drills Innovation Center will open in 2019 at the Sandvik site in Tampere, Finland. The Innovation Center will introduce state-of-the-art production and testing facilities for a core Sandvik technology - the rock drill.

The Rock Drills Innovation Center will be home to extensive rock knowledge and drilling technology expertise, creating a hub for innovation. It will complement the existing world-leading drilling technology competence centre, and will consist of an R&D centre, an underground test mine with laboratories, a modern factory environment and university cooperation. The Rock Drills Innovation Center provides an opportunity for Sandvik customers to get a sneak peek at the development and production of Sandvik rock drills. It will also host customer events that take visitors on a journey from the origins of rock drilling technologies to the future of the industry.



Rewarding commitment

▶ Independent research firm Verdantix has awarded Sandvik Group its 2018 International Health, Safety and Environmental (HSE) Innovation prize under the Mining and Metals category. The award recognizes organizations that are instrumental in launching innovative technologies to ease the management of HSE and deliver superior results. Sandvik was awarded for creating an EHS performance league table for multiple business units, which has resulted in improved hazard close-out rates, annual EHS plan completion and compliance with Sandvik's EHS standards.

On track for platinum

▶ Sandvik and Anglo American, the world's leading producer of platinum group metals, have been working together on the development of Sandvik PM100F for more than five years. The new mobile continuous conveying system is around 86 metres long and can handle up to 100 tonnes per hour.

The conveyor system is designed to continuously follow a rock cutting machine as it advances, and can even negotiate 90-degree bends. It's suitable for a variety of applications, and helps improve safety as well as reduce the emission of harmful fumes, as no shuttling transport vehicles are needed.



Sandvik and Anglo American collaborated to develop Sandvik PM100F, a mobile conveyor system.

Russian handover

▶ The Russian city of Novokuznetsk hosted the Ugol Rossii & Mining 2018 exhibition in June, dedicated to mining equipment and technologies. The widely known international event brought together more than 600 equipment suppliers and 35,000 professionals from 24 countries.

At the event, Sandvik showcased a flagship Sandvik MB670-1 bolter miner purchased by SUEK-Kuzbass JSC. The unit was handed over to the customer for deployment at the Yallevskiy mine. The 105-tonne electric track-mounted bolter miner is known for its quality engineering and high performance capabilities. In 2016 its predecessor Sandvik MB670 established a monthly record of 1,272 metres at the Taldinskaya-Zapadnaya-2 mine.

"Sandvik Mining and Rock Technology is a frequent guest at the Ugol Rossii & Mining exhibition," says Roman Tonyshev, sales area business line manager for mechanical cutting. "Equipment handover during the event has become a tradition for us. Besides, it is a perfect place to meet new customers, share experiences with industry professionals and demonstrate our latest achievements in mining tools and equipment development."



Forty years young



▶ The Rammer brand of hydraulic hammers, part of the Business Unit Breakers, celebrates its 40th birthday this year. Several events marked the anniversary of this enduring brand, including one at the breaker factory to commemorate delivery of the 3,000th pedestal-mounted boom.

In addition to this, Rammer now has an updated range with two new extreme duty breaker booms, making it easier for customers to find the right breaker boom for their needs. These new booms have a higher raking capability, which reduces wear and tear on parts, as well as wider coverage and service access, which increases production rates whilst reducing operating costs. The Rammer brand originated in 1978 in Finland, and it has been a part of Sandvik since 1998. The product line has seen a number of significant developments over the years, many of which have become established as industry standards, including constant blow energy, idle blow protection and automatic lubrication.

Plate performance

▶ AngloGold Ashanti is one of the world's largest gold producers, and the Crixás unit in Goiás, Brazil, wanted to further improve its performance as well as improve the safety of its employees. With that in mind, AngloGold Ashanti installed Sandvik HX900 wear plates, a tungsten carbide model, on site in August 2016.

After 13 months of operation, Sandvik HX900 had a result 26 times greater than the hardened steel equivalent, and by early 2018 the plates were still in operation after more than 500 days of service. In addition to exceeding performance expectations and reducing operational costs, the plates also reduce the risk exposure of workers, and fewer interventions are needed.

Sandvik HX900 wear plates had results that were 26 times better than hardened steel.



Eastern partners

▶ Sandvik Mining and Rock Technology has secured a strategic partnership agreement with Kolmar. Located in the Neryungri District for the Republic of Sakha, the Russian coking coal miner and processor is a major contributor to infrastructure development in the region, and is currently engaged in the largest investment projects in the Far Eastern Federal District.

The agreement covers the development and maintenance of strategic partnerships and piggybacks the provision of Sandvik equipment, including Sandvik MC430 double pass miner and Sandvik TS490-1 underground shield hauler—the first such hauler supplied to Russia—at the new section of the company's Denisovskaya mine.

THE QUOTE

“When our customers choose us to process data on their behalf, we don't take it lightly. Access to data needs to be defined and restricted, because it is often operator related and commercially sensitive.”

Manny Maloney, general counsel at Sandvik Mining and Rock Technology, on data interoperability.

Real-time analysis

▶ Sandvik has developed and launched a new technology for top-hammer drilling that is set to mark the beginning of a new era – RockPulse. This add-on system integrates directly with the rock drill and its control system, and it is the first practical solution for real-time tool stress monitoring, as well as enabling drilling process optimization in varying rock conditions.

Ensuring profitable rock drilling involves striking a fine balance between cost and efficiency. RockPulse assists by analyzing each piston blow in real time, measuring the stress on the tool and allowing the operator to optimize based on the data. Tests have shown up to a 5 percent increase in average penetration rate, along with a noticeable decrease of 4 percent in percussion power. This technology also helps optimize bit regrinding intervals, which boosts efficiency and productivity.

Excavating excellence

Czech contractor Metrostav is on track to meet the planned opening of a road tunnel in remote north-western Iceland, thanks to the record-breaking performance of a Sandvik DT1131i tunnelling jumbo and iSURE tunnel management software.

Text: DAVID NIKEL Photo: ADAM LACH



The team at Metrostav partnered with Sandvik to meet its 2020 tunnel completion date.

CZECH CONTRACTOR METROSTAV

recently achieved a record-breaking 105 metres of tunnel excavation in just six days. While records are nice to set, it's the consistent performance and progress that should see the Dyrafjardurgong tunnel – a vital transport link for this remote corner of Iceland – open on time and on budget.

When complete, the 5.3-kilometre Dyrafjardurgong tunnel is set to make the biggest impact on the regional

economy since the opening of the 9.1-kilometre Vestfjardargong tunnel in 1996. As such, the entire community is keeping a close watch on how the 69-million-euro tunnel is progressing by way of weekly updates to a Facebook page. So far, residents like what they see.

The road is due to open in September 2020, and Metrostav is well on its way to meeting that target. Josef Malknecht, Metrostav project manager, explains that the operation is a numbers game with many variables.

“WE WORK AROUND the clock in shifts, six days a week,” Malknecht says. “Each round of planning, drilling, charging, blasting, clearance and reinforcing takes around seven hours. We have completed a round in as little as 6 hours and 16 minutes, and we aim to achieve a minimum of five metres progress on each round.”

To achieve its targets, Metrostav needs a drilling jumbo capable of consistent performance with a minimal interruption. While the record-breaking week of 105 metres was welcome, Malknecht explains that consistent progress is the most important goal, because with a single-face operation,

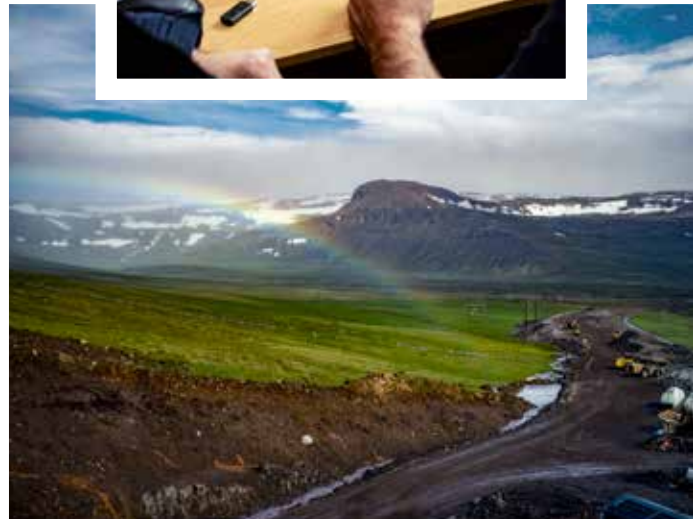
any equipment problems bring the entire operation to a halt.

“We plan for 80 metres progress per week, but our goal is to achieve consistent weekly progress of 90 to 95 metres over the long term,” he says. “Time is short, and any breakdown can undo weeks of good progress, so for this project we need a machine we can rely on.”

The team chose a Sandvik DT1131i as its sole tunnelling jumbo for the project. From a management perspective, the rig is attractive because one operator can control the whole drilling process with multiple booms, while buying a brand-new machine further reduces the risk of trouble.

“THINGS WORK DIFFERENTLY here,” Malknecht says. “There are not many people in Iceland, and everyone is used to doing many different jobs.” Malknecht is no stranger to the challenges presented by working in the high north. Between 2013 and 2017, Metrostav completed a 7.6-kilometre road tunnel in a different part of the country before turning its attention to the Westfjords.

“For at least three months of the year, access roads to the southern portal are usually closed, with scheduled opening



windows of just a few days every four weeks,” Malknecht says. “With transport options limited, we have to stock up on supplies and pay close attention to maintenance and the reliability of everything we need. We used Sandvik rigs on our previous tunnel project, so we knew we could rely on them as a partner for this project, too.”

Metrostav site manager Tomáš Janoušek has nothing but praise for the performance of Sandvik DT1131i. “Our operators are able to manage multiple booms from a single comfortable position,” he says. “This is important for us as a small team.”

THE MOUNTAIN THROUGH which the tunnel is being excavated is principally basalt, the most common volcanic rock on the planet. Although the rock isn’t tough, there is a lot of variety, from coarse crystal several millimetres wide to much finer-grained basalt. Some less-common minerals, including chabazite and the calcium-rich thomsonite, have been found in cavities and pockets within the basalt. This means the team needs a process in place to analyze the rock and the profile following each blast.

“The geology gives us a helping hand, but our success is down to a combination of many things,” Janoušek says. “We are well organized, and everyone knows their jobs. We have a good drill from Sandvik, but what makes the whole operation even more productive is iSURE software. It enables our people to do their best work, especially at the points where the tunnel shape is changing.”

Land surveyor Lubomír Krchňavý says iSURE software is a major

improvement on what he had used previously. “It’s a more modern software with improved functionality, but most importantly it’s much more accurate,” he says.

“We make one drill pattern, and then it is very easy to modify that to make another,” he says. “We can take the data from the actual drill, look at the penetration rate and learn something from the drilling to improve things next time.”

Within the tunnel project, iSURE automatically creates folders for the curve table, tunnel profiles, drill plans, navigation laser data, navigation sets and related files such as photographs. For a team that makes full use of the software, that’s another important time saver.

SANDVIK’S ARI LAITINEN, business development manager, Underground Drilling, says he is pleased to see a customer getting the full benefits from the combination of Sandvik DT1131i and iSURE drill and blast design software. “It is nice to see customers make the plan at the bottom of the blasting round, gaining the full pull-out

and good profile quality after blasting,” he says.

Laitinen is also pleased to see the customer consider the total cost of ownership. “Metrostav sees beyond the net penetration rate,” he says. “The reliability and durability of the rig and the ease of preventive maintenance routines means the availability of Sandvik DT1131i is high. On a project such as this, where consistent progress is so important to success, that makes a huge difference to the total project cost. Metrostav needs the best-performing equipment with the highest availability to deliver the project on time while turning a profit.” ■

Excavation through the Dyrafjordurgong tunnel reached record-breaking advances with the help of Sandvik DT1131i and iSURE.

SANDVIK SOLUTION

- One Sandvik DT1131i tunnelling jumbo, which is suitable for tunnels of 20 to 177 m².
- One Sandvik DT1130-SC is available as a backup rig.
- Engineers use iSURE tunnel management software to create the drill patterns and blast design and to analyze feedback from Sandvik DT1131i.
- Metrostav also makes use of Sandvik rock tools including shank adapters and couplings. The new Sandvik drill bits were tested in February.
- Service is provided via the Sandvik global support operation in Reykjavik, Iceland’s capital.

Q & A

MOUNTAIN MANAGER

SITE MANAGER AND ENGINEER Ines Hagspiel wears many hats – only one of them made from reinforced plastic. Her expertise in tunnel production is vast, and on any given day she could be found coordinating shifts for drilling and blasting, compiling data on the day's progress or generating reports for the clients of PNC Norge, a subsidiary of European construction giant PORR Group. Her current project involves digging two tunnels through two mountains 10 kilometres south of the Arctic Circle in Norway, with the help of the country's first Sandvik drill rig equipped with a 3D scanner. *Solid Ground* caught up with her to talk about her role, modern-day tunnelling and what it's like to work on the top of the world.

Q WHAT IS THE FOCUS OF PORR/PNC NORGE?

PORR's core competency is construction, primarily in Europe but also in other countries. Since 2012, PORR has been operating in Norway and has used the name PNC Norge AS since 2016. For this market, the major focus is infrastructure building, including building tunnels, bridges and railway systems.

Q WHAT ARE YOUR KEY RESPONSIBILITIES AT WORK?

My primary responsibilities at work involve the many steps required to organize and produce high-quality tunnels as safely and economically responsibly as possible. Acquiring and developing my competency while understanding every

single part of building a tunnel can be challenging at times, as it involves knowledge of controlling, machines, electrical functions, human resources management, new construction methods and software, to name a few.

Q WHAT DO YOU FIND MOST ENJOYABLE ABOUT YOUR JOB?

The expansive diversity of my everyday work life is really enjoyable. Dealing with our team on site, our clients and tasks in the office is great, but then you get to go out to the construction site, here amongst these majestic mountains and beautiful fjords, and see the result of what you planned improving day by day.

Q WHAT WOULD YOU SAY ARE THE BIGGEST STRENGTHS OF THE SANDVIK 3D SCANNER?

With the 3D scanner the operator can see the excavated tunnel compared with the theoretical tunnel line in real time, which saves a lot of time. Also, we can generate 3D models of the tunnel for our client to show where we are in the project in a more visual way. We definitely made the right choice. ■

INES HAGSPIEL

TITLE: Site engineer

HOBBIES: Cooking, cycling, reading, working in the garden, hiking.

BACKGROUND: Born and raised in Altdorf, a little village near Stuttgart in Germany; studied in France, Switzerland and Germany.



The Experts



Erhan Uludag (left) and Paseka Leeuw are both senior lecturers at Wits School of Mining Engineering.

IN THESE DAYS of digitalization and automation, understanding R&D for mining equipment manufacturers can be an elusive endeavour. Senior lecturers Paseka Leeuw and Erhan Uludag, of Wits School of Mining Engineering in Johannesburg, South Africa, share their thoughts with *Solid Ground* on what is driving R&D for mining OEMs in today's modern mining landscape.

Q IN YOUR EXPERIENCE, WHAT IS THE BIGGEST DRIVER OF DEVELOPMENT?

PL: A combination of safety improvement and the need to contain or reduce costs in the face of declining mining grades. The combination of these two factors ensures long-term sustainability of mining operations.

EU: Visionary people and champions in the companies are the biggest drivers of development. There have always been technical challenges in the mining industry. People make it work or fail.

Q WHAT DRIVES R&D FOR MINING OEMS CURRENTLY?

PL: In South Africa, particularly in the narrow reef mining sector, the focus is on mechanization. This sector is characterized by challenging mining conditions encountered daily by miners largely because of unfavourable geological and geotechnical conditions as well

For technology to be fully accepted in mining, it must be client driven

as increasing heat loads associated with increasing mining depths. In other sectors of mining, the focus should be on autonomous technology beyond hauling into a more

complex part of the loop, namely loading. This is applicable to both underground and surface mining.

Q HOW MUCH OF THE WORK IN R&D IS DRIVEN BY CLIENT DEMAND?

EU: Challenging conditions present themselves in mining environments where the client operates, so a manufacturer's focus is always on such conditions. Products should be able to work in these conditions, be safe and benefit the mining operation financially. Client demand is the main driver, although sometimes clients might not be able to see how to solve their problem, and then equipment manufacturers might take the initiative to propose and develop solutions in collaboration with the client. Obviously there are many challenges and limitations on information gathering and exchange.

PL: For technology to be fully accepted in mining, it must be client driven. Very often off-the-shelf technologies in mining do not work because each mine has its own set of unique challenges. Technology developed by suppliers should be such that it can be adapted easily by mines according to their own circumstances.

Q WHAT WILL BE THE MOST IMPORTANT AREAS OF R&D IN THE FUTURE?

PL: I think real-time digital mining will be very important in the future, and universities must produce champions to steer this area of research. In the era of information technology and social media, young people tend to loathe physical and sweaty careers, and if mining is to attract appropriate talent, it should embrace digital mining. To the extent that digital mining improves the quality of decisions made daily, accidents and fatalities can be avoided, mines' profitability can be improved, and better utilization of capital assets can be achieved.

EU: In South Africa we have deep and difficult-to-mine deposits of gold and platinum. Conventional mining methods are not viable because of extreme environmental and geotechnical conditions, which require remote mining methods. As I have been an advocate of keyhole surgery kinds of remote operations since 1999, I see that as an important field of development. Robotics or autonomous vehicles are also being developed in other industries, and there are well-established applications in the manufacturing industry. So technology transfer is also an important task for the mining industry in general. ■

THE AUTONOMOUS NAVIGATOR

■ BAIE-JAMES, QUEBEC. Hecla's Casa Berardi gold mine has implemented automated underground truck haulage on a dedicated drift, the latest and largest step in the operation's automation journey and one expected to save several million dollars.

Text: ERIC GOURLEY Photo: ADAM LACH



Automation was the key to improving operations at Hecla's Casa Berardi mine.



TEN MONTHS AGO, Sonny Melancon had never set foot on a mine site. He ran the garage at a local automotive service shop in La Sarre, 100 kilometres south of Hecla's Casa Berardi gold mine in north-western Quebec.

In December 2017, Melancon became one of the first remote operators of Casa Berardi's new automated haul truck.

"I was looking for a shift in my career," he says. "I was eager for something new. Stars aligned, and I'm here. I had no experience at all with mining or automation."

The mine itself has rapidly gained automation experience since embarking on an incremental journey in 2015, soon after Alain Grenier was appointed vice president and general manager.

"The basic goal of the automation is really to give us all the tools for facing financial cycles," Grenier says. "For us, the main goal is making sure we have a long-life asset. One of the best things to help us on that goal is clearly automation."

Grenier, general superintendent Ronald Durham and other mine management started planning projects to solve bottlenecks and increase throughput. The first step was

automating the mine's hoisting system to boost capacity.

"At that time we were only an underground mine, so bringing up ore to surface was our priority," Durham says. "Being able to hoist between shifts while ventilating blast gases was a relatively small success, but we did it ourselves and it inspired us."

THE MINE THEN eliminated another bottleneck by automating its loading facilities, followed by enabling tele-remote operation of its hydraulic rock breakers from surface.

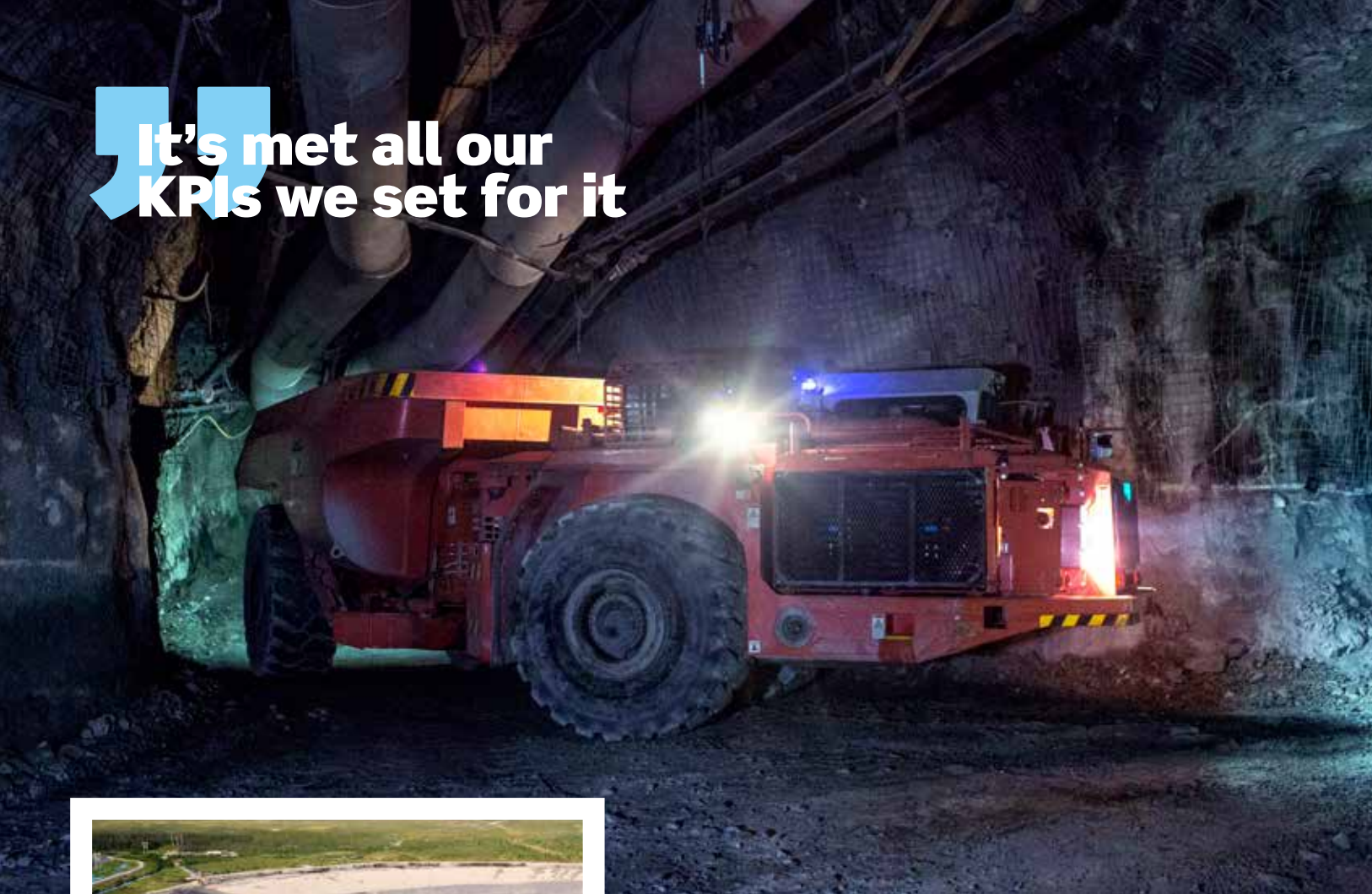
"When you have three successes, it's easier to sell a fourth one," Grenier says.

Looking to downsize its underground truck fleet next, Casa Berardi revisited its ore pass network.

"We looked at many scenarios for transporting ore more efficiently, but most of them were too costly," Durham says.

Casa Berardi ultimately studied five different scenarios for improving truck haulage. Driverless trucking appealed to mine management, who toured Barrick's Williams mine in Ontario to see Sandvik automated trucks in action.

It's met all our KPIs we set for it



Even when running at reduced capacity, Hecla's automated Sandvik TH540 has improved productivity by 20 percent.



"They told us it was a mistake having a connection with the drift," Grenier says. "They suggested we have no direct connection with the ramp."

Casa Berardi's 985 automated drift project was soon born.

The mine developed a 15-million-Canadian-dollar network of dedicated drift and ore passes and waste passes fitted with automatically controlled chutes, and built a new mine operations control centre on surface for the remote operator's station.

"It's a large capital expenditure," Grenier says. "We have to dedicate a drift, chute, dump."

Adds Durham: "We do a lot of calculation to be able to see a payback on these projects. For the material we need to transport every year, we saw that the automated trucks from Sandvik would be the best option for us within two years, and they just keep being better and better for the rest of life of mine. It's cash-flow positive after two years."

The mine appointed its electrical engineer Dave Descôteaux as project manager, a crucial step in ensuring

implementation occurred on time and within budget, according to Grenier.

"It was really challenging but it was really exciting, too," Descôteaux says. "One of the biggest challenges that we faced was the drift dimension. The drift we developed was a little too tight for the truck in some places, so we've had to take some slashes to enlarge the drift, including in places where optical fibre was already installed."

EVEN WHEN OPERATING the automated truck at reduced capacity due to drift constraints, Casa Berardi has already improved trucking productivity by 20 percent.

"It's met all our KPIs we set for it," Durham says.

The truck autonomously navigates a 1.5-kilometre route 1,000 metres below surface, making trips between chutes and dump points up to seven minutes faster than Casa Berardi expected.

"When we did the theoretical calculation, we were estimating it at around 18 minutes for a cycle, and with the automated truck, we're able to go down to 11 minutes," Durham says.





HECLA

Hecla is the largest and one of the lowest-cost U.S. silver producers, the third-largest U.S. producer of both zinc and lead and a growing gold producer. Hecla operates mines in Alaska, Idaho, Quebec and Nevada.



**Remote operator
Sonny Melancon.**

The integrated AutoMine system from Sandvik uses wireless communication, onboard cameras and a navigation system to monitor and control the unmanned truck.

At the start of a shift, underground maintenance personnel access the automated level, start the truck and automate the zone – closing safety barriers that isolate the haulage route from personnel or other equipment –

before informing operators like Melancon sitting in the surface control room that it's safe to start moving muck.

"After the pre-op is made on the Sandvik truck and the area is secured, we can run the truck till the operator gets his ride to go back home," Grenier says.

FROM THE COMFORT of the purpose-built control room, Melancon operates remotes for loading chutes and rock breakers. Rarely has he had to intervene with the automated truck.

"Everything is intuitive," he says. "Sandvik held a training here to help us learn the system, and within a week I was already comfortable with it. We have a series of buttons that we can press, and everything is already set

up in the buttons, so when you have a command to send to the truck, you just press a button. It's a very user-friendly system."

Fellow operator Steve Bouchard says the AutoMine system's self diagnostics save time if something does go wrong.

"In the rare case the truck has a problem, I can diagnose it and inform the mechanic," Bouchard says. "He doesn't need to diagnose it himself, so we're more productive. The truck will basically tell you what to do to get it back up working."

For Melancon, being able to operate from surface is paramount.

"The safety aspect is very important for me because I'm a father of four young children," he says.

CASA BERARDI HAS reduced its LTIFR by 50 percent since the start of its automation journey in 2015.

"Our employees being able to go home safely to their families after every shift, that's most important at Casa Berardi," Grenier says. "The automaton of the hoist, the loading facilities, rock breaking facilities, and now with the trucks, it's not the only answer, but it helps to decrease our health and safety frequencies."

CASA BERARDI MINE

Casa Berardi mine has produced 1.9 million gold ounces since operations began in 1988 and has gold reserves of approximately 1.34 million ounces. Hecla acquired the mine with its purchase of Aurizon Gold in 2013. Sixty percent of

production comes from underground and 40 percent from an open pit started in 2016. The mine produced 156,600 gold ounces in 2017 and is expected to produce 160,000 ounces in 2018. The operation employs around 900 people.

We handle a large volume of ore without any injuries. We are pretty proud of the result.”

Automated haulage has already enabled Casa Berardi to reduce its conventional truck fleet, and a forthcoming even greater reduction figures to add more value to the mine’s bottom line. When the first Sandvik TH540 started operating autonomously in December 2017, the mine removed two trucks from an upper level. A second identical automated Sandvik TH540 is scheduled for delivery in November 2018, and within two years Grenier expects to be able to reduce the total fleet from what was once 13 trucks above the haulage drift down to just six.

“WE FORECAST TO reopen the East Mine by 2020, and we think we don’t have to buy units for the upper part of the mine,” Grenier says. “We could migrate old units from West to East. It could be really interesting in terms of manpower, fuel consumption, mechanical components. On a five-year

Our employees being able to go home safely to their families after every shift, that’s most important at Casa Berardi

project, from 2017 to 2022, we forecast CAD 5.6 million savings.”

During its first eight months of operation, the first automated Sandvik TH540 has delivered 20 percent higher availability at 30 percent lower maintenance costs than the average manned truck in the mine’s fleet.

“WHEN WE SOLD the project to the board we were looking for CAD 3.05 a tonne, just for maintenance to run the equipment,” Grenier says. “We are currently at CAD 2.69, and we think we could improve that with the second unit and a larger volume of ore and waste handling. In terms of productivity, depending on the location of the chute, it’s from 39 to 50 percent more efficient than what we expected. We

are more than happy with the Sandvik truck up to now.”

Grenier admits that after a 33-year career spanning 13 mine sites, the automated drift project required a mindset shift for himself and the mine’s senior leadership.

“Normally we adapt the development to the orebody and the equipment to the development for the orebody,” he says. “Now we have to do the inverse. You have 20, 25, 30 years of experience behind you with your paradigm. At the moment you have in your mind you want to go with automation in your operation, you have to accept to change your mind. It’s a unique opportunity to extend your mine life, extend careers, and have a better health and safety result.” ■



Digital underground

- **OptiMine Analytics uses predictive modelling technology to process overall equipment efficiency and productivity rates into actionable recommendations.**

Text: **TURKKA KULMALA** Photo: **SANDVIK**

OPTIMINE, SANDVIK'S MODULAR production management system for visualizing and managing various data sources linked with mine instrumentation and for controlling mining operations, has evolved. A new component, OptiMine Analytics, transforms the acquired data into predictive insights and actionable dashboards.

OptiMine Analytics builds on the IBM Watson artificial intelligence platform and merges its analytic and

predictive modelling capabilities with Sandvik's extensive knowledge of mining operations and equipment. Thanks to the joint expertise, the predictive modelling power of the system is clearly superior to generic analytics solutions.

"This is truly something that no one else can offer," says Petri Mannonen, product line manager with Sandvik Mining and Rock Technology. "In the case of OptiMine Analytics, the word 'unique' is not hyperbole."

The starting point for OptiMine Analytics is the raw data obtained from the local mine instrumentation system, through other OptiMine modules and the My Sandvik fleet monitoring system. Other customer-specific data sources can include HR, ERP and maintenance management systems, typically to provide operation monitoring data, location tracking data, scheduler data and task management data. Tapping into My Sandvik databases, with fleet monitoring data from more than 1,000 units of Sandvik mining equipment, is a key technique that enables extremely accurate predictive modelling capabilities.

IT GOES WITHOUT saying that stringent data security is an integral aspect of OptiMine Analytics. GDPR compliance is ensured by anonymization of all personal data. Safe protocols and encryption technologies are used for all data exchange and storage operations to create a secure cloud

IBM WATSON

The "engine" of OptiMine Analytics is IBM Watson, a powerful computer system designed to integrate artificial intelligence (AI) into business processes by means of automated reasoning and machine learning technologies. The system uses smart data discovery, automated predictive analytics and cognitive capabilities to enable conversational interaction with the data. In terms of data and analytics, Watson offers a wide range of engines and technologies to utilize various types of data and storage configurations.



environment. Redundant access control systems ensure that users can only access their own data. Sandvik was one of the first mining equipment suppliers to provide an Interoperability Policy to outline the principles of data accessibility, fleet data compatibility and data privacy in compliance with the GDPR.

The backbone of OptiMine Analytics is the descriptive component that shows the current and historical values for the equipment, operator and productivity data integrated from all the available data sources. Based on these machine- and operator-linked KPIs and availability rates, the system indicates and visualizes the overall equipment efficiency (OEE) in a few uncluttered parameters: How does the actual production tonnage compare with the target? What is the breakdown of OEE losses in terms of their main causes?

BUT OPTIMINE ANALYTICS is not simply a performance dashboard. It builds on the descriptive analytics data

The real question is how to translate data into actionable insights, and that is where we can offer a truly unique solution

to offer predictive and prescriptive analytics. While the descriptive component answers questions such as “What was the availability figure for this loader during the last six months?”, the predictive analytics offer answers to questions like “Which component in this unit is likely to need unplanned maintenance next month?” The prescriptive analytics, meanwhile, advise the operator on how to avoid the

predicted issues, such as by replacing the component that is likely to become faulty.

Expressed on a more general level, the predictive analytics forecast potential problems and bottlenecks in mine operations, and the prescriptive analytics offer specific, actionable recommendations to increase overall equipment efficiency and productivity. In addition to performance fine-tuning





and maintenance measures directly related to equipment, the analytics data can also be utilized for optimizing production cycles or identifying potential training topics. A longer-term approach can include pre-emptive maintenance schedules, which again helps to minimize unplanned downtime and improves productivity.

A major strength of OptiMine Analytics is that these predictive models do not rely on data from a single mine or customer. Through My Sandvik, the system leverages the big data obtained from Sandvik's entire customer base. Thanks to this force multiplier, the accuracy of the predictions is superior to other comparable

solutions, and this also keeps the capabilities of the system progressively improving.

As with all technology, software and hardware alone are simply tools. Gaining real impact and results also requires qualified people to operate the systems. In addition to building up in-house capabilities, mine operators can make use of OptiMine 365 service. This practically means that Sandvik mining experts and data scientists join forces to help mine managers find bottlenecks or other issues critical for their specific operations.

"THE DATA IS already out there," Mannonen says. "Sensors and systems are producing it and databases are storing it all the time. The real question is how to translate data into actionable insights, and that is where we can offer a truly unique solution. OptiMine Analytics essentially processes data to information, knowledge and, at the end of the day, real-life OEE and productivity improvements." ■

BENEFITS

- Readily available data from fleet monitoring and other business systems transformed into powerful predictive insights and actionable knowledge
- Available to all types of underground mines and mining applications, across the board in the entire mobile fleet, including non-Sandvik equipment
- Real-time dashboards for overview, production, operators and equipment
- Seamless integration across the entire mine ecosystem with API interfaces
- Over 40 percent more precise predictive analytics models compared with conventional models built without industry-specific application expertise
- Fewer production losses
- Higher efficiency over the fleet life cycle through predictive maintenance
- Higher production quality thanks to operator competence development

The ability to track a variety of variables has had a major impact at Petra Diamonds Finsch mine.



OPTIMINE ANALYTICS AND PETRA DIAMONDS

PETRA DIAMONDS, a leading independent diamond mining group, operates the Finsch mine in the Northern Cape province of South Africa. Finsch is a globally significant diamond mine and South Africa's second-largest diamond operation by production. The mining operations, using block cave and sub-level cave methods, started in 1967 and currently extend to the depth of 700 metres.

Petra Diamonds says a key factor in favour of starting a joint analytics project

was Sandvik's commitment and in-depth understanding of the local challenges.

"THE MAJOR IMPACT at Finsch Mine has been [that it allows] us to track performance of both machines and operators, track the completion of various tasks and minimize potential delays and the re-assigning of resources during the shift," says Alex Holder, group technical service manager.

"We now have the ability to change to plan B on the fly," he says. "Predictive

maintenance and other predictive algorithms will in the future lower the need for implementing a plan B all the time."

OptiMine Analytics also turned out to be an effective training tool for Petra Diamonds. Improved visibility of the fill factors of trucks and loaders has driven better awareness of the productivity impact of these parameters among the operators. This resulted within a few weeks in improvements in truck and loader tonnages of 6 percent and 9 percent, respectively. ■

SUEK TALDINSKAYA ZAPADNAYA-2 COAL MINE

Merit in the Motherland

■ Record-setting heroes may sound like the stuff of literature, but with the help of Sandvik Mining and Rock Technology's industry-leading equipment and training, it is as real as it gets at SUEK's Taldinskaya Zapadnaya-2 mine in Siberia.

Text: MICHAEL KORENEV Photo: VOZDUH FILM COMPANY



Sandvik MB670 is the best equipment that I have ever operated



LAUNCHED IN 2001, Taldinskaya Zapadnaya-2 mine is located in the Kemerovo Region of south-western Siberia. It sits in the centre of Yerunakovskiy geological industrial district, practically in the middle of the coal mining heart of Russia. Owned and operated by the Siberian Coal Energy Company (SUEK), Taldinskaya Zapadnaya-2 had an opening annual capacity of 600,000 tonnes and has since developed into one of the most productive regional mines with the capacity of 3 million tonnes per year. In terms of scale and productivity, Taldinskaya Zapadnaya-2 is considered an ideal coal mine.

SUEK is a leading Russian coal producer that uses both underground and surface mining methods. The lion's share of the raw materials it excavates consists of bituminous coal and lignite coal. The company also has a strong position in the global coal market: it is sixth in terms of production and fourth in terms of exports.

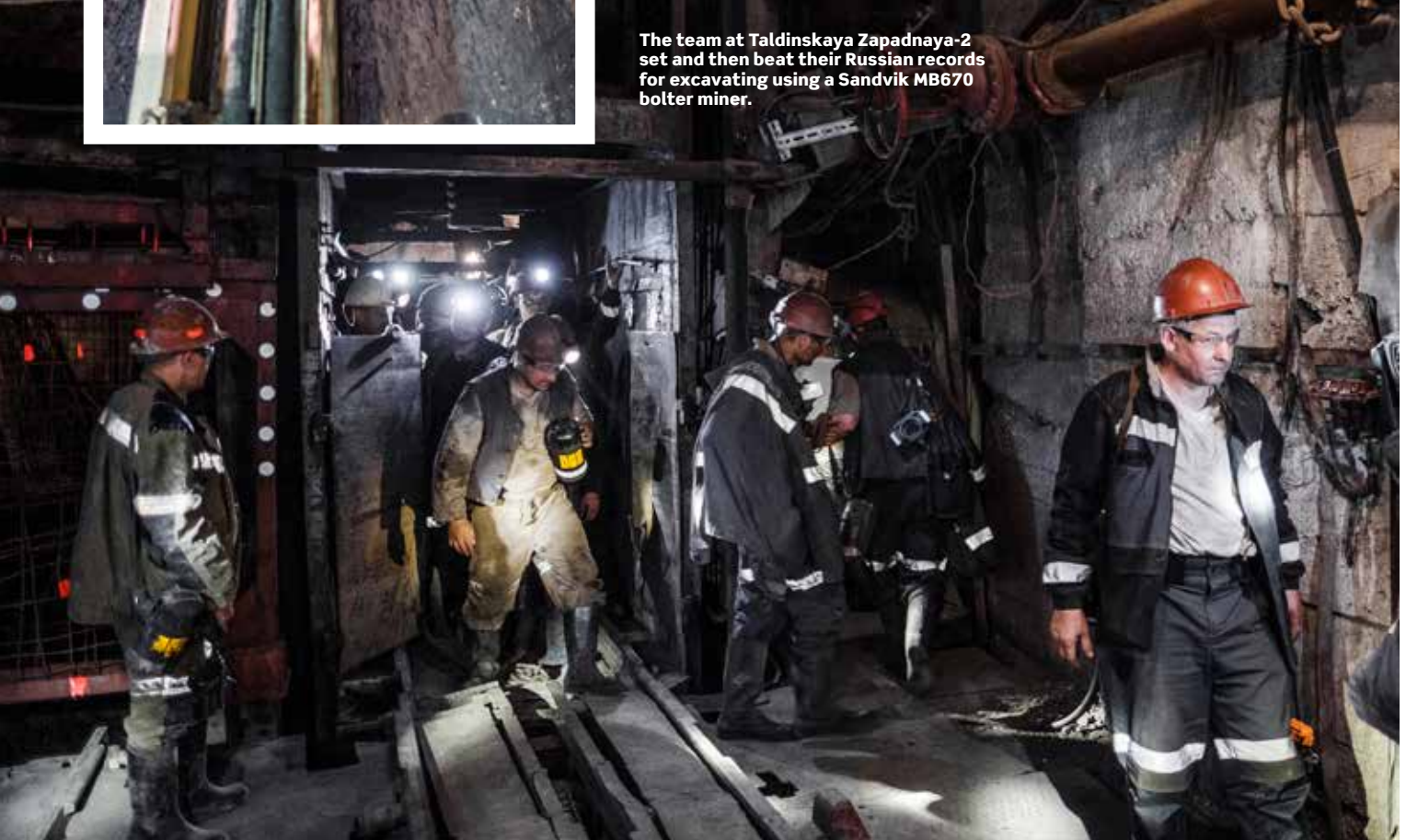
Taldinskaya Zapadnaya-2 is also the workplace of “Hero of Labour of Russia” award winner and SUEK team

leader Aleksandr Kulichenko. He was presented with the Golden Star by the Russian president on April 25, 2018, and eight years earlier he was awarded a second-class medal of the Order of Merit for the Motherland for his proficient work at the mine. In 2015 Kulichenko's team of 44 set a monthly record in the Russian coal industry for excavating the coalface 1,012 metres. Then, in December 2016, Kulichenko set another record of 1,272 metres. For his efforts, he was given the title “Hero of Kuzbass,” and he did it all with a Sandvik MB670 bolter miner at his command.

TODAY, THE 49-YEAR-OLD hero only works on the first shift to prepare the face for mining operations over the next 24 hours. Kulichenko acknowledges that he did not seek to set industry records – they just happened.

“I wanted to make good progress working together with my team, and thanks to good new machinery we achieved great results,” he says. “Sandvik MB670 is the best equipment that I have ever operated because of its

The team at Taldinskaya Zapadnaya-2 set and then beat their Russian records for excavating using a Sandvik MB670 bolter miner.



usability, lining of the mine and level of safety. The advantage of the miner is in its extension-type frame with a hydraulic drive that allows the cutter to cut without using a track drive. We got set in the drift, sped up and could see that this bolter miner can go a long way.”

Sandvik MB670 has an explosion-proof design, and Kulichenko says it is thought out to the finest detail. And while he confesses that minor faults have happened, Sandvik technical support engineers have always rectified them promptly, helping to avoid long-term downtime.

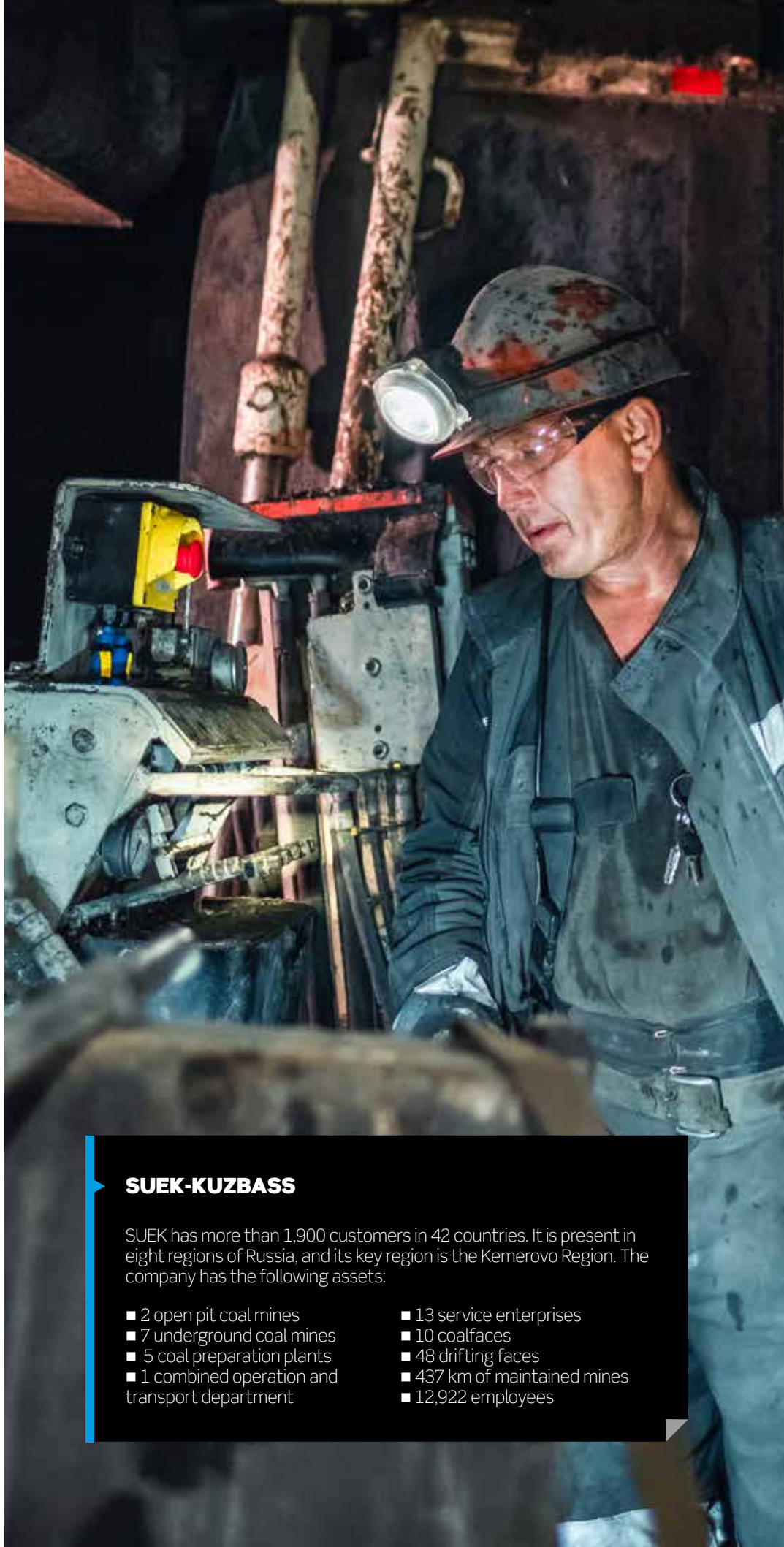
Anatoliy Meshkov, first deputy CEO of the joint stock company and technical director of SUEK-Kuzbass, researched long and hard about which equipment to buy when the opportunity presented itself. He explains why the company chose the new Sandvik MB670-1.

“We have experience working with Sandvik MB670, setting excavating records of more than 1,200 metres in a month,” he says. “We have already learned how to mine a lot of coal, and now our biggest challenge is to quickly excavate the metres. This is why we chose Sandvik bolter miners. Two of the eight purchased machines have been put into operation, and we are awaiting delivery of the third one.”

THE NEW SANDVIK MB670-1 bolter miners inspire high expectations for mine development. The machines are used for mining a new coal bed. At the company’s Yalovskiyy mine, a large longwall with 11 million tonnes of reserves is being prepared. A six-kilometre drift needs to be mined in six months, which, if accomplished on time, will be an excellent result. There are also ambitious plans for Taldinskaya Zapadnaya-2.

Along with Sandvik MB670, Taldinskaya Zapadnaya-2 is currently using several pieces of Sandvik equipment: Sandvik MR340 roadheaders, a Sandvik TC790 shuttle car, a Sandvik DE880 exploration drill rig, a Leopard DI550 for surface drilling, a Sandvik CR620 side sizer and a Sandvik CR320 feeder breaker.

Meshkov says the design of the equipment can seem complicated, but it is not difficult to learn how to operate it. Operators and maintenance specialists are trained to operate and



SUEK-KUZBASS

SUEK has more than 1,900 customers in 42 countries. It is present in eight regions of Russia, and its key region is the Kemerovo Region. The company has the following assets:

- 2 open pit coal mines
- 7 underground coal mines
- 5 coal preparation plants
- 1 combined operation and transport department
- 13 service enterprises
- 10 coalfaces
- 48 drifting faces
- 437 km of maintained mines
- 12,922 employees



With a capacity of 3 million tonnes per year, Taldinskaya Zapadnaya-2 is one of the most productive coal mines in Russia.

maintain the equipment at the Sandvik facility in Zeltweg, Austria, and get personal certification after completing their training. These specialists are further involved in maintaining the new machines.

WHILE THE EQUIPMENT is under warranty, machine operators communicate with Sandvik technical support specialists every day. They record motor hours and assist in rectifying any failure, as machine downtime can lead to failure to meet the production plan and subsequently result in significant financial losses. Sandvik professionals maintain their reputation: even the most complicated technical issue is resolved within 24

hours. Roadheader operator Petr Boretskiy points to several advantages of Sandvik MB670-1.

“I like that the bolter miner is equipped with a telescopically extended cutting drum,” he says. “It ensures continuous mining and roof bolting of the mine roof and walls. It saves significant time and effort and ensures the safety of the underground work. I noticed that the noise level and vibrations have also decreased. The bolter miner has a more space-efficient dust holding bin and a cooling water system. A big advantage is a smooth soil surface of the mine, which is ensured by the adaptable system of automated cutting.”

Every day, miners diligently cut into

the coal-bearing layer with the new Sandvik MB670-1, helping implement the new, more ambitious plans. Whatever records and plans for expansion the company has, and however advanced the machines are that the miners use, for SUEK safety always comes first.

“We spend lots of money on occupational safety for the sake of both people and the environment,” Meshkov says.

AND IT SHOWS. The company was awarded an EraEco prize for the Creation of Environmentally Friendly Production sponsored by UNESCO. In 2016, SUEK-Kuzbass won the Evolution Award from the Ministry of Natural Resources for the Best Complex Solution in Environmentally Friendly Technologies.

Still, most on the job are openly impressed with the equipment. Boretskiy practically glows with pride describing the digital control of Sandvik MB670-1’s travel speed and manoeuvrability, all of which optimize the cutting cycle.

“I really like the view when operating the new bolter miner,” he says. “I feel like a captain on the bridge of his ship. I also like the fact that you can monitor the state of the coal mass remotely using wireless link control.” ■

TECH SPECS SANDVIK MB670-1

- Total length: 11.24 m
- Platform width: 4.36 m
- Ground clearance: 27 cm
- Loader width: 4.5 m to 5.2 m
- Conveyor width: 76 cm
- Cutting width: 5.2 m
- Cutting height: 3.5 m to 4.5 m
- Cutter motor power: 270 kW
- Hardness of mined rocks: 50 MPa to 80 MPa
- Loading capacity: 25 t/min
- Diameter of rotary drill: 20 mm to 30 mm
- Total mass: 105 t



We spend lots of money on occupational safety for the sake of both people and the environment

LEOPARD DI650i



TRIED, TESTED AND TRUE

■ Sandvik Mining and Rock Technology has launched an entirely new high-pressure DTH drill rig to complete its offering in the upper hole size range. Building on sound and proven engineering solutions and components, Leopard DI650i delivers solid productivity and advanced automation options for challenging rock conditions.

Text: **TURKKA KULMALA** Photo: **SANDVIK**

DOWN-THE-HOLE (DTH) DRILLING has for decades been one of the dominating technologies in surface drilling applications. Sandvik Mining and Rock Technology is now complementing its offering of high-pressure DTH drill rigs with a totally new design, Leopard DI650i.

“Our main focus was on surface mining operations, but the productivity and versatility of this machine also lend themselves very well to construction applications such as cement production,” says Jari Läntinen, product manager with Sandvik Mining and Rock Technology. “The fundamental design philosophy with Leopard DI650i was to opt for trusted main components, particularly the engine and the compressor, that have a proven long-term track record in the marketplace.”

The prime mover is a 403-kilowatt Tier 3 CAT C15 diesel engine that drives a GHH RAND compressor to provide an airflow of 28.8 cubic metres per minute (1,000 cubic feet per minute) pressurized up to 30 bar (435 pounds per square inch). The maximum pressure rating gives excellent capability for high-pressure drilling with a 5-inch hammer.

THE DOMINANT DTH hammer size is likely to be 6 inches, but 4- and 5-inch hammers are also possible. The pipe sizes range from 89 to 140 millimetres, depending on the size of the hammer. Over the 115- to 203-millimetre hole size range, the recommended optimum size is 165 millimetres. The rig weighs 30 tonnes (about 66,000 pounds) fitted out in a fully operational condition, topped with fuel and fluids and the selected set of drill piping and options on board.

Depending on the pipe size (89–140 millimetres, or 3.5–5 inches), the carousel can take a set of 8 + 1 pipes or a 4 + 1 set, giving a maximum hole depth of 53.6 or 29.6 metres, respectively (175 feet, 10 inches/97 feet, 1 inch). The rod handler system is entirely redesigned for improved efficiency.



The standard rotary head option, HTRH6.0, has performed successfully on existing Sandvik DTH rigs and again reflects the philosophy of building on trusted main components. Leopard DI650i also offers a new heavy-duty option, MRH6, to match the demands in the upper range of the capacity area. The HD rotary head also makes a perfect match with the new series of Sandvik RH560 DTH hammers.

The superior performance of Leopard DI650i does not merely rely on the powerful engine and compressor. It is the product of overall optimization of several factors, including the ergonomic

iCAB cabin, excellent serviceability, mobility and fuel economy, as well as scalable automation packages.

THANKS TO EXCEPTIONALLY advanced serviceability and reliability, Leopard DI650i can offer up to 20 percent higher availability compared with conventional DTH rigs at a similar technology level. All daily servicing tasks are possible at ground level on both sides of the machine. Critical components and assemblies swing out, or can be pulled down or driven out, for easy access to all locations with regular servicing needs. The modular covers can be easily

CUSTOMER CASE

Boliden Kevitsa mine has produced nickel, copper, gold, platinum and palladium in northern Finland since 2012. The new Leopard DI650i was tested by Boliden's drilling contractor E. Hartikainen Oy in the demanding arctic conditions in early 2018, in temperatures as low as -35 °C. The ground conditions at Kevitsa are challenging due to extremely hard fragmented rock. Leopard DI650i was taken to regular 24/7 production use after a brief set-up. Over two months, the unit accumulated more than 900 engine hours and more than 500 drilling hours and produced more than 15,000 drilled metres. Leopard DI650i delivered excellent availability throughout the test.



removed for maintenance work. All this helps the maintenance personnel to work productively without compromising on safety.

Leopard DI650i uses the same silent and ergonomic iCAB cabin as Sandvik DXi top-hammer drill rigs; only the control panel layout is slightly different. The excellent visibility to the drilling area and a single integrated touch screen for all monitoring, diagnostics and mining automation displays are

significant productivity factors for the rig operator. Leopard DI650i also stands out from the competition with its extra seat for a trainer or a maintenance technician.

Fuel efficiency is a crucial parameter in terms of both productivity and environmental sustainability. Leopard DI650i saves fuel with an intelligent compressor control system that matches the compressor rpm with the required pressure and airflow. The hydraulics

system additionally applies intelligent control technology to optimize the cooler fan speeds according to the weather and machine load conditions. These improvements cut down Leopard DI650i's fuel consumption by up to 15 percent compared with conventional DTH rigs.

THE FLOW-CONTROLLED DRILLING

control system is yet another innovative option in Leopard DI650i. Whereas conventional pressure-controlled systems may suffer from fluctuations in the airflow, Leopard DI650i can keep the airflow constant and instead let the pressure level fluctuate to respond to more difficult ground conditions and increased backpressure. Advanced torque control functionalities prevent jamming and damage to pipe threads. The drill control system additionally includes an intelligent control sequence for hole finishing to discharge residual air in a controlled manner to prevent damaging blows without rock contact.

"THE BEAUTY OF our new drilling control system is that you can still decide to use the traditional pressure control and save fuel when the ground conditions are not challenging," Läntinen says. "But if there is significant backpressure, due to groundwater or collapsing holes, for example, you can maximize the flushing pressure and penetration rate by using the flow-controlled set-up."

Leopard DI650i joins Sandvik's other latest drill rigs in its compatibility with the newest scalable automation solutions. The latest on-rig options include TIM3D navigation, My Sandvik fleet tracking system and full-cycle drilling automatics, which merge functionalities such as uncoupling, feed auto-aligning and feed auto-positioning into a single efficient sequence. These capabilities can be further upgraded with more advanced modules such as single-rig or fleet remote control systems. All in all, Leopard DI650i strikes a well-rounded balance between tried and tested engineering solutions and the latest advances in intelligent control systems and mine automation. ■

TECH SPECS

- Drill hole diameter: 115–203 mm (165 mm optimum) (4.5–8"; 6.5")
- Drill pipe sizes: 89 mm (3.5"), 102 mm (4"), 114 mm (4.5"), 127 mm (5") and 140 mm (5.5")
- Carousel capacity: 4 + 1 or 8 + 1, depending on the pipe size
- Maximum drilling depth: 53.6 m (175' 10")
- DTH hammer sizes: 4", 5" and 6"
- High-pressure compressor: 28.8 m³/min (1,000 cfm), max. 30 bar (435 psi)
- Engine: 403 kW (Tier 3)
- Operating weight: 30 t (approx. 66,000 lb)



BENEFITS

- Intelligent engine and compressor control systems for at least 15 percent better fuel efficiency
- Advanced iCAB cabin for excellent visibility and very low noise level – safer and more productive working conditions for the operator
- All daily maintenance items at the ground level, improved accessibility to all components to help the maintenance crews work more safely and productively
- Intelligent flow-controlled drilling control system for optimal penetration in challenging rock conditions
- Scalable automation solutions for effective fleet control and mining automation



Lending a helping hand

■ PAKYI, GHANA. When a rainstorm devastated a local school in rural Ghana, Sandvik Mining and Rock Technology answered the call for help.

Text: **ERIC GOURLEY** Photo: **ADAM LACH**



THE STUDENTS AT Pakyi School No. 1 dream of becoming doctors, pilots and engineers. Their teachers emphasize how taking their studies seriously can improve their future career prospects.

But conditions haven't been conducive for learning since a rainstorm in December 2014 razed several classroom blocks at the 900-student school in a rural farming community 20 kilometres south of Kumasi, one of Ghana's largest metropolitan areas.

Teacher Hannah Amankwah vividly remembers the Friday downpour.

"WE HAD CLOSED from school, so we were at home," says Amankwah, who has taught English, home economics and information and communication technology (ICT) at the school since 2010. "We woke up the next morning only to come to school to find out that the primary section, some parts of the building, had collapsed. And it was so pathetic that that day, the kids didn't have any place to go. They were down. They were stranded. We were all stranded."

In the weeks that followed, teachers improvised to keep the school open for the displaced students. They converted the school's ICT building into a classroom and demarcated it to hold two classes, 60 students on each side of the 190-square-metre room. Some primary classes were combined into already-overcrowded classrooms that had survived the rainstorm.

"It was stressful for the students and the teachers," says headmaster Jacob Anane. "Children were easily distracted."





Students, teachers and the community were all grateful for Sandvik's support.



Sandvik HR manager Samuel Brewu.



warehouse facility just a few minutes' drive from the school on land the company purchased from Pakyi tribal elders. The storm that toppled part of the school also severely damaged the Sandvik facility, shearing off part of the service centre's roof.

AS SOON AS Sandvik restored its facility, Nuhu Salifu, the company's vice president for Sales Area West Africa, visited the school and was moved by the damage.

"Wherever we work in West Africa, we take the view that we are not just here to work," Salifu says. "We actually work to impact the life of the society at large. We have a number of stakeholders that we need to work to satisfy, including our shareholders, our employees, and then also the communities where we work.

"So if we could help the community to bring the school back to life, then we help the whole society, and that is the view that we took."

Local Sandvik leadership obtained top management approval to finance construction of a six-classroom block. Following consultation with local opinion leaders, chiefs and traditional rulers of the community, and permitting from local authorities, construction began in 2017.

"When they heard that they were going to get a new classroom, they

were really happy," Anane says. "We the teachers, the children and the entire community, we were all happy. We are really excited. We are elated."

Sandvik selected a local contractor following a sealed-bid tender process. HR manager Samuel Brewu says the company was impressed by the contractor's past work in similar community-based activities.

"Part of the proposal was to use local resources as much as possible," Brewu says. "This is an artisanal community and we have many carpenters in the area. Instead of going to a bigger township to find contractors, we wanted to enable the local community to contribute to the rebuilding of the school."

REFLECTIVE OF THE emphasis on using local resources, portions of the new block's roofing integrate wood recycled from pallets and containers used to ship Sandvik spare parts and equipment.

"It's heaven on earth for us because we really do have problems with infrastructure," Amankwah says. "This building is going to give us a comfortable room for them to stay. So we are most grateful and we are really, really happy. The kids are excited and we are also happy that our work here is going to be a little comfortable."

Fifty years after the school was first built, Sandvik inaugurated the new classroom block in early 2018.

"We are appreciative for the new building they have built for us," Appiah says. "It will help us focus on learning again." ■

TO ENABLE YOUNGER primary classes to remain indoors, makeshift classrooms were established outside under trees for the older junior high school students. On rainy days, their classes had to be cancelled.

The drastic measures were difficult for students like Janet Appiah.

"It has been very difficult for us to learn sitting under the trees," says Appiah, a third-year junior high school student who hopes to become a nurse.

When repeated attempts by Pakyi community leaders and school authorities to obtain financial assistance from the cash-strapped Ghana Education Service proved unsuccessful, they turned to neighbour Sandvik Mining and Rock Technology for help to rebuild.

In 2013 the company had opened its West Africa service centre and



Customer **INPUT** for better **OUTPUT**

■ Innovation drives economic growth, but what drives innovation? Research and development activities enable companies like Sandvik Mining and Rock Technology to create ever better solutions as we race towards a digital future. But in order to meet shifting customer needs, that R&D process is increasingly placing customers at its heart.



That level of detailed customer feedback is only likely to come out of an event like this

AT LEADING INNOVATIVE companies, R&D and product development have become digital endeavours. That's the finding of the Boston Consulting Group (BCG) 2018 ranking of the most innovative companies, in which seven of the top 10 are digital natives.

The vast majority of the others on the list have put digital at the core of their innovation programmes, and this extends even to the most traditional of industries. The report says that a digital divide in terms of innovation has opened up, and threatens to widen, between leaders and the rest.

Virtually all companies claim that their strategies are customer-driven, but few have truly embraced the concept. In the retail sector, Amazon devotes significant resources to pleasing consumers, over and above anything else.

It constantly tests and iterates its product recommendation algorithm in

real time to see what customers respond to best. Innovations such as the "Prime" free shipping programme have been criticized by many as unprofitable, but placing customers at the centre of their R&D process has created brand recognition and customer loyalty that are the envy of virtually every other company in the world.

Of course, manufacturing and selling mining equipment and rock tools is not the same thing as running a worldwide retail business, yet lessons can be learned from the Amazon customer-centric approach.

Smart companies in a variety of traditional industries are setting up systematic dialogues with their primary customers to dig into details when it comes to needs and wants. Managers at FedEx hold twice-yearly summits with a sampling of business customers not to talk about their own service, but to understand in what areas their competitors are doing a better job.

AT THE GERMAN adhesive giant Henkel, the "tops to tops" programme has all executives meet regularly with their counterparts at major customers, allowing them to ensure that the company maintains a current dialogue and can respond appropriately to even the subtlest shifts in the market, which would be otherwise invisible.

Customers of Sandvik Mining and Rock Technology are already enjoying

the benefits of being more involved in the product development process. Sandvik has held workshops to gather future customer needs, and at one recent event more than 200 customer ideas for the new Sandvik LH517i loader were generated.

"The overriding feedback was that we have a great machine," says workshop leader Minna Pirkkanen. "Customers provided insight on how it can be further developed to make their work easier. That is truly valuable feedback, and it's really only possible at an event like this when everyone feels able to speak freely, ask questions and really drill into the detail beyond high-level comments."

Pirkkanen says that as a direct result of the customer forum, Sandvik has enhanced the "intelligent" aspects of the loader, improved ergonomics and serviceability, reduced maintenance time and reduced operating costs, with safety always at the forefront of the design.

According to the BCG survey, four types of innovation – all related to digital – have grown in importance and are being pursued by more companies: big data analytics, the fast adoption of new technologies, mobile products and capabilities, and digital design.

Adding intelligence to mining equipment and rock tools is something Sandvik is already doing, but it has become clear that customers also want help with making sense of big data.

THAT'S THE IDEA behind the My Sandvik digital service solution, which gives customers access to much of the data produced by their mobile equipment. "With My Sandvik, we have taken customer needs into account from the very beginning," says Thomas Hecke, digital services manager at Sandvik.

The My Sandvik digital services team has found through extensive dialogue with customers that not everyone is ready to take advantage of the more advanced reporting capabili-

AUTO PIPE HANDLING AUTOMATING COMPLEX MANUAL OPERATIONS

Auto Pipe Handling is a software feature designed to automate the complex, manually intensive task of connecting drilling pipes together. It was developed as a direct result of customers wanting a more efficient way to deal with this previously error-prone process. The team takes into account customer feedback at both the concept generation and the design review stage. They also consider whether such functionality can be added to other in-the-hole solutions.



ties, so more intuitive dashboards are being designed and added to the toolkit.

“NOT EVERY CUSTOMER has the resources to analyze this onslaught of big data,” Hecke says. “While we offer advanced reporting for those that do, our product can be tailored to customers who are taking the first steps in moving away from a paper-based system.”

Hecke and his team, together with other digital stakeholders, hold regular meetings where product engineers listen to customer feedback gathered by the sales teams to keep solutions relevant. At the same time, the digital services team works on improving the front end.

A perfect example of this was the internal workshop organized in Tampere at the beginning of June 2018, Hecke says. “This workshop helped us to assess what level of detail our customers and internal stakeholders require from the reporting dashboards,” he says. “It’s a continuous process, and as our customers’ ways of working change, our tools must be improved to support them through that change.”

SANDVIK LH517i ADDING INTELLIGENCE TO EVERY MODEL

Sandvik LH517i is a 17-tonne underground loader. The development team went beyond the existing customer feedback process and held a series of customer forums in Australia, Europe and South Africa to truly dig into the details of customer needs. Important features that have come directly from these forums include a focus on the ease of maintainability and good operator ergonomics.

WHILE DIGITAL TOOLS have the power to join up the fragmented manufacturing processes of design and planning, preparation, machining and evaluation, this is not something that Sandvik can achieve on its own.

Product development is no longer restricted to the core tasks of a loader or drilling equipment. Adding intelligence into the equation creates all sorts of questions for the

product engineers. When will customers want this data, and what will they do with it? What third-party products or services do we need to interface with? Are these reports being used, by whom, and how?

With questions like this needing answers, placing customers at the heart of future product development isn’t just an option for Sandvik to remain an industry leader. It’s essential. ■

MY SANDVIK TURNING EQUIPMENT DATA INTO EASY-TO-USE KNOWLEDGE

The My Sandvik portal provides users with access to information on their fleet, and the ability to request quotations and place orders. Customers can use it to keep track of their fleet’s performance, plan for better maintenance and base decisions on accurate data. The suite of reports available is under constant development based on customer input.

A large red Sandvik LH514 underground loader is shown maneuvering through a complex glass labyrinth. The loader is positioned in the center-right of the frame, with its large bucket and front-mounted equipment visible. The labyrinth is constructed from tall, vertical glass panels that create a series of narrow, winding paths. The lighting is dramatic, with a strong blue tint on the left side and a bright, white light source on the right, creating a high-contrast scene. The loader's movement is smooth and precise, demonstrating its agility in a confined space.

A-MAZE-ING GRACE

Showing off its agility, a Sandvik LH514 underground loader maneuvered smoothly and flawlessly through a glass labyrinth all by itself.

Text: **JEAN-PAUL SMALL** Photo: **ROBIN ARON**



IT'S NO SECRET that Sandvik Mining and Rock Technology has remained at the forefront of automated mining equipment for some time. In fact, with regard to automated underground loaders, the company has provided its customers with nearly 20 years of accident-free operating hours involving people. Challenging though it may be, a primary goal of this industry-leading innovation has been to relocate miners from underground environs to comfortable surface control rooms.

Recently, the company took that challenge to the next level by bringing a Sandvik LH514 underground loader up to the surface and having it drive itself perfectly through a labyrinth constructed of 589 glass sheets in a hangar in Helsinki, Finland. The project showcased the maneuverability of Sandvik LH514, highlighting its symmetrical articulation, which means it can move backward with the same precision that it moves forward.

Sandvik automated loaders, like Sandvik LH514, are able to navigate drifts and tunnels (and glass mazes) using the vehicle's intelligent system that employs lasers to map out and record the labyrinthine pathways found underground. Using gyroscopes, sensors and Sandvik's patented algorithms, the loader is able to know where to go in the darkest of places underground without the guidance of GPS.

And recently, engineers at Sandvik have even automated the loader's bucket. This offers customers the ability to fully automate the entire production cycle, from loading to hauling and dumping in any conditions. ■

Sustainable solutions

Sandvik Mining and Rock Technology knows how important it is for our customers to remain productive in a competitive landscape. With safer, industry-leading services and solutions, we'll be here when you need us to help you enhance your daily operations.

ENVIRONMENT, HEALTH AND SAFETY (EHS)

Stay safe. Our objective is to eliminate 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, our products are designed to minimize environmental impact and reduce health and safety risks in your operations.



GENUINE PARTS AND SERVICES

Prioritizing uptime. In an industry where an hour of downtime can cost thousands, Sandvik 365 parts and services can save you millions, with round-the-clock service, qualified engineers and genuine parts on demand. When you can predict your productivity, you predict profitability. We not only supply industry-leading mining and construction equipment, our comprehensive aftermarket offering includes service solutions to add even more value to your operation, and genuine parts to extend your equipment lifetime.



SURFACE DRILLING

Power and precision. Sandvik surface drilling equipment is renowned for durability, reliability and productivity. For decades, our surface top hammer, surface down-the-hole and dimensional stone drilling rigs have delivered low total cost of ownership in quarrying, opencast mining and construction applications. We specialize in engineering surface drilling equipment that marries power and precision while improving operator safety and productivity.



UNDERGROUND DRILLING

Know the drill. Sandvik underground drill rigs are engineered to maximize your productivity in mining and tunneling applications. Equipped with high-performance hydraulic rock drills, they are ergonomic, efficient and reliable. Every underground drill rig and rock drill we engineer is designed to deliver you the lowest possible cost per foot drilled and a low life-cycle cost. Our drills range from robust, simple rigs to automated units that deliver extraordinary production rates.



CONTINUOUS MINING AND TUNNELING

Always advancing.

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



LOADING AND HAULING

Reliable loaders and trucks.

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



CRUSHING AND SCREENING

Maximum size reduction.

Sandvik crushing and screening solutions are engineered for productivity in mines, quarries and civil engineering projects. 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 consumables. Whether you're crushing tons of hard rock or producing several sized aggregates with our mobile screens, our solutions deliver the robustness and versatility you need.



BREAKING

Hit harder.

Sandvik breakers and demolition tools make short work of difficult jobs. They are optimized to deliver high-impact cutting or crushing forces, with high power-to-weight ratios, easy interfaces and simple connections. Whether you're looking for breaker booms for your crushing applications or hydraulic breakers for your demolition projects, we have the precision tools and equipment you need to get the job done efficiently.



MINE AUTOMATION

Complete control.

The AutoMine 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, tunneling, 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 mining equipment raise productivity sharply.





EVOLUTION ON THE OUTSIDE REVOLUTION ON THE INSIDE

Sandvik CH800i connected cone crusher series brings you a revolution in intelligent crushing. Connected via the My Sandvik portal they give you 24/7 access to data generated by your connected Sandvik crusher fleet. So you make decisions based on facts, and see areas where you can improve uptime and profitability. E-commerce lets you order and reorder parts, tracking and tracing your shipment.

With major components up to 65% stronger, these premium crushers provide more reliability, higher availability and greater productivity.

Time to make decisions based on facts. Join the connected crusher revolution at rocktechnology.sandvik/CH800i

