Mining & Construction

No.01

A magazine from Atlas Copco

miningandconstruction.com

The Connected Issue 01–2017

INSIDE

[Our customers]

Out to optimize

Mine Manager **Sunniva Haugen** is changing routines at Boliden Kristineberg.

08–13

"Epiroc aims to serve you even better"

IT HAS BEEN AN intensive 2017 for all of us. Earlier this year, we announced the proposed split of Atlas Copco into two companies, to ensure that both entities are given the best growth opportunities in their respective markets. One will keep the name Atlas Copco and will focus on industrial customers. The other – our part – will be fully focused on mining, civil engineering and natural resources. This is **Epiroc**. A separate board and management team dedicated to the demands and market drivers of our industries will enable us to serve you, our customers, even better and respond faster to market requirements.

WE AIM TO BE on top of things, just like our name says. Epi is latin for "on" or "at", while Roc signals stability and, of course, rock – reflecting our core business.

In many ways, this is the start of a new and exciting journey, together with you. As Business Area President, it is inspiring to work with all the motivated teams to make Epiroc into a success for all of us. And yes, we are proud of our history and values. Continued belief and investment in both innovation and our people is part of what we will take with us from Atlas Copco into Epiroc.

WITH OUR HISTORY in mind we are ready to take on the journey into the future.

Together with you, we want to build the mining, infrastructure and natural resources industries of the future. We look forward to welcoming you on the journey.

On my radar

Connectivity
The importance of connectivity between everyone, and everything, is ever increasing.

Battery technology
Providing vast possibilities to improve health, decrease emissions and save money.

Mining & Construction Magazine
The magazine has been given a reboot. We hope you enjoy the read.

Enjoy!

Helena Hedblom
Business Area President,
Mining and Rock Excavation Technique

The business area provides equipment for drilling and rock excavation, a complete range of related consumables and service through a global network.

Atlas Copco

About Atlas Copco

Atlas Copco serves customers with innovative compressors, vacuum solutions and air treatment systems, construction and mining equipment, power tools and assembly solutions. The Group develops products and service focused on productivity, energy efficiency, safety and ergonomics.

We are committed to sustainable productivity, aiming to create lasting results with responsible use of resources – human, natural and capital.

Mining and Rock Excavation Technique

About us

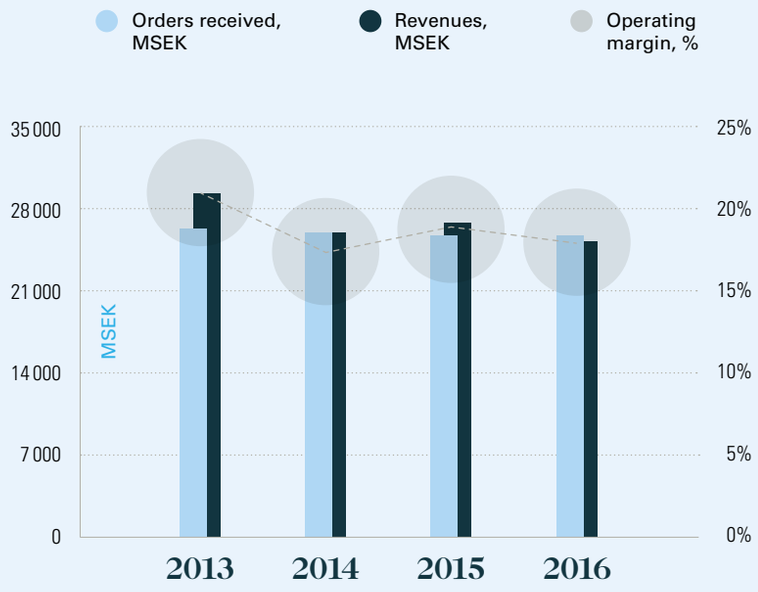
10 911

- The main product development units are located in Sweden, Germany, the USA, Canada, China and India.
- Revenues: MSEK 25 043 (2016), 25 percent of total Group revenue.
- 10 911 employees (2016).

What we do

- We innovate for sustainable productivity in surface and underground mining, infrastructure, construction, well drilling and geotechnical applications.
- Mining and Rock Excavation Technique has a leading market position globally in most of its operations.

Orders received, revenues and operating margin

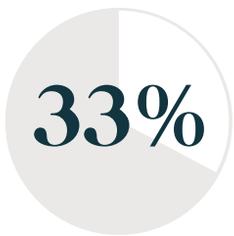


The Group in numbers

- Founded in 1873 and based in Stockholm, Sweden.
- Sales in 180 countries.
- Revenues: MSEK 101 356 (2016).
- 44 695 employees (2016).

44 695

Other Atlas Copco business areas
(percentage of total revenue, 12 months ending September 2017)



33%

Compressor technique

Provides industrial compressors, vacuum solutions, gas and process compressors and expanders, air and gas treatment equipment and air management systems.

14%

Industrial technique

Provides industrial power tools and systems, industrial assembly solutions, quality assurance products, software and service through a global network.

17%

Vacuum technique

Provides vacuum products, exhaust management systems, valves and related products mainly under the Edwards, Leybold and Atlas Copco brands.

11%

Power technique

Provides air, power and flow solutions, offers specialty rental and provides services through a global network.

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From February 25–28, 2018 the **SME Annual Conference & Expo and 91st Annual Meeting of the SME-MN Section** will take place in Minneapolis, MN. The event provides a forum for more than 6000 industry professionals from across the world. smeannualconference.com

SHUTTERSTOCK

26–41 | EXPO
CONNECTIVITY

People all over the world are already connected. By 2020, the majority of Atlas Copco's machines will be too. How will this affect our way of working and doing business?

ON THE COVER
The bolting process is the bottleneck for Boliden when mining in Kristineberg, Sweden. To increase production, the company is working closely with Atlas Copco in the BoltOpt project, using data from the Certiq telematics solution. Mine Manager **Sunniva Haugen** is delighted with the results.

ELIN BERGE

08

OUR CUSTOMERS

"The aim was to find time thieves"

Half of the drill-and-blast cycle time at Kristineberg mine is spent on reinforcing the rock. Organizing work so that the Boltec LC can get more bolts in is key for operator Boliden to enhance efficiency.

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Mining & Construction is published by Atlas Copco's Mining and Rock Excavation business area. It focuses on the company's know-how, products and methods used for mining and construction worldwide.

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Safety first

Atlas Copco is committed to complying with or exceeding all global and local rules and regulations on personal safety. However, some photographs in this magazine may show circumstances that are beyond our control. All users of Atlas Copco equipment are urged to think of safety first and always use proper ear, eye, head and other protection as required to minimize the risk of personal injury.

New COP W4 hammer saves time and money

Low fuel consumption makes the **COP W4** hammer ideal for Säffle Brunnsborrning – not least since the end quality has also improved.

ØYVIND LUND

When drilling holes for geothermal heating and water wells Säffle Brunnsborrning aims to work swiftly and with low fuel consumption, while never compromising on quality. The new Atlas Copco COP W4 hammer makes that job easier.

"This hammer is the best one we've used," said **Daniel Carlsson**, owner and CEO, Säffle Brunnsborrning. "It saves us time and money thanks to its efficiency. Normally, we dedicate one day per job, and diesel is often a bigger cost than the driller's salary. But it's not just about the low fuel consumption. I would also say that the quality of our end product has improved."

SÄFFLE BRUNNSBORRNING has six employees and operates mainly in Värmland County, located in western Sweden on the border with Norway. The company used the COP W4 during a test year and provided feedback to Atlas Copco.

"I think that Atlas Copco hit the nail on the head with this one. The durability is fantastic and since the hammer is also easy to operate and service, we are more than satisfied," said Daniel Carlsson.

THE NEW DTH HAMMER had a limited release on the Scandinavian market in 2016 after 250 000 test meters had been drilled. It is already a proven success; compared to competing hammers, productivity is up to 10 percent better, energy consumption is up to 20 percent lower and the service life is up to 10 percent longer.

"The Secoroc COP W4 has a whole new design. The piston is smaller and lighter, and since the hammer weighs only 36.5 kilos it can easily be handled by one man. The hammer can also be rebuilt without loss of productivity, thanks to improved materials in internal components and casing. This means that our customer can basically get a new hammer at half the cost by using economy kit," said **Pavel Vedeneev**, Product Line Manager DTH.

DURING THE SECOND quarter of 2017, the COP W4 was released globally.

"We will now focus on developing DTH hammers of different sizes, so that we can offer a full range of hammers," said Pavel Vedeneev.

Säffle Brunnsborrning

- Founded in 1982.
- Employs six people.
- Uses two Well-Drill 3062 and two COP W4 hammers from Atlas Copco.
- Customers include plumbers as well as homeowners wanting geothermal heating and/or water wells.

Towards the future as Epiroc

IN 2018, a new company will be launched as a fully-owned subsidiary of Atlas Copco AB. Provided shareholders agree, Atlas Copco will stay focused on industrial customers and Epiroc AB, the company to be dividended out, will be a leading productivity partner for customers in mining, infrastructure and natural resources. The decision on whether to dividend out Epiroc will be taken at the Annual General Meeting in April 2018.

Read more on page 2.

Boyles C8C drill rig improves Chinese uranium exploration

AS THE CHINESE government continues to reduce coal power, the country's nuclear industry keeps expanding.

To drill for natural uranium, the Geology and Mining Division (GMD) of China National Nuclear Corporation has purchased an Atlas Copco Boyles C8C exploration drilling rig.

It has been used in multiple projects since 2015, greatly improving the exploration capacity of uranium mines in areas like inner Mongolia.

Healthier working environment with Boomer M2 Battery

DID YOU KNOW that our battery driven Boomer M2 Battery drill rig will charge the battery while drilling the face, so there's no need to stop for charging during tramming. This has been achieved without changing the size and usability of the machine. The Boomer M2 Battery can outperform diesel machines in most applications, with less heat generated and lower noise levels. Thus it provides a safer and healthier working environment underground, with much better air quality.

ELECTRIFICATION

80%

Batteries to change the face of underground mining

ROUGHLY 80 PERCENT of diesel consumed in mines is used for loading and truck transportation. However, the battery revolution is upon us and with the launch of the Scooptram ST7 Battery loader, Atlas Copco has shown that the technology is ready. The prototype stage is complete and mass production is underway.

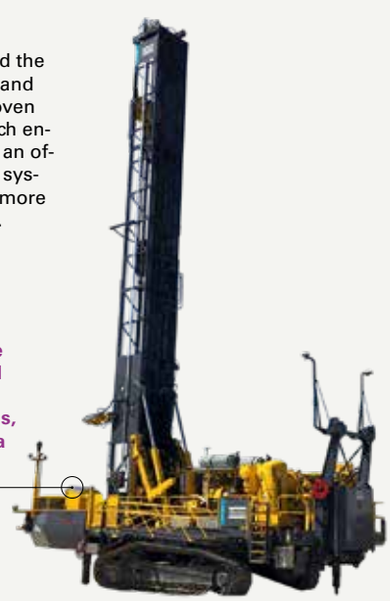
PROJECT NEWS

The future of mining is now

At MINExpo 2016, Atlas Copco presented the Pit Viper PV-275 CA, a fully autonomous and cableless blasthole drill. It features the proven CAN-bus Rig Control System (RCS), which enables the miner to operate the drill from an office. Thanks to Atlas Copco's automation system, utilization benefits can increase by more than 20 percent while operating the drill.

NEW TERMINAL

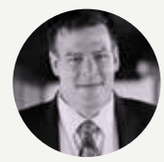
For maneuvering the vehicle during maintenance the drill is equipped with a terminal with an RCS display, controls, stool, and table along with a Bluetooth-enabled remote.



More bit.do/pitviperfacts

*In 2018 Atlas Copco's **Mining and Rock Excavation Technique** business area will form a new company, **Epiroc**.*

What possibilities do you foresee?



Jess Kindler

President
Mining and Rock Excavation Service division

"We have to take the chance to regroup after recruiting five new presidents and more than a dozen general and country managers. We have to do the right things when it comes to developing the next generations of leaders and managers. It's important that we provide them with opportunities for learning and training, and also challenges to develop them in a good way."

Claudio Strobl

Vice President Logistics Rock Drilling Tools division

"I trust the decision-making process will become faster, allowing us to concentrate our efforts on our customers. Epiroc's strategy is 'growth' and it will be a great challenge for the supply chain to offer service to match. We are determined to establish logistics as a competitive advantage, with precision in our services and speed in what we do."

Jon Torpy

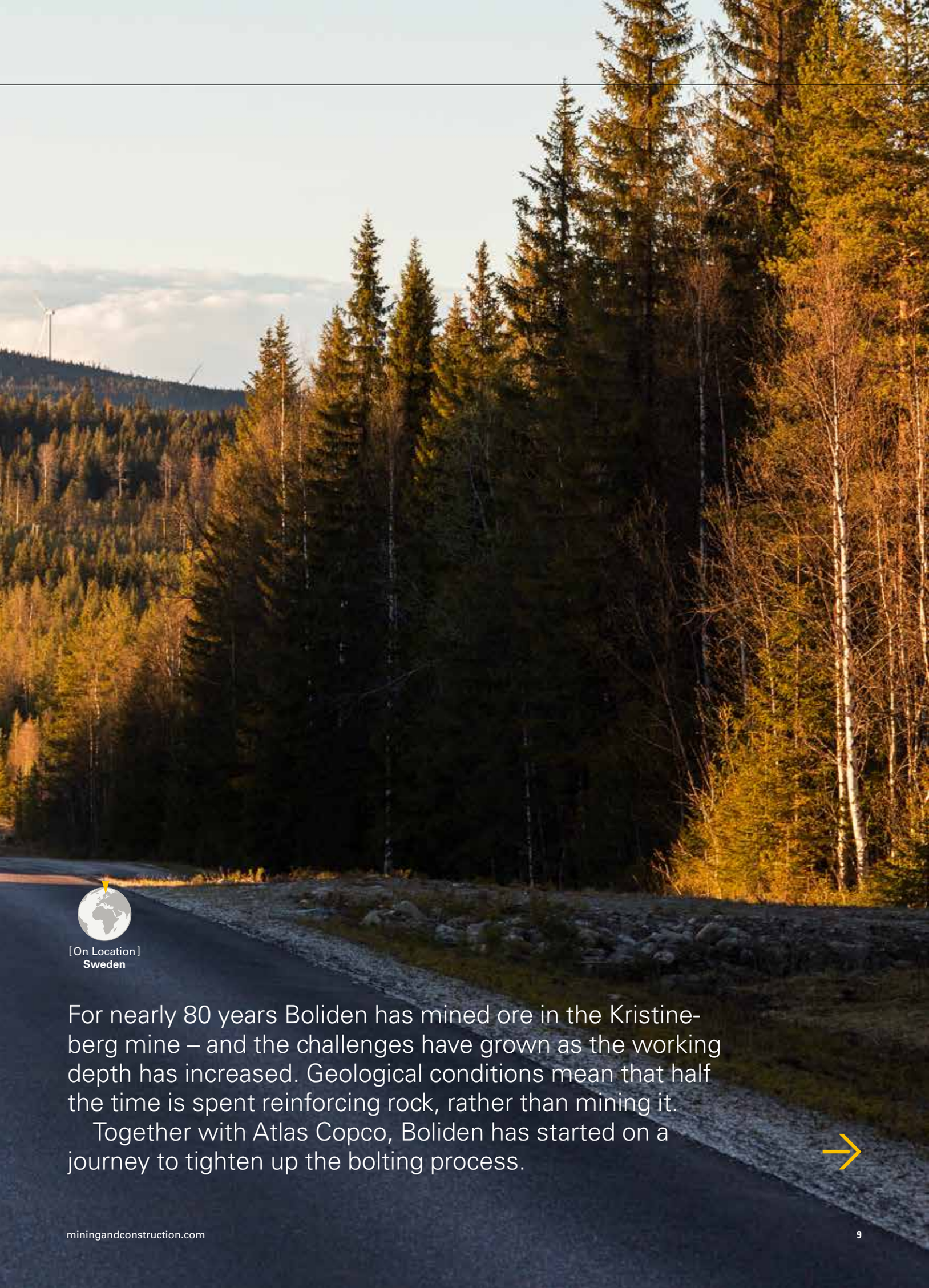
Vice President Marketing Advanced Drilling Solutions division

"I hope that we see Epiroc positioned as an innovation and technology leader in the industry. We have the chance to introduce ourselves to the market as a fresh and innovative company that maintains the experience and knowledge from our many years as Atlas Copco. Developing some key projects, partnerships and acquisitions around technology and automation will help to set that tone."

Gustaf Höök Elin Berge

Concrete results down the road

QUICKER BOLTING PROCESS ALLOWS BOLIDEN KRISTINEBERG TO MINE MORE ROCK



[On Location]
Sweden

For nearly 80 years Boliden has mined ore in the Kristineberg mine – and the challenges have grown as the working depth has increased. Geological conditions mean that half the time is spent reinforcing rock, rather than mining it.

Together with Atlas Copco, Boliden has started on a journey to tighten up the bolting process.

Daniel Lithell uses a theodolite to position the next round. The trick is to follow the irregular ore-boundaries that the geologist has entered into the onboard computer guidance system.

THE HEADLIGHTS OF the Boltec LC rock bolting rig light up the walls and roof of the concrete-covered drift. The last dark patches have almost completely disappeared.

"The concrete's now been hardening long enough for me to be able to start bolting," says operator **Magnus Linder**, fixing his gaze on the screen in the cabin of the bolting rig.

He focuses the optical instruments on the last row of bolts in the wall of the drift, "zeros" the rig on them and enters the preset bolt pattern in the Bolt View program. The screen shows him exactly where to position the bolts to form a perfect fan, with a gap of 1.2 meters both between the bolts in the rows and between each row. Magnus directs the boom towards the wall and drills with the drill steel, then changing over to the cement hose and filling the hole with cement. Finally, he uses the rig's bolt driver to drive home the 2.7 meter long rock bolt – a reinforcing bar with a threaded end and a plate at the far end.

Another 59 bolts and the drift will have been sufficiently reinforced.

BOLIDEN HAS BEEN mining ore in the Kristineberg mine, situated in Lycksele municipality in northern Sweden, since 1940. Initially a large part of the production was from open-pit mines, but now all the ore is mined underground – right down to a depth of 1 350 meters. The high rock pressure and the weak nature of the rock mean that the rock has to be reinforced so that it does not collapse after blasting. Walls and roof are coated in sprayed concrete, and the drifts are then reinforced with long bolts.

Magnus Linder
Operator, Boliden

Sunniva Haugen
Mine Manager, Boliden

"Half of the drill-and-blast cycle time is spent on reinforcing the rock," says Mine Manager **Sunniva Haugen**.

"That's a huge amount of time. Rock reinforcement is vital for safety, but generates no revenue. Bolting takes twice as long as blast hole drilling and is the bottleneck in the mine – in other words, the limiting factor on production capacity. The more bolts we can get in, the more rock we can mine."

At the shift start, Rock-support Supervisor **Jens Jonsson** (left) distributes work orders and informs his crew of risks or non-routine conditions in the mine.

IN 2016, BOLIDEN began working in partnership with Atlas Copco and ABB to streamline the bolting at Kristineberg. The Boltec Optimization (BoltOpt) project aims to reduce the time it takes to drive drifts by 20 percent. The work began by collecting a large amount of data, primarily through Atlas Copco's telematics solution Certiq (that gathers, compares and communicates vital equipment information) and Boliden's own systems, but also from field studies and by talking to operators, technicians and supervisors. Having compared this information with performance indicators, Atlas Copco – in dialog with the operators – came up with suggested improvements. The main conclusion was that the logistics down in the mine could be tightened up.

"The aim was to find time thieves, and we got them in black-and-white thanks to Atlas Copco," says **Michael Andersson**, Development Engineer at Boliden's central technical department.

"We were aware that a lot of time was being lost both through transporting people and replenishing stocks, but we didn't realize how much."

INITIALLY, THE SEARCH for new deposits in Kristineberg went more or less straight downwards, but over the years the tunnels and drifts have moved westwards – with the result that distances in the mine have increased. It is not uncommon for operators to travel several kilometers from one point to another during a shift. As regards transporting people: It all comes down to the fact that the operator of the bolting rig is generally the one driving the vehicle, so is the last to get to his or her workplace – despite the fact that he or she has the most time-consuming task. The reason for this is that the Boltec operator spends nearly all his or her time in the same place (the others will move their machines to new drifts in the meantime), so he or she is always by the vehicle when it is time for a meal break or shift change.

The Boliden area

- Established when gold was found in Boliden in 1924.
- Over the years, ore has been mined in around 30 mines.
- Today it encompasses three underground mines, one open-pit mine and a concentrator, in what is known as the Skellefteå field.
- Employs about 600 people.

This is a well-known fact to the operators, who at the time of Mining & Construction's visit to the Kristineberg mine have just been sitting in a meeting of one of the improvement teams, led by Michael Andersson and part of the company's Lean work.

Michael Andersson
Development Engineer, Boliden

André Lindholm
Operator, Boliden

"Transporting people takes up a lot of time," says **André Lindholm**. "One way to reduce this might be to have a transport vehicle, and that is a suggestion that we operators have made."

Michael Andersson nods:

“Needless to say, being helped to get as much as possible out of our machines is a good thing – and we want to spread the knowledge.”

Michael Andersson
Development Engineer, Boliden

“That has been up for discussion, but would require an extra person per shift. What we have done for now is tighten up the procedures so that we get the Boltec operator in position as quickly as possible.”

To reduce time spent on transporting bolts and cement, a new stockpile is being built up closer to the part of the mine where most mining is going on.

“It’ll save time, but in the longer term we may need to have a vehicle driving material out there. That’s also something we’ve discussed,” says Michael Andersson.

ON TOTALING UP the first part of the BoltOpt project it became clear that the shift team’s effective working time had increased and that the number of bolts being positioned was up by around 10 percent. In terms of generating money for Boliden, this represents an extra drill-and-blast cycle per month.

“Since a round cycle is worth half a million kronor – or roughly 50 000 euros – it’s extremely important to be as efficient as possible,” says Sunniva Haugen. “So it’s great that the BoltOpt project is having such excellent results. To start with, Certiq provides very useful information. As soon as we identify a problem, Certiq helps us find out all of the details. What’s more, the fact that Atlas Copco has been able to have such close dialog with our employees and has gathered information in the field is of great value.”

The next step in tightening up the processes at Kristineberg will involve more shift teams as well as the Boomer E2 drilling rig.

“In the longer term, more of Boliden’s mines can definitely be involved,” says Michael Andersson. “Needless to say, being helped to get as much as possible out of our machines is a good thing – and we want to spread the knowledge.”

Kristineberg

- Mining takes place underground at depths down to 1 350 meters, using the cut-and-fill method.
- The rock consists of complex sulfide ore containing zinc, copper, gold, silver and lead.
- Produces around 650 000 metric tons of ore annually.

Atlas Copco and Kristineberg

Kristineberg uses five rock bolting rigs (three Boltec LC rigs and two Boltec EC rigs) and three drill rigs (Boomer E2) from Atlas Copco, and has also had an underground loader (Scooptram ST18) for field tests. Atlas Copco has produced software to facilitate both bolting (Bolt View) and drill rig navigation.

Since 2016 Kristineberg, Atlas Copco and ABB have been collaborating on BoltOpt, a project to streamline the bolting process.

5 KEYS TO SUCCESS

1 Production data from Certiq

Atlas Copco's telematics solution Certiq connects all Kristineberg's new machines from Atlas Copco, giving automatic access to accurate production data. This is then compared with performance indicators to identify possible efficiency improvements.

2 Streamlined logistics save time

Kristineberg has put greater focus on getting the Boltec operators out to their workplaces as quickly as possible, since their part of the process takes the most time. A new stockpile for materials aims to shorten transport times.

3 New organization improves learning

Each shift now has its own supervisor for rock reinforcement and extraction respectively, meaning that the supervisor can be more effective and also find time to coach staff and develop their skills.

4 Improvement teams increase involvement

Each shift has its own improvement team – a forum for involving employees and benefiting from their knowledge. The teams' work also brings more opportunities to catch problems far out in the organization.

5 Bolt View for better bolting

The Bolt View program was produced by Atlas Copco at Boliden's request. Preset bolt patterns speed up bolting and improve accuracy compared with manual bolting.

SmartROC T45

- **Model: SmartROC T45.**
- **Year: 2013.**
- **Performance: 3 ½–5" hole range, hydraulic rod handling system, 230/240 bar rock drill, chain-driven feed, 242 kW diesel engine, screw-type compressor, folding boom.**
- **Navigation: Atlas Copco HNS, a GNSS site-navigation system, with two-joystick operation in air conditioned cabin.**

[On Location]
Norway

Granodiorite exposed after clearing pine woods comprises the target for SmartROC rigs acquired by entrepreneur Natland Graveservice in Norway.

Automatic for the people

⟶ Keeping the stones rolling from Northern Europe's largest aggregate quarry requires top people with rugged motivation and a staggering portion of patience. Or less so, when operating a SmartROC T45 drill rig.

The automatic drilling function of the SmartROC T45 works smoother than anything **Morten Natland** has tried before. "It feels almost like sitting at home," he says. Natland is one of the seasoned operators at Natland Graveservice, a local entrepreneur with 20 employees drilling all the blasting holes in the aggregate quarry in Jelsa, Western Norway. Striving for an annual capacity of 10 million tons of grandiorite, a highly sought after stone variety used in construction, the quality and regularity of Natland's drilling is crucial.

Founder and owner of Natland Graveservice, **Geir Natland**, is making the investment calls. Currently, he has received three SmartROC T45 drill rigs and one SmartROC T40 drill rig. After two years of operation, Geir Natland has a firm grip on the SmartROC T45.

Why did you pick the SmartROC when acquiring new drilling rigs?

"I've basically got three reasons: Reliability in operation is number one; fuel consumption ranks second, due to substantial savings compared to former rigs. Reason number three is comfort of operation, which shouldn't be underestimated."

How do you assess the overall performance of the SmartROC T45?

"I'd have to say it's one of the world's best drilling rigs. I like the speed of the chain-driven feed, the noise is quite low, the operator's cabin is really comfortable and the automatic drilling system runs smoothly. We have reached 5 000 hours of operation with practically no incidents at all. Even though we require every bit of the service contracts with Atlas Copco, it's much more important that the base quality of the SmartROC T45 is optimal. Which clearly it is."

Could you disclose some specific details from your evaluation of the rigs?

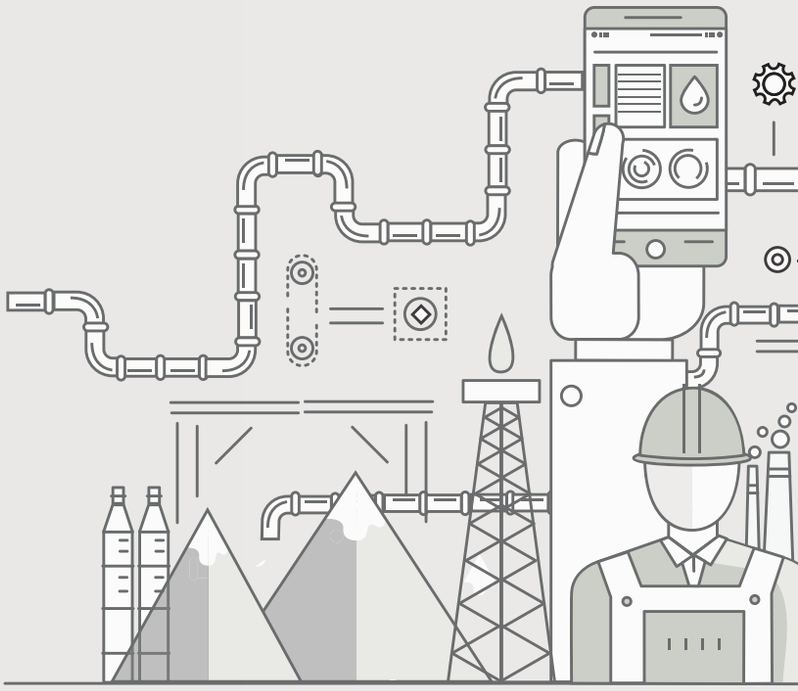
"Sure thing. Every hour of operation we save between 12 and 15 liters of fuel per machine, compared with the old rigs from a different supplier. The new chain-driven feed mechanism makes it more reliable and easier to repack than the old wire concept, adding a plus to the boys' working situation."

Tricky question: What improvements could make the SmartROC T45 even better than today?

"As your readers would know, the SmartROC rigs can be modified to suit almost any condition. That said, our extremely hard granite drilling in steep and untidy terrain requires maximum flexibility from rig and boom, as well as great mobility of the vehicle itself. Any improvement to that aspect would be welcome, no matter how great these rigs get. It's the driller's stairway to heaven; more flexibility and bigger hammers at the same time." ×

Geir Natland
Founder and owner of Natland Graveservice

Are SmartROC drill rigs the most fuel efficient in the world? See the world record attempt: mostfuelefficient.com



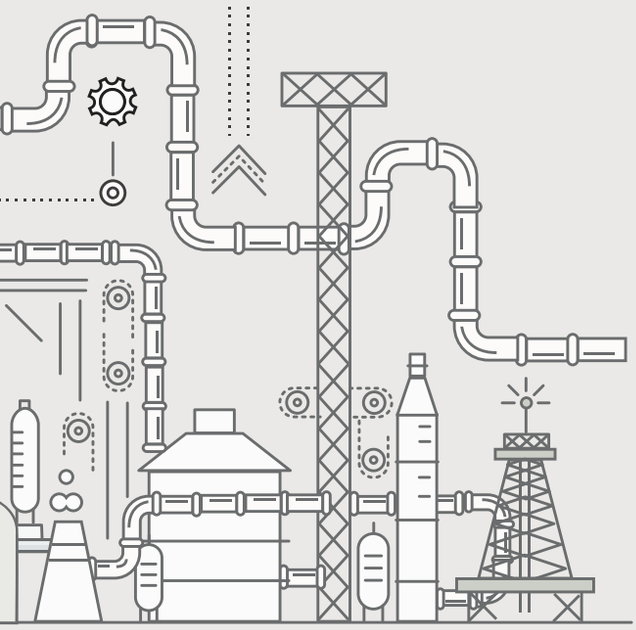
Sharing is caring

THE NEXT STEP IN UNDERGROUND ROCK EXCAVATION

The Mobile Miner offers a new way of continuous hard rock mining with the potential to change the mining industry. It exists thanks to a successful partnership between Atlas Copco and Anglo American.

ROLAND BERNDT
Head of Transformative Technology, Mining at Anglo American. Based in Brisbane, Australia.

[On Location]
South Africa



Back in 2012, Anglo American approached Atlas Copco to discuss their future challenges. Anglo American, a globally diversified mining business with operations and projects on five continents, wanted to move towards a continuous mining system based on mechanical rock cutting with a view to improving safety and productivity, initially within its Platinum business.

Five years later, after advanced trials at the company's underground mining operation at Twickenham mine, South Africa, Atlas Copco is launching the Mobile Miner. It is a small and flexible machine that enables faster, safer and more predictable mining – using a technique that has never before been used for hard rock mining.

Mining & Construction brought together Anglo American's **Roland Berndt** and Atlas Copco's **Mikael Ramström** for a discussion on innovation and successful collaborations.

How did the collaboration between Anglo American and Atlas Copco begin?

MIKAEL RAMSTRÖM: "Anglo American wanted to look into new technological possibilities of mechanical mining. The intention was to apply Mechanical Rock Excavation, a technique we had developed with another miner. In the fall of 2012 we started work on the Rapid Mine Development System, or RMDS. Over time we started using the name Reef Miner. Atlas Copco has now launched the machine and it is called the Mobile Miner 22H."

MIKAEL RAMSTRÖM

Director, Global Strategic Projects and Alliances at Atlas Copco Rock Drills AB. Based in Örebro, Sweden.

"It is very flat, and primarily excavates valuable reef instead of waste rock."

Roland Berndt, Head of Transformative Technology, Mining, Anglo American

ROLAND BERNDT: "We realised there wasn't an off the shelf product already available. So we sought a development partner. Atlas Copco's solution was interesting. There are tunnel boring machines that can do the same kind of tunneling, but they tend to be very large. For platinum, where the reef is quite narrow and thin, those machines are excavating a lot of waste material and the economics become a problem. The RMDS was designed for the excavation of low-profile tunnels in hard rock; it is very flat, and primarily excavates valuable reef instead of waste rock. Anglo American Platinum had a need for this kind of machine, and the Anglo American Group as a whole wanted to explore continuous hard rock cutting as a more general mining innovation as part of its FutureSmart Mining proposition."

Mikael, you have described the mining industry as conservative, but Anglo American as an open-minded operator. What do you mean by that?

MR: "Anglo American is a truly global company, just like Atlas Copco. Their set-up at the Twickenham mine is more or less unique, and it is ideal for testing and R&D. We used an existing technology, commonly used in other types of tunneling and in civil engineering, and we packaged it in a smaller machine. The trick for us is not to develop the cutting method itself, but to adapt and package a proven and already existing technology for the mining industry."

RB: "Many mining companies adopt a 'fast second' or 'fast follower' technology strategy, so yes, the mining industry can be conservative. However, Anglo American has strategically chosen to be a technology leader in certain areas. We believe safety and sustainability go hand in hand and that the Mobile Miner will help the industry take a step in the right direction in achieving both."

In focus: Anglo American

Anglo American is a globally diversified mining business with operations and projects on five continents. With headquarters located in London, United Kingdom, its primary products are diamonds, copper, platinum group metals (PGMs), iron ore & manganese, coal and nickel.

The Twickenham mine is located in the northwest of South Africa, at one of the largest platinum reserves in the country. At the moment the mine is used primarily for testing and research.

- **87 000 employees worldwide.**
- **Founded in South Africa in 1917.**
- **Underlying EBITD: $6.1 bn (2016).**

More angloamerican.com

The Mobile Miner 55V is typically used in large access tunnels for mine development and material haulage. Some of the available automation features are laser navigation, remote monitoring and automatic rock cutting of the face.

This collaboration has been favorable, but what were the difficulties along the way?

RB: "One concrete problem is that there's a lot of activity at the mine. Many different projects mean that there is competition for time and space. We had to make the Anglo American underground site team available and had to make sure the infrastructure was robust. One of the classic difficulties is that you have the supplier sitting in Europe and the mining operations and project team in South Africa. Fortunately, Atlas Copco has good representation in Johannesburg. We communicate well and all parties have had an open approach to solving problems."

MR: "We are equal partners on this project, but sometimes you fall back into the more traditional roles of customer and supplier. For the ones who were working daily on the project this has never been an issue, but people who are involved intermittently can be confused because our way of working is so transparent. We share insights and knowledge, and that is quite rare between a customer and a supplier."

Roland Berndt
Anglo American, Australia

Mikael Ramström
Atlas Copco, Sweden

So is the Mobile Miner a new step in technology?

MR: "Yes, and we are happy to have this product family and we want to share it. There is still testing going on, but we are confident the project will deliver."

RB: "Yes. One of the real benefits of going mechanized is the productivity improvement, but it is also about safety. The cutting process doesn't do as much damage to the surrounding rock, which leads to less risk of fall of ground. A mechanized mining method improves safety by taking people away from the riskier areas. We want people to appreciate that this kind of modernization actually improves the performance of the mine and makes it more successful, so everyone benefits."

Will Atlas Copco and Anglo American maintain their partnership after this project?

RB: "We think these machines could be incorporated at other Anglo American sites. In that case, we would go to Atlas Copco and buy a machine off the shelf; but without this development work we could never have reached that stage."

MR: "We have another project running in parallel, the Slotborer Project, which is linked to the RMDS project. We will continue to work on that for at least another year, but we believe there is potential to work together in other areas as well." ×

4

KEYS TO A SUCCESSFUL PARTNERSHIP

Despite the best intentions, cooperation does not always run as smoothly as one would like. After working together on the Mobile Miner project, here are Roland Berndt's and Mikael Ramström's best advice for a rewarding collaboration.

Expert knowledge

✓ Both parties trust each other's expertise. Anglo American had confidence in Atlas Copco's rock cutting knowledge, and Atlas Copco knew that Anglo American would be able to provide valuable feedback from a state-of-the-art test ground.

Collaborative behavior

✓ During design, fabrication and test phases, you need as much input as possible from all parties. The views of operators and service technicians are just as important as those of engineers and managers.

On the ground presence

✓ Once you start testing, you need both customer and supplier on site. Hundreds of details need to be managed, which is hard to do remotely.

Commitment from the top

✓ You need commitment and understanding all the way up to the CEOs. There will be setbacks, and that's when you need perseverance and the support of management.

More bit.do/mobileminerfacts

AROUND THE WORLD IN BRIEF

Want to keep track of what's happening in the mining and construction business? Visit **miningandconstruction.com** for links to industry news and other interesting reading.

SPACEX

Miners on the Moon

LUNAR MINING SOUNDS like a concept lifted straight out of the realm of science fiction, but the fact is that it could soon become real.

In April 2017 the Elon Musk company SpaceX successfully reused a Falcon 9 first stage rocket booster, claiming that recycling boosters can, in time, cut the cost of space launches by a hundredfold. In that case, business in space – including the harvesting of resources – will become a viable and attractive option.

For example, the company Moon Express plans to shortly begin surveying the Moon for, among other things, precious metals and rare metallic elements such as niobium, yttrium and dysprosium. Private exploration company Ispace has even more far-reaching plans, including building a sustainable lunar ecosystem and firmly establishing a space economy. Much of the focus on the Moon is on its vast reservoirs of water, which can be used to produce efficient rocket fuel.

Exploring the asteroid belt

IN JANUARY 2017, NASA announced a mission to study the massive asteroid 16 Psyche. It is thought to be comprised mostly of metallic iron and nickel, containing almost one percent of the mass of the entire asteroid belt.

The Psyche robotic mission is targeted to launch in 2023, arriving in 2030. Several private companies have drawn up plans to explore the asteroid belt for potential mining and refueling opportunities.

RUBIN/NASA/JPL-CALTECH

George Nikolakopoulos
Professor of Robotics and Automation, Luleå University of Technology, Sweden

How might drones change the business?

Why is the mining industry looking at automation and robotization?

"The mining industry has a vision of removing people from what is called Zero Entry Production Areas – that is, the harshest environments in the mines. To that end, we're developing robotized solutions with high accuracy and efficiency that will allow the workers to remain in safer locations."

What solutions are your teams developing?

"The area we're mostly focusing on is drone technology – fully autonomous drones, with no human intervention beyond defining the mission. For example, drones can inspect volumes on site after blasts, or inspect shafts. They are faster and more accurate than other solutions."

How feasible is this drone technology?

"We have a couple of obstacles to overcome. Firstly, the problem of localization – drones and robots need to know exactly where they and all their parts are in relation to the environment, with millimeter precision. To solve this, we're developing software algorithms to combine and analyze a multitude of data from a variety of sensors, including stereo cameras, lidars, IMUs and UWB positioning. Secondly, we have to make the drones better protected from the harsh environment in mines. For instance, magnetic dust can cause motors to stop working after mere days or even hours of use in a mine."

More simsmining.eu

Pinpointed

01 Into the abyss
Papua New Guinea

➲ Increased depletion of land resources compels many companies to look seaward, where there is a largely untapped potential for the mining and harvesting of minerals. Nautilus Minerals has stated plans to mine the seafloor outside Papua New Guinea for copper and gold deposits in a project called Solwara 1.

Material will be collected as slurry using an auxiliary cutter, a bulk cutter and a collecting machine, then pumped to a floating production ship. Residual seawater will be filtered and sent down again to the original environment.

02 Internet of Things number one priority
London, UK

➲ The Internet of Things (IoT) has become the leading technology for digital transformation and is the number one priority for 92 percent of organizations – including companies from the mining sectors, according to global research findings published by London based Inmarsat. Improved service delivery capabilities (47 percent), better health and safety across the organization (46 percent), and greater workforce productivity (45 percent) were identified as the top three benefits to be gained from the deployment of IoT-based solutions.

03 Solar power to reduce emissions at iron ore mine
Jharkhand, India

➲ Tata Steel recently inaugurated a 3-megawatt solar photovoltaic power plant at the company's Noamundi mine, located in the state of Jharkhand in India. It is the country's first solar project located at an iron ore mine and will help Tata Steel, the second largest steel maker in India, replace a part of the electricity it consumes from the grid and from diesel-based generators.

The installation covers 19 acres of land and is expected to help reduce CO_2 emissions by about 3 000 metric tons each year.

04 The Quarry Life Award
Germany

➲ HeidelbergCement has announced the fourth edition of the Quarry Life Award, which targets innovative approaches to studying and boosting biodiversity at quarry sites.

The award has been split into two main areas: Research, with scientific projects that increase knowledge of mining ecology and lead to improved biodiversity, landscape and water management; and community, which focuses on engagement and outreach projects that help quarries to better connect with local stakeholders.

Project registration is now open and runs until November 20, 2017. Several prizes will be awarded, with the best overall project receiving 30 000 euros.

HEIDELBERGCEMENT

Ulf Roosvald Jarkko Mikkonen
Atlas Copco/Rubrik AB (COPROD), Atlas Copco/Visual Work (SmartROC CL)

GROUNDBREAKING TECHNOLOGY

AHEAD OF THE PACK

The new SmartROC CL drill rig is a step ahead when it comes to automation, safety and power. To ensure this, the machine was tested under the harshest conditions in Finland.

THE ENVIRONMENT at the Yara Siilinjärvi mine is a challenge for both humans and machines. Here, in central Finland, winters are cold and summers are wet. To keep producing at required pace at the biggest apatite mine in Europe, personnel with a certain mindset are needed – as well as durable equipment. The site consists of a mixture of hard and soft rock formations, which makes the task even more difficult. For these reasons, the place is a perfect setting for testing.

"The challenges in Siilinjärvi are the freezing temperatures in the winter and humid summers with damp stone. This poses challenges to making holes," says drill rig operator **Henry Posio**.

Posio is one of the operators at E. Hartikainen Oy who has been working extensively during 2016 with Atlas Copco's new SmartROC CL, the successor to the FlexiROC C65.

Juhani Tiikkaja
Site Manager,
E. Hartikainen Oy

"My impression of the machine is good," he says. "It's easy to use, all the controls have been remodelled and it was easy to familiarize myself with everything."

THE SIILINJÄRVI MINE is owned by fertilizer producer Yara. E. Hartikainen Oy has been operating at the site for a long time, since 1979, and has a long history of using Atlas Copco equipment. The SmartROC CL comes with new and improved COPROD technology.

"We got our first COPROD in 2004. The oldest one still in use dates from 2006," says site manager **Juhani Tiikkaja**. "Last year Atlas Copco offered us the chance to test the new rig during a trial period. We discussed it and decided that it would be nice."

Drill Rig Operator **Henry Posio** enjoys the performance and comfort of the new SmartROC CL drill rig.

The SmartROC CL was heavily used in two shifts in production. It was then sent back to Sweden, with some feedback from the Finnish crew, for fine-tuning and software updates, after which E. Hartikainen Oy purchased the machine.

[On Location] **Finland**

THE IDEA BEHIND developing the SmartROC CL was to create a rig that could lower the cost for the total drilling operation. Atlas Copco also wanted it to be flexible and able to drill both small and large holes.

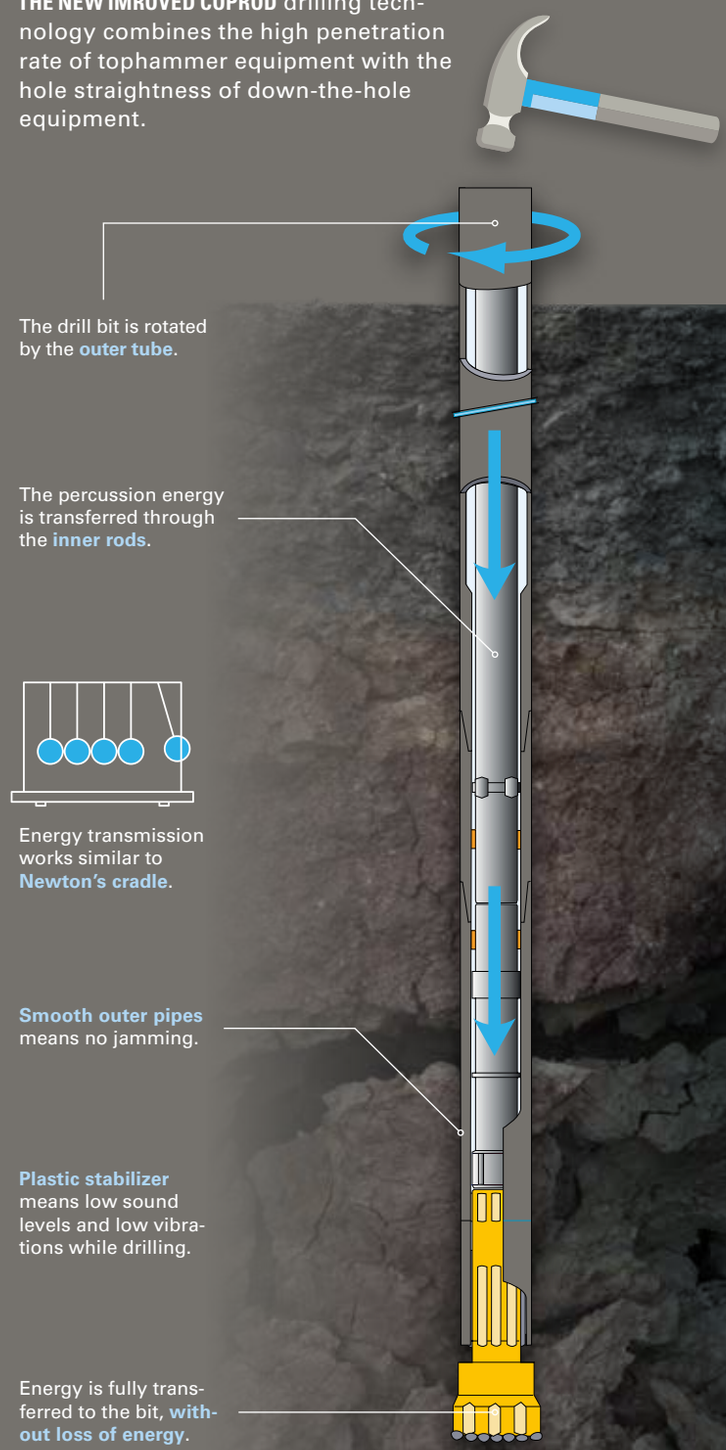
The tests seem to confirm the theories.

"The fuel consumption is significantly lower than that of the FlexiROC C65. We are also expecting longer life for the drilling tools," says Juhani Tiikkaja. "The rock types here at the Siilinjärvi mine are very different. For this particular environment, the SmartROC CL is the most cost-efficient for us. The new rig will also improve the

LEARN MORE // COPROD

Fast and straight drilling

THE NEW IMROVED COPROD drilling technology combines the high penetration rate of tophammer equipment with the hole straightness of down-the-hole equipment.



More bit.do/smartrocclfacts

E. Hartikainen Oy has a long history of using COPROD technology. **Juhani Tiikkaja**, Site Manager at Siilinjärvi mine, is more than pleased with the new SmartROC CL rig.

Henry Posio
Drill Rig Operator,
E. Hartikainen Oy

work environment of the operators. The cabin is quiet and ergonomically designed, and the controls have been revamped."

Henry Posio says:

"The cabin is very pleasant to work in. New features include stepless adjustment of the compressor, dust collector and water mist. There is no need to go outside to adjust the air pressures. All this is a great step forward for us drill rig operators."

Henry Posio has more than ten years of experience with COPROD equipment and he appreciates that Atlas Copco is continuing to develop it, not least from a safety perspective. Thanks to the new technology there will be less human error as the automation takes care of drilling and dismantling.

"WE HAVE USED COPROD in all the Atlas Copco models. It's an advantage that you get straight holes, it is very user-friendly, it is easy to dismantle from the hole, and it's durable," says Henry Posio.

Juhani Tiikkaja sums up all the new features which made up this machine in a typically understated Finnish manner:

"The SmartROC CL is better than the FlexiROC C65. The operators are satisfied. But then, it's a new machine, so we didn't expect anything less from Atlas Copco." ×

Lower fuel consumption

The new SmartROC CL consumes 50 percent less fuel than the DTH and 30 percent less than its predecessor, the FlexiROC C65. This means a **low total cost of ownership**.

Precise and accurate drilling

The Auto Drill Cycle and Hole Navigation System make it easy for the operator to **control proceedings from inside the cabin**, with little reason to step outside.

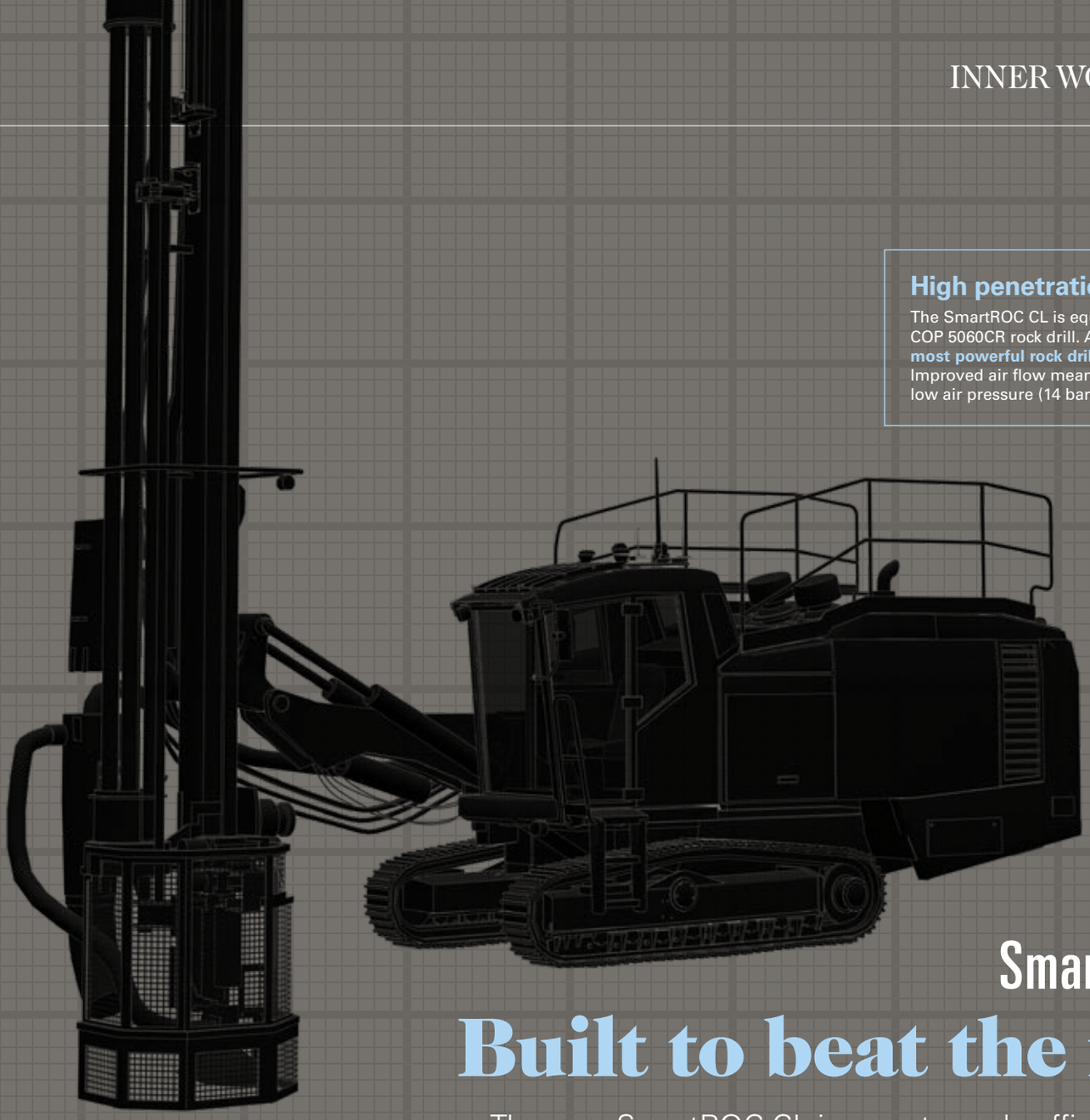
BenchREMOTE technology

The machine can be safely operated from up to 100 meters. One operator can control **three rigs at the same time**, taking productivity to a new level.

E. Hartikainen Oy

ONE OF FINLAND´S major contractors in the mining industry, with a fleet of more than 200 units. Mainly focused on mining services, mining operations and infrastructure construction for mine sites. Important mining operations include the Yara Siilinjärvi mine, Terrafame nickel mine, Boliden Kevitsa mine and Mondo Minerals talc mines.

- **Car dealer:** 220 employees.
- **Mining and construction:** 460 employees.
- **Mine production drilling (165 mm):** >1.5 million meters.
- **Other excavation drilling (89 mm):** >0.5 million meters.
- **Mass movement, rock:** >50 metric tons.
- **Mass movement, topsoil:** >2 million cubic meters.



High penetration rate

The SmartROC CL is equipped with the COP 5060CR rock drill. At 50 kW it is **the most powerful rock drill on the market**. Improved air flow means it also requires low air pressure (14 bar).

SmartROC CL

Built to beat the rock

The new SmartROC CL is an extremely efficient surface drill rig. Equipped with the COPROD* system and the most powerful rock drill available, it will drill large or small holes under any conditions; safely, quickly and reliably.

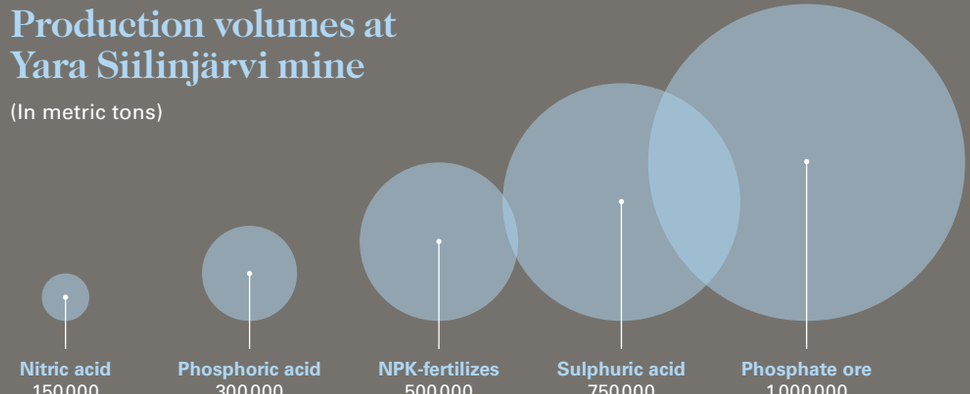
(*see page 23)

Siilinjärvi site facts

OWNED BY NORWEGIAN fertilizer producer Yara, located just north of the town of Kuopio, in North Savolax, Finland. The site consists of one mine, two sulphuric acid plants, one phosphoric acid plant, one nitric acid plant and one NPK-fertilizer plant. The mine is the only producer of phosphate ore in Western Europe, producing apatite, biotite and calcite.

Production volumes at Yara Siilinjärvi mine

(In metric tons)



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[EXPO]

CONNECTIVITY

It has been labelled the fourth industrial revolution. Whatever the term, the effects of increased connectivity are changing the game plan around the world. With new technologies fusing the psysical, digital and biological worlds, the possibilities are almost endless. What is its potential for the mining industry – and what is Atlas Copco doing to enhance business for customers?

CONTENTS

Revolution or evolution?

Ulf Roosvald Björn Öberg Shutterstock

Machines are becoming more and more automated, and at the same time more connected to each other. This connectivity reduces distance and time to a minimum, making communication between machines and humans faster than ever. Some say we are on the verge of a fourth industrial revolution. So how should we react?

The term "fourth industrial revolution" was not totally new. But it was in January 2016, at the World Economic Forum's meeting in Davos, Switzerland, that the concept became a catchphrase. In his opening speech, the forum's founder and executive chairman **Klaus Schwab** said: "We must develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural and human environments. There has never been a time of greater promise, or greater peril."

These were big words, optimistic and scary in equal measure, and the meaning was clear: We are standing on the brink of a revolution unlike any other. And it will affect all aspects of our daily life.

THE FIRST INDUSTRIAL REVOLUTION took place when the steam engine enabled mechanical production in late 18th century Britain. The second industrial revolution began when automation enabled mass production at assembly lines a hundred years later. The introduction of the microchip indicates the start of the digital age and the third industrial revolution.

And now, through artificial intelligence, advanced robotics, big data and extreme connectivity, we are entering a new phase. When machines are connected to each other, sharing data, time and distance are no longer a hurdle. Instead, instant communication will be possible globally and universally. In the best scenario, this will mean a democratization of the way we communicate. But it also poses challenges for industries and their workforces – not least for a traditional heavy industry like mining operations.

Håkan Schunnesson
Professor at Luleå University of Technology

INDUSTRIES WILL BE digitalized and will need to find new business models, and the workforce will also be affected. There is a risk of job losses when it is highly skilled people that are needed for operation, but also an opportunity to educate and upskill people. Equally, there is an opening for a highly skilled maintenance crew when much higher reliability is required for automated, unmanned production systems.

As usual, those who are early adopters will prosper; those who are not are at risk at being left behind.

Klaus Schwab describes the development of the fourth industrial revolution as "a tsunami", which definitely sounds dramatic.

However, not everyone agrees. Yes, a lot of things are happening as industries and physical manufacturing become integrated with the Internet of Things. At the same time, the changes might not be so fast, and for the mining industry, the changes might be all for the better.

Håkan Schunnesson, a professor at Luleå University of Technology in Sweden, is one of those working hands-on with this development in his research on Mining and Rock Engineering.

"The real challenge is to retrieve the right data and use it in a valuable way in the production process."

Håkan Schunnesson,
Professor at Luleå
University of Technology

He is thrilled by the possibilities, but does not expect a quick overhaul of the industry.

"This has been going on for a number of years. We are working with new technology applied in a new way, but nothing will change overnight the way it almost was with the Spinning Jenny, for example." he says. "Just because there's talk of the fourth revolution we shouldn't be misled into believing that there will be shortcuts or that things will be solved by some kind of magic. It's a slow development where people in the industry need to learn new processes."

STILL, THE POSSIBILITIES to change and modernize the mining industry are bright.

All the mining processes – such as drilling, boring, blasting and loading – will be affected by new digital processes that will increase productivity, and the data generated will also help safety and environmental work.

"We are working on data-logging for many different types of mining equipment, both above and below ground," says Schunnesson. "With drilling data we are able to predict ore quality, locate ore boundaries and have the opportunity to measure the geomechanical features of the surrounding rock mass."

THAT WAY MINING COMPANIES will be able to let lithology and ground conditions improve resource efficiency and mining economics. Unit operations, such as blasting to predict fragmentation, will also be improved and will be carried out long before starting the downstream operations. All thanks to machines being connected to each other. But a revolution?

"Well, connecting machines is just the first step," says Schunnesson. "They generate incredible amounts of data, and that is excellent. But the real challenge is to retrieve the right data and use it in a valuable way in the production process. It will be some time before we are there." ×

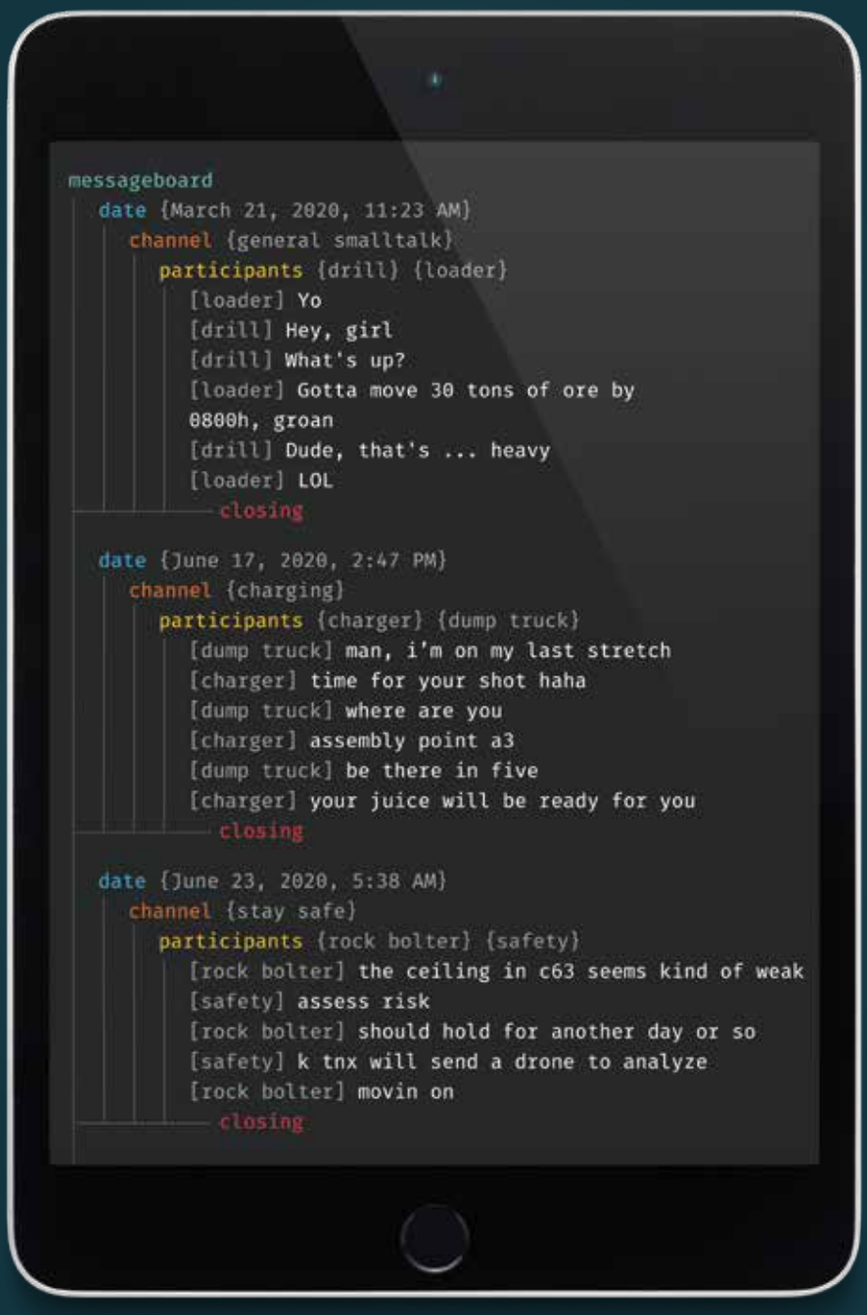
SAY WHAT?

Internet of Things or *Industrial* Internet of Things?

NEW TERMS TEND TO be thrown around carelessly once they become established. What exactly is, for example, the difference between Internet of Things and Industrial Internet of Things?

The Internet of Things:
A network of physical objects with embedded electronics that enable the objects to share data. Includes smart home appliances, like connected refrigerators, or heart monitoring fitness bands.

The Industrial Internet of Things:
Draws together fields like the Internet of Things, big data and machine learning to analyze data and use it to adjust operations. This could concern the oil, gas or mining industries, power generation or healthcare. The Industrial Internet helps operators to optimize productivity or detect a failure before it occurs, and it can deliver powerful financial outcomes. The more machines, systems and devices that are connected, the more data and valuable insights we will get.



Look who's talking

⟿ Improving fleet management is vital to Atlas Copco and we've set the bar high. By 2020, the majority of machines are to be connected. The Atlas Copco automation team is at the heart of the revolution.

Gustaf Höök Andreas Hylthén

[On Location]
Sweden

"We need to ensure that customers are getting the most from what they buy."

Olav Kvist
Vice President Mining Technology,
Atlas Copco

Karin Jirstrand switches on her Pit Viper drill rig and starts the engine – but rather than tramming off in the machine, she logs into a web portal.

"You can follow what the machine is doing here," she says. "Right now I'm going to run through a drilling process to verify that everything can be seen in the portal."

We're not in a mine somewhere. Instead we are at Atlas Copco's automation department in Örebro, Sweden, where Karin Jirstrand is the project leader in a team that is working to connect digitally to all machines. The control panel she is sitting at is identical to that of the Pit Viper drill rig, but in all other respects the panel is a virtual one. Just like more than 700 operating Atlas Copco machines around the world, it is connected through the Certiq telematics platform. All the machines can be tracked via the web portal, and now Karin tests various alarms on her control panel to check that they can be seen there.

She then looks at her laptop on the Certiq portal to track two real machines.

"They have had an abnormally high number of alarms over the past 24 hours," she explains. "One of them has stabilized, so the operator must have remedied the fault. The other one is still having problems, so I need to download the settings and assess them."

AT THE LAB in Örebro, Karin and her colleagues are coming up with definitions to allow the easy evaluation and tracking of more than 60 different models. Their work helps the Atlas Copco Customer Centers around the world to become more proactive and the equipment to be used more efficiently. Atlas Copco's goal is for the majority of machines to be connected by 2020. New products are being designed in order to achieve this, while older machines are being adapted so that they can be linked through Certiq. The idea is to collect as much valuable information as possible, which can then enable customers to use their equipment to its full potential.

Karin Jirstrand
Product Manager
Interoperability,
Atlas Copco

"Atlas Copco's job is not just to develop and sell good equipment and then provide quick service. We also need to ensure that customers are getting the most from what they buy. We are moving from being quickly reactive to being slowly proactive," says **Olav Kvist**, Vice President Mining Technology.

He continues:

"Take spare parts, for example. Traditionally, our role was to supply new parts as quickly as possible when something broke down, but if you can measure the 'health' of a machine then you can predict when the part is going to fail. We call it anomaly detection. It means we can send spares efficiently and in an environmentally friendly way, replacing a part before its failure causes the machine to stop working. Our vision is to have zero unplanned stops, since the cost of having expensive machines standing still is high."

EXTRACTING DATA FROM equipment is nothing new to Atlas Copco, but the methods and possibilities have changed radically. In the 1990s various types of portable memory were used, moving in the early 2000s to satellite communication in the ProCom system. Now it is done by wireless telecommunication, so at the heart of Atlas Copco's work is Certiq – a telematics solution that is available for all types of mining and construction equipment, both surface and underground. Real time data allows owners and operators to monitor and optimize the operation of their equipment at any time and from anywhere.

Olav Kvist pulls out his laptop and logs on to the Certiq portal. One customer page displays a chart featuring low yellow and green bars, and considerably higher red ones.

"Red means that the machine has been shut down, yellow that it is idle and green means that it is in active production. It shows this data for each 24-hour period and as you can see in this example, the machine is operating at a low rate. That is the reality for most of our customers, and we want to help them increase their productivity."

Karin Jirstrand nods and interjects:

"It's about generating business benefit from the opportunities offered by the Internet of Things and the Industrial Internet. For our part, it is about helping customers to connect digitally with their fleet – but also to interpret the information provided by relevant indicators. Partly so that we know when preventive maintenance is needed, and partly so that our customers can create optimal strategies for achieving their business goals."

ATLAS COPCO HAS around 64 equipment models connected, which creates a major challenge when creating useful indicators and benchmarks – they need to be relevant to each customer in each given context.

Q&A

Martin Wallman
Product Manager,
Customer Center USA

In early 2016, the first drill rig was connected through the Certiq telematics solution in the US market. Since then more than a hundred machines have been connected, with new being added every week.

Q How has Certiq been received in the US?

A "The response from our customers has been very positive. Maintenance people are using the planning and service part to optimize their service operation, while people that are more focused on the operational side of the business are primarily using the machine performance data available in Certiq to fully utilize the machine. In the end, Certiq is a tool to help our customers to reduce their total cost of ownership and optimize their operation."

Q What are the main challenges for the customers to use Certiq to the max?

A "It is important that the customers understand how the data is collected and what it is based upon when they are looking at different KPIs in the Certiq portal. What is key to one customer might not be as important to another. Therefore, we give our customers the possibility to modify and adjust what they can see in the portal to what will fit them best, based on their operation. Connectivity was something that our customers had some initial concerns about, but so far we haven't seen any need for a satellite connection, which is an alternative to the standard 3G solution for surface customers. Going underground, a local network is required if pickup points are not the preferred solution."

Q How has Certiq changed the way you work within the parts and service field?

A "It enables us to be more proactive and efficient. We can support our customers in a more proactive way since we know how the machine fleet is utilized, or for example when a specific machine is due for service or is having operational issues. This will of course reduce and minimize customer downtime while also lowering the total cost of ownership. As more machines get connected, and we produce more KPIs, we will also be able to reach out to customers to discuss how we can help them improve their profitability and not just performance and service."

More certiq.info


Reaktivt snabba.
Service
Planering
100-tals maskiner
anomali-detektion
Proactive Production Planning
Optimize
Control
Autonomy

“We want to make data available to other contractors or third parties selected by our customers.”

Karin Jirstrand
Product Manager Interoperability,
Atlas Copco

“Demand for benchmarking figures has increased enormously,” says Olav Kvist. “Our customers want to know what good looks like. It’s only once they see relevant information from a comparable part of the world that they know how they are doing, so we are giving benchmarking high priority.”

He continues:

“Sales are of course important, but the most important task for us is to help the customer increase their productivity. Certiq will give our product managers the ability to identify customers that might need help in taking the next step when it comes to productivity. Quite simply, we want to take greater responsibility for the customer’s business. Our aim is that our customers will do better than comparable companies. I have been a product manager myself, and I know the great difference between theoretical performance and real productivity. While theoretical performance can be dismissed as sales talk, the information available in Certiq is on a completely different level. What you can see in Certiq shows the reality in black and white.”

TO GENERATE THE MAXIMUM possible customer benefit, Atlas Copco is also facing a number of technical and practical challenges outside of the actual telematics solution – such as connectivity underground or for remote areas, having the data secured from non-trusted sources and available to trusted ones.

“We need to create interfaces so that all our information works with other systems that the customer is using, like Maximo for maintenance or the Dassault system for dispatching, just to name a few,” says Karin Jirstrand.

“Generally speaking, we are in favor of open access. We want to make data available to other contractors or third parties selected by our cus-

Olav Kvist,
Vice President
Mining Technology,
Atlas Copco

The automation department in Örebro, Sweden, makes sure that Certiq, Atlas Copco's telematics platform, can be of optimal use to customers.

tomers so that they can utilize data to create services that maybe we haven't thought of. The more people who can benefit from the data, the more it increases the value of our equipment. It's a win-win situation."

SO ALTHOUGH THERE are lots of challenges, the opportunities are many more and much greater. When 5G becomes standard, remote services will be taken to a whole new level. For example, it will be much easier to troubleshoot and update programs remotely – which will lead to an explosion in the market for connected equipment.

"We are firm believers in the value of information from our connected machines," says Karin Jirstrand. "They carry a huge amount of data that needs to be interpreted and converted into usable information. By using this to make comparisons, we can help our customers become more efficient. The future looks extremely exciting!"×

Steve Molter
Rental Equipment Manager, Luck Stone

How is your fleet connected to Certiq?

What kind of machines, and how many, do you have connected through the Certiq telematics solution?

"We have two SmartROC D60 drill rigs connected. Luck Stone is a mining operation based in Richmond, Virginia. We are one of the largest family owned and operated producers of crushed stone, sand and gravel in the US, and we use those rigs every day."

How has Certiq changed the way you use your machines and operate your business?

"It has helped us to better utilize and monitor our production. Before, we relied on the drillers to provide us with information using pen and paper, but with Certiq we are a bit more accurate. The machine performance data enables us to maximize how the rigs are operated, be it drilling or tramming. We are also able to track and monitor our moving from location to location. I would also like to mention that the CO_2 monitoring system in Certiq has been very beneficial. It has helped us track our emissions, which is a big benefit for our environmental stewardship program with the State of Virginia."

What has been the gain for the company?

"Using the SmartROC D60 drill rigs more efficiently, Luck Stone has improved production by at least 8–10 percent. We are very happy with Certiq and the information that can be extracted. With time, we learn more and more about the system and I am certain it will help us be even more efficient in the future." ×

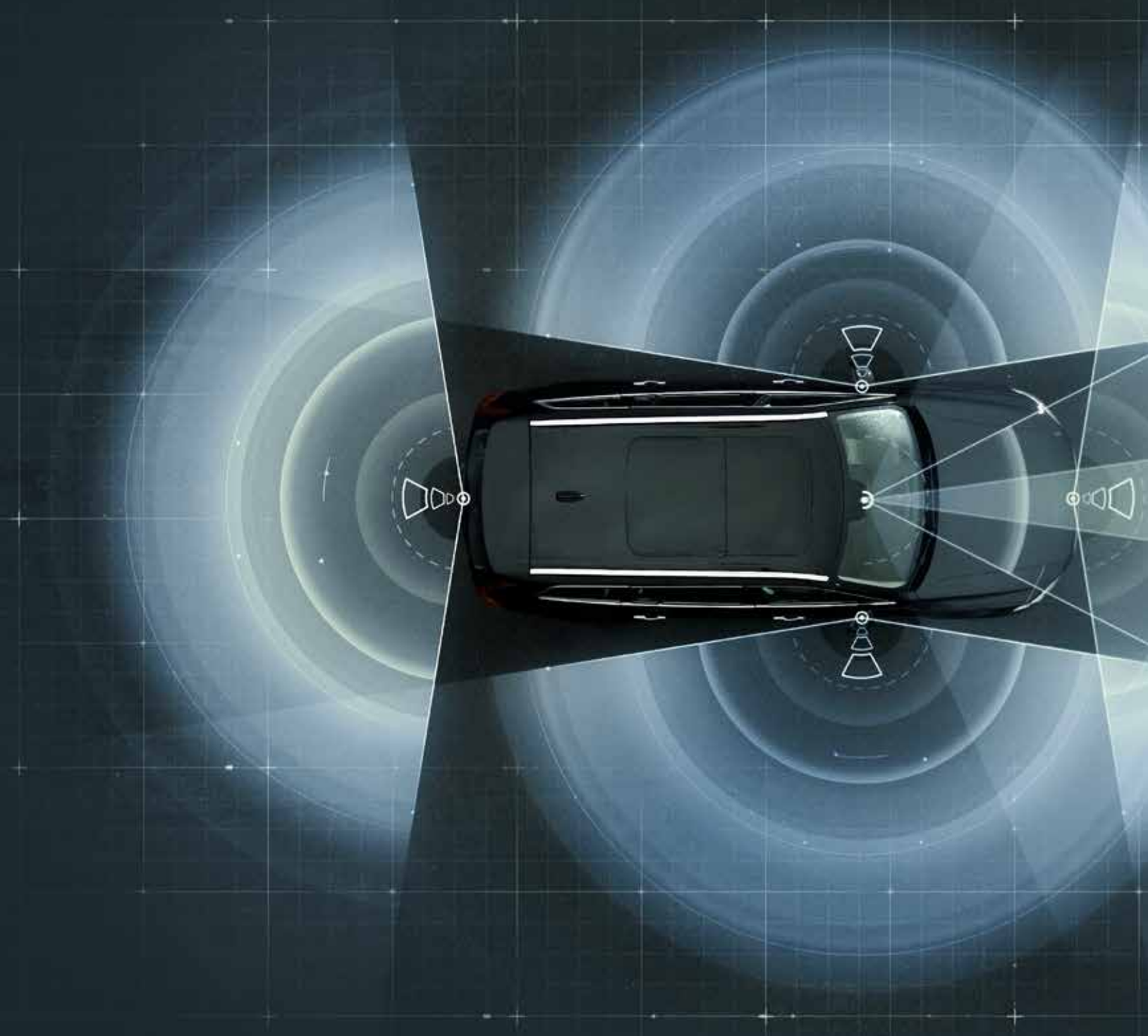
More certiq.info

PERSPECTIVE
VOLVO/DRIVE ME

There are always things to be learned from other organizations and other industries. This is how another player has approached the theme of this issue.

Christian Tarras Ericsson
Volvo Cars

"The aim of Drive Me is to enhance people's lives"



AN ESTIMATED 1.2 MILLION people die in vehicle related accidents each year, at least 90 percent of which are caused by human error. The safest bet seems to be to eliminate human involvement in driving altogether.

Experiments with self-driving vehicles have been conducted since the 1920s, but the pace has picked up considerably in the last decade with heavyweight companies like Google, Tesla, General Motors and Volkswagen investing heavily in the field.

One of the cutting edge competitors is the Drive Me project, helmed by Swedish car company Volvo, which is on the verge of conducting an extended public pilot test. To that end, a 50 kilometer long section of road has been staked out, consisting of a double loop along heavily trafficked highways and routes around Gothenburg, Sweden. The cars will be carrying passengers doubling as backup drivers, and the search for 100 brave, pioneering families is underway.

"The aim of the Drive Me research project is to focus on how to enhance people's lives and have a positive impact on society. No one else to our knowledge is developing autonomous drive from a human-centric standpoint," said **Henrik Green**, Senior Vice President, Research and Development at Volvo Car Group.

EACH PARTICIPANT WILL be assigned a state-of-the-art semi-autonomous Volvo XC90. The hybrid cars come equipped with radar, lidar (kind of like a radar, but using laser light), an assortment of cameras in every conceivable direction, a connection to the cloud for maps and, in charge, a highly advanced piece of machinery – the Autonomous Driving Brain.

The test period will, for instance, help determine how self-driving cars can improve traffic conditions, and give hints as to what changes need to be made in existing infrastructure. The feedback provided by the human users will help to gradually perfect the technology.

"We want to learn more about how people feel when they engage and disengage autonomous drive, what the handover should be like, and what sort of things they would do in the car when it's driving them to their destination," added Henrik Green.

A PARALLEL TEST will take place in London, UK, starting in the summer of 2018. Further tests are planned for several cities in China. ×

In focus: Drive Me

Drive Me is a research project headed by Volvo, automotive safety company Autoliv and the City of Gothenburg. The aim is to collect data on safety, user experience, traffic flow, and energy efficiency to pave the way for introducing safe autonomous cars into society.

The project is a part of Drive Sweden, a government-funded strategic innovation program with the long-term goal of finding new mobility business models enabling sustainable cities. The program encompasses not only driverless cars, but solutions for public transport and freight transportation as well.

More drivesweden.net/en

SURVEY
INTERNET OF THINGS

Want more input on this theme? Three people from different fields give their views to help paint a broader picture.

Ulf Roosvald

01 Is it correct to talk about the development of connectivity and automation as a "fourth industrial revolution", or is this an exaggeration?

02 What are the challenges for traditional industries in order to keep up to date with this development?

Henning Banthien

Secretary General, Plattform Industrie 4.0, Federal Ministry of Economic Affairs and Energy, Germany

01 **"IN OUR OPINION**, it is correct to talk about a revolution. In the world of Industrie 4.0, people, machines, equipment, logistics systems and products cooperate with each other directly. This makes manufacturing more efficient and flexible, but most importantly: Completely new business models are developed. In the tradition of the steam engine, the production line, electronics and IT, smart factories are now determining the fourth industrial revolution."

02 **"VARIOUS STUDIES** have identified six major challenges: IT skills, data security, new work and company structures, standards, costs for investments and the overall infrastructure. The changes caused by digitalization reflect differently in every company. However, interdisciplinary approaches and software skills are becoming more important. The employee in charge of the machines needs to understand the production process as a whole to react to problems in an agile way."

Maher Cheddo

Chief Commercial Officer, Global Power Solutions, General Electric, France/USA

01 **"I CAN'T SAY**, but something big is changing. This fourth industrial revolution is about transforming data that can help you do new things. This is a new era of machines doing what the brain does; collecting data, analyzing data and making decisions based on the data. With the right algorithims we can make predictions that benefit both companies and customers."

02 **"THE DRIVING FORCE** behind this development is industry cost-savings. Barriers to adoption include companies not understanding where to fit it in their budget, or uncertainties about how to integrate IT systems with operational technology. GE helps industries justify the investment by showing them key performance data. For example, mining is an intensive industry with many key questions centered on how to reduce energy consumption. A digital platform could lower energy consumption. We show how digital can help create a more successful business model. If you don't do it, you lose."

Håkan Schunnesson

Professor, Mining and Rock Engineering, Luleå University of Technology, Sweden

01 **"IT'S AN IMPORTANT** development, but more of a slow process. Connecting machines is just the first step. They generate incredible amounts of data, and that is excellent. But the real challenge is to retrieve the right data and use it in a productive way. It will be some time before we are there."

02 **"INDUSTRIAL COMPANIES** need to bring in new expertise to be able to track and analyse data. This is happening already. The mining industry will become much more efficient in the future, which is good for productivity, safety and the environment. By integrating state-of-the art measurement-while-drilling technology with the blasting operation, mining companies will be able to let lithology and ground conditions decide what blast technique to use and predict the results, well before starting the downstream operations."

More bit.do/worldeconomicforum

Synergy: Combinations outshining the sum of their individual parts. This is the evolution of connectivity.

01

Trade routes
Culture + culture

Trade routes have been around for thousands of years, knitting cultures together and allowing for the exchange of goods and knowledge. Prime examples are the Silk Road (east-west) and the Amber Road (north-south).

02

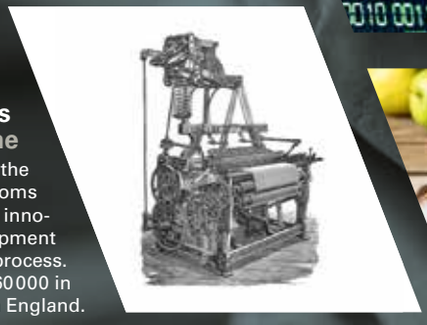
Aqueducts
Water + city

Bringing fresh water into cities laid the ground for rapid population growth. The Roman Empire perfected the art of aqueduct construction – the Valens Aqueduct connected Constantinople with springs 240 kilometers away.

03

Power looms
Steam + machine

In the late 18th century the first steam-powered looms appeared. The mechanized innovations were a key development in the industrialization process. By 1850 there were 260000 in operation in England.



04

Switchboards
Telephone + telephone

Early telephones were rented in exclusive pairs, but the advent of the switchboard let anyone connect with anyone else. Direct dialling, automation and long distance direct calls were soon to follow.

05

Assembly lines
Tool + conveyor

The moving assembly line envisioned at the Ford plant in the early 1900s reduced the production time for the Model T from over 12 hours to merely 93 minutes – "faster than the paint dries", as the saying went.

06

ARPANET
Computer + computer

The ARPANET, grandfather of the Internet, transmitted its first message – "login" – from one computer to another on October 29, 1969. An earlier attempt crashed the system after sending the letters "l" and "o".

07

Apple pie
Apple + cinnamon

Flavor combinations can bring a powerful taste experience: salt/caramel, mango/chili and chocolate/strawberry are all good examples. None, though, is as alluring as the marriage between apple and cinnamon.

Next issue [Expo]

Want to delve deeper into another subject relating to the mining and construction business? Make sure not to miss next issue's Expo.

MY WORK: STRUCTURAL ANALYST

Atlas Copco's greatest asset is our employees. We take pride in offering them an outlet for their creativity in order to provide the best possible value to our customers.

Gustaf Höök
Andreas Hylthén

"Solving problems is never boring"

Hanna Kristofferson is part of a group that's vital to Atlas Copco's product development. As a structural analyst, she makes sure the products are sound enough to be up to the job.

"I'm a structural analyst in the Rocktec division and my field is solid mechanics, so it's up to me and my colleagues to ensure that the products live up to quality demands in that regard. We might be involved in product updates, new product development or failures, for instance. Our job is to analyze strength and service life, and to predict behavior. We carry out calculations for everything from components to complete vehicle models – so it's quite a broad scope. We might be looking at welded or bolted joints, or the consequences of making small holes in sheet metal for hosing purposes.

HANNA KRISTOFFERSON

Age: 37.
Job: Specialist Mechanical Analysis (Rocktec division, Örebro).
Joined Atlas Copco: 2006.
Best part of the job: "It's never boring – and you never stop learning."

WHEN WORKING ON product development, we have to understand the application and the conditions it will be exposed to. We look at all of the parts of the product and apply different loads and use boundary conditions in our equations. It's all done in a virtual environment, using information about the geometry and material that we get from other Atlas Copco teams – mainly working with finite element software. Since Atlas Copco's equipment is used in very diverse environments, we also use statistics. We work closely with design engineers throughout the analysis process.

THE BIGGEST CHALLENGE in my work is to help adapt the models so that the finished product satisfies the required quality and performance standards. Field measurements are made to verify our analyses. Coming up with solutions to problems I've never dealt with before can also be pretty demanding, but that's part of the attraction. The job is all about being analytical and solving problems – and that's never boring. It also feels great to be part of something bigger: I love it when I play a part in enhancing something so that the customer gets a better product."

Structural Analyst **Hanna Kristofferson** helps adapt models so that the finished product meets quality and performance standards.

[On Location]
United Arab Emirates

THE SECOND WIND

As good as new

At RAK Rock's limestone quarry in the United Arab Emirates, a 15 year old drill rig was breaking down frequently and slowing down production. Instead of buying a new machine, the company tasked Atlas Copco's Midlife services with sparking new life into the rig.

Ulf Roosvald Celia Peterson

1

THE CHALLENGE

IN 1997, Atlas Copco delivered its first drill rig to Ras Al Khaimah Rock Company (RAK Rock) in the United Arab Emirates. Since then, the two companies have had a close relationship, while RAK Rock has developed into one of the area's major suppliers of limestone.

Vasanthalu Shivakumar
Sales Manager, Atlas Copco Middle East

Today, seven drill rigs supply more than 22 million metric tons of limestone per year to cement plants across the Gulf region, particularly to Kuwait and Bahrain. One of the drill rigs, however, was losing pace. The 15 year old ROC F7, with a low availability rate of 55–60 percent, was not performing to its expected capacity and was not meeting production demands. With the downturn in the market, it was not viable for RAK Rock to invest in a new machine to improve reliability and performance.

"The drill rig was quite old and RAK Rock had trouble reaching its production targets. The company needed to prolong the life of the ROC F7 until they could afford to invest in a new machine. During regular meetings with Atlas Copco they were looking for advice and a solution," says **Vasanthalu Shivakumar**, Sales Manager at Atlas Copco in the Middle East.

2

THE SOLUTION

ATLAS COPCO PRESENTED the Midlife services program as the best alternative for RAK Rock. It was the best option in the present market conditions, rather than investing in a new machine, and also more economical than a major re-building of the rig. Still, a midlife rebuild could mean several years of added life to an old machine.

"For a couple of months we had discussions on pricing, since it is still a big investment for the customer and Midlife services was a new thing for the RAK Rock management. But after so many years of working together, they were always confident in us and we were confident that we would be able to make a deal. Eventually, we settled on a price," says Vasanthalu Shivakumar.

THE SERVICE CONSISTS of engineers and technicians from Atlas Copco going through the machine thoroughly, replacing vital parts. In this case, feed beam components and the electrical harness were the major components that needed an upgrade.

Shivakumar says: "In situations like this, we have to convince the customer that our service team will perform the job in a right way to Atlas Copco standards and with high quality compared to repairs carried out by the customer, who are obviously constantly fixing the machines. So we have to make the customer understand that our service will be of a higher level."

THE AVAILABILITY of spare parts was a challenge, as this particular machine model has been out of production for several years. Thanks to good communication with the Distribution Center and parts planning in Sweden, as well as contacts with sub-suppliers, the parts were eventually found – and within the agreed time frame. An agreement was made that when the majority of the spare parts had arrived in the UAE, the Atlas Copco crew would start working to save time, and the machine was being stripped.

3

THE RESULT

IN JUST EIGHT WEEKS, the Atlas Copco workshop completed the job. When the ROC F7 was running again, the drill rig's availability increased from 55–60 percent to 95 percent with improved performance, reliability and operational efficiency.

The operation turned out so well that RAK Rock has already confirmed an order to perform a midlife rebuild on a second ROC F7 rig, and on completion Vasanthalu Shivakumar is expecting to carry out midlife rebuilds on a ROC F9 rig as well.

"I have been working with the Customer Center for 12 years now and I have been part of a number of midlife rebuilds. The outcome is always good," he says.

JEFF RIDLEY, Quarry Superintendent at RAK Rock, says: "We could not be happier with the results. We are now reaping the benefits of the much improved drilling accuracy from this machine, with operators now able to collar the machine better and drill straighter holes. This is helping us to realize down the line operational costs savings through improved blast performance."

More bit.do/midlifeservicesfacts

Ulf Roosvald Mikael Lorin

Engineer **Sonam Wangchuk** is the man behind the idea of the ice stupas. His invention has helped villagers in Ladakh to store winter water to use in springtime.

Ice to water in India

In the north of India the glaciers are melting, threatening the population's water supply. Innovative artificial glaciers, supported by Atlas Copco's Water for All, may be the solution.

In Ladakh in northern India, by the northern slopes of the Himalayas, some of the clearest signs of the Earth's increasingly warm climate are noticeable. Those who live here can see how the glaciers are shrinking and creeping upwards along the mountainsides, with the consequence that the glaciers' function as water reservoirs is becoming more uncertain.

It is a serious situation for the population – but as we know, necessity is the mother of invention. Last winter **Åsa-Kajsa Zetterman** and Mikael Lorin, Water for All representatives at Atlas Copco, visited the region and were able to see two examples of ingenious engineering that have enabled farming to continue or be resumed in fields that had recently been threatened by drought.

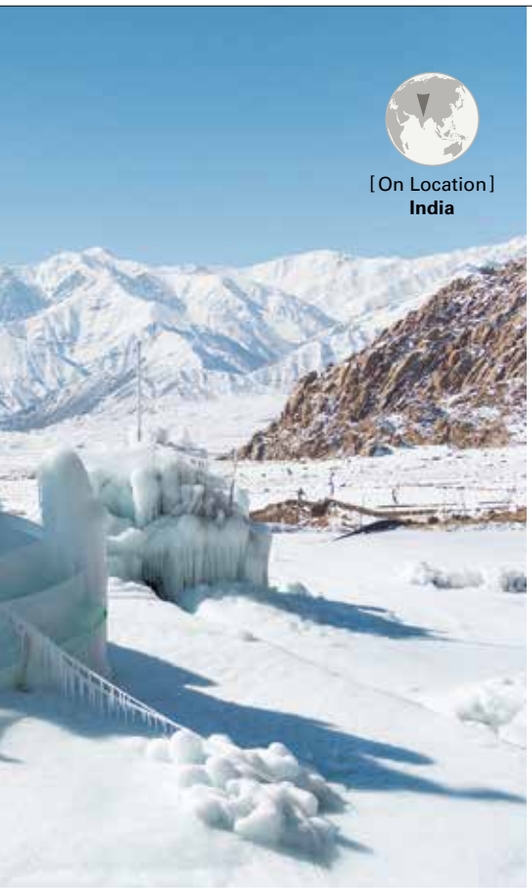
Åsa-Kajsa Zetterman
Water for All representative, Atlas Copco

THE FIRST INVENTION is what is known as an ice stupa, in the village of Phyang. The idea is to utilize the meltwater that would otherwise run down the valley and be wasted. Instead, the water is channeled down from the mountain in pipes and hoses, in order to then be sprayed over a pile of gathered brushwood. When the water meets the cold air it freezes to ice, rather like the principle behind a snow gun. The next day more brushwood is put onto the pile, onto which water is sprayed during the cold nights. All this is done with no pumps or power, using only the difference in altitude. The more water that is sprayed onto the conical stupa, the higher it grows. The shape of the ice stupa is carefully calculated so that the ice does not melt until the spring, when the water is most needed on the cultivated areas of the slopes below. The inventor of the ice stupa, engineer Sonam Wangchuk, has won various international awards for his work.

THE SECOND INNOVATION, a development of the ice stupa, can be found in the village of Kugshok. Here an artificial glacier – or a frozen waterfall – has been constructed along similar lines, acting as a water catchment basin. For a number of years this project has received grants from Water for All via the Swedish-Tibetan Schools and Cultural Association.

For Åsa-Kajsa Zetterman, the trip was an amazing experience – even if the weather prevented the Atlas Copco delegation from actually reaching Kugshok.

"One of the climate problems in the region is that it snows considerably less compared with a few years ago. But just when we were there, there was substantial snow fall which meant that



[On Location]
India

The cone-shaped stupas are built with a base of brushwood, which is then sprayed with water. When the water freezes to ice, the stupas grow and can become more than 30 meters high. Read more: icestupa.org and facebook.com/artificialicefallglacier

we were unable to get through on the roads right up to the village and the glacier," says Åsa-Kajsa Zetterman.

"However, we got to meet both the local population and those responsible for the water projects. It makes you aware of how vulnerable some places in the world are to climate change," says Åsa-Kajsa Zetterman.

KUGSHOK HAS AROUND 60 households; half are Buddhist and half Muslim. Religious differences have never hindered good collaboration. The residents celebrate each others' festivals and help each other out with the most important thing: Securing the supply of water.

"The artificial glacier has resulted in significantly better harvests, and the people have been able to resume their farming. We got to meet the monks who manage the project. They're amazing people, and we're keeping in contact with them via Facebook and Instagram," says Åsa-Kajsa Zetterman. ×

Water for All

FROM ATLAS COPCO WITH LOVE

Water for All was started as a private initiative by two Atlas Copco employees in 1984. Since then, this charity work has provided nearly two million people with clean drinking water and operates in 60 countries.

THE STORY OF how Water for All came about has been told before, but is still fascinating. In 1984, Atlas Copco employees Torgny Rogert and Peter Håkansson happened to see a TV documentary on the drought in Peru – and the following day they decided to do something about it.

They collected money among their colleagues and when Atlas Copco's management saw how committed the employees were, they decided to match the sum raised by the employees. The Peru project was a success and, with the company's support, they continued to raise funds among the employees in Sweden to help people in other parts of the world get clean water.

JUST OVER 10 YEARS AGO the idea of Water for All spread beyond Sweden. The idea is that all Atlas Copco employees can contribute part of their salary, wherever in the world they live and work. The amount raised by the employees is then doubled by Atlas Copco.

Today, just over 30 years since the first charitable initiative, Atlas Copco has employees in more than 60 countries who are involved in Water for All.

All of the initiatives act as individual organizations, and Josefine Gustafsson is the link that brings them together. A quarter of her working time is devoted to coordinating Water for All globally.

"Water for All is the employees' initiative, rather than Atlas Copco's. The nice thing about Water for All is that the employees themselves can find a partner and a project they want to support. They can have a personal relationship with the people we want to help, while centrally we can help with administration, community contacts and communication with authorities."

Josefine Gustafsson
Water for All

Josefine Gustafsson is also on the committee that receives applications from Water for All units seeking contributions to projects from the Peter Wallenberg Water for All Foundation. This Foundation was formed on the death of Peter Wallenberg Sr, when funds were donated to Water for All by both private individuals and companies.

"Initially, SEK 3 million went to a flagship project in Malawi. The remaining funds in the Foundation are invested to provide a return, and then reinvested in Water for All," says Josefine Gustafsson.

The idea is for the Foundation to facilitate the establishment of new ventures and small Water for All organizations.

IN APRIL THIS YEAR, Josefine Gustafsson had opportunity to visit some of the beneficiaries of Water for All initiatives when she visited Kitui, a region southeast of Nairobi in Kenya.

"It was amazing to see. We visited five projects in the region, all with a few years behind them. Our trip included visits to two schools that have been provided with water, as well as a dam construction project. A barrier is built on the riverbed ahead of the rainy season. It's filled with sand and when the rain comes, the sand draws in the water – which becomes groundwater and fills the dry wells. It's a brilliantly simple way to create a sustainable supply of clean drinking water." ×

More water4all.net

BLAST FROM THE PAST
1948

Innovative products and a wide array of customers: Atlas Copco has a long and rich history. In each issue of Mining & Construction, we glimpse in the rearview mirror.

Gustaf Höök
©Crazy Horse Memorial Foundation

Portfolio
Crazy Horse Memorial

In the Black Hills of South Dakota, the figure of legendary warrior Crazy Horse is emerging. It has been since 1948, when acclaimed sculptor **Korczak Ziolkowski** pledged to create a work of art dedicated to all Native American tribes. When completed, the **Crazy Horse Memorial** will be the world's largest mountain carving: 563 feet (172 meter) high and 641 feet (195 meter) long (the face is 87.5 feet tall, equalling 27 meter). The sculpture is being carved out of red pegmatite granite. Atlas Copco has been a part of the blasting and carving work during much of its history. At present, a radio remote controlled Atlas Copco FlexiROC T15 R drill rig is being used – along with SB hydraulic breaker attachments and RH handheld rock drills.

More crazyhorsememorial.org

Gustaf Höök Shutterstock

AT YOUR SERVICE

Closer than you might think

OUR CUSTOMERS ARE located all over the world and so are we. There is always an Atlas Copco office to turn to, making us truly local. At the same time, we are a global enterprise with worldwide resources. We have sales offices in 33 regions. In each one, there are one or more Service Centers.

All this supports our goal: To provide sustainable productivity solutions for our customers.

01 Canada
Toronto

02 USA
Denver

03 Mexico
Mexico City

04 CVCA
Bogota

05 Andean
Lima

06 Chile
Santiago

07 Brazil
São Paulo

08 Argentina
Buenos Aires

09 Sweden
Stockholm

10 Finland
Helsinki

11 Norway
Oslo

12 UK & Ireland
Hemel Hempstead

13 Europe
Essen

14 Italy/France (incl. N. Africa)
Milan

15 Spain
Madrid

16 Portugal
Lisbon

17 Central Europe
Prague

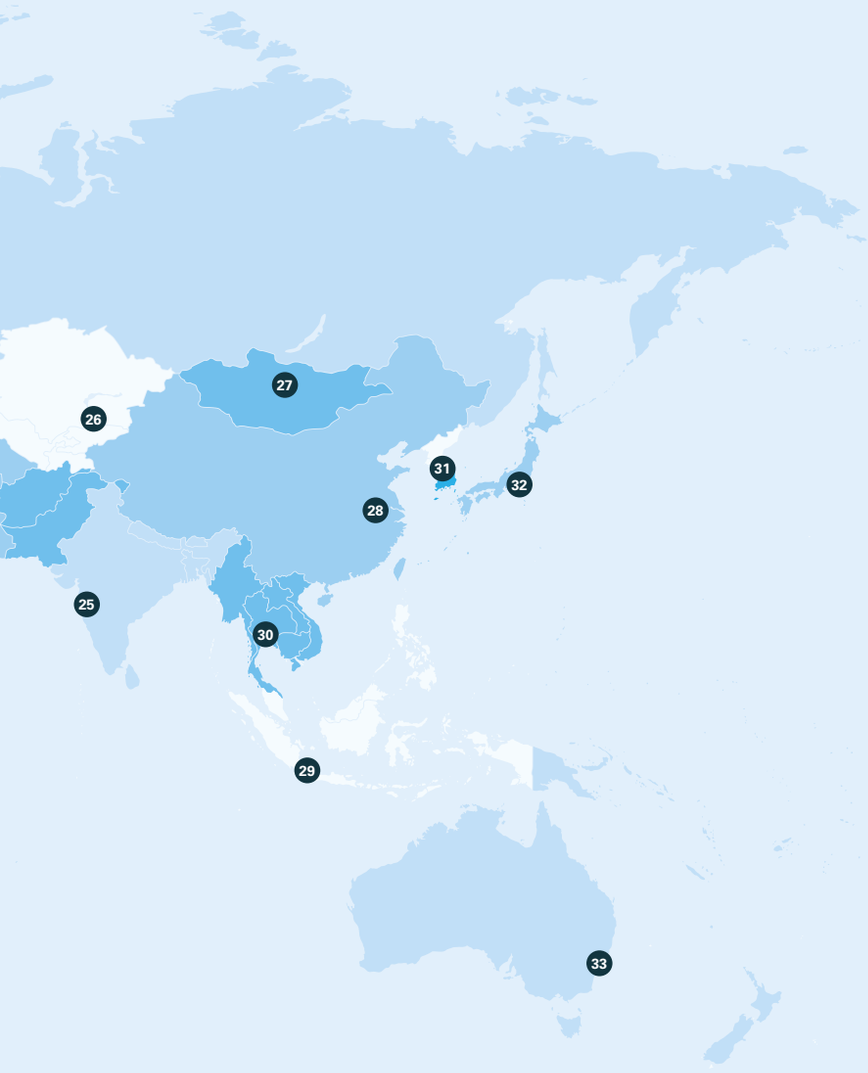
18 Turkey
Istanbul

19 Russia
Moscow

20 Mali & Burkina Faso
Bamako

21 Ghana
Obuasi

22 Eastern Africa
Nairobi



[In focus]

Polkowice, Poland

Hello there! What's happening in Polkowice?

Andrzej Mielko
General Manager
Atlas Copco
Central Europe

IN APRIL OF THIS YEAR, a Mining and Rock Excavation Service Center was opened in Polkowice, Poland. **Andrzej Mielko**, General Manager Atlas Copco Central Europe, explains the thoughts behind the launch.

"The market demand for remanufactured components and machine overhauls has increased. When calculating TCO (Total Cost of Ownership), customers seriously consider giving second life to their existing fleet. In principle, it's money very well spent. Mining and Rock Excavation Service Center Polkowice has a workshop area, allowing us to perform everything from simple component reconditioning or exchange to entire machine rebuilds."

What kind of customers are you looking to serve?

"Today, our priority is a customer segment within the underground rock excavation business, with the focus mainly on mining equipment (drill rigs, loaders and trucks) and components (feeds, booms, hydraulic cylinders, transmission and axles). In the next phase, we expect to evaluate the business within surface and exploration equipment."

Why was Polkowice chosen as the location?

"This is a Regional Service Center, so we're not only serving Poland. The new center will support almost 20 countries in terms of repair, rig overhauling and Midlife services. We have created high standards, including many new ones. It is about a smooth start with a focus on quality and delivery. Mining and Rock Excavation Service Center Polkowice is located close to European Highway A4, so logistics are excellent and our main mining customers are all in the area." ×

Find Atlas Copco in your country: atlascopcogroup.com/en/atlas-copco-in-your-country

23 Southern Africa
Johannesburg

24 Middle East
Dubai

25 India
Pune

26 Central Asia
Almati

27 Mongolia
Ulaanbataar

28 Gr. China
Nanjing

29 Southeast Asia (South)
Jakarta

30 Southeast Asia (North)
Bangkok

31 Korea
Seoul

32 Japan
Yokohama

33 Australia
Sydney

Sanna Persson Shutterstock

The AutoDrill 2 system adapts to the varying ground conditions and can be used on all Pit Viper models.

AutoDrill 2

Changing the game – again

Atlas Copco's engineers spent three years conducting field tests at several sites with different terrain. They then went back to the lab and created AutoDrill 2, our latest automated Rig Control System.

Peter D. Miller, Product Engineer at Rig Control Systems, is one of the people behind Atlas Copco's newest automation solution.

Why choose a Rig Control System in the first place?

"Computerized control systems do not deviate from how they are trained to perform but instead create a predictable, safe and repeatable day, which means increased productivity for everyone involved."

What were your main challenges?

"The original AutoDrill required machine-specific setup by someone with in-depth knowledge of how the drill works and how to drill properly for the current consumables and ground conditions. AutoDrill 2 simplifies the setup and interface with preset operating parameters. The main challenge for us was going from an autodrill system that worked for one ground condition on one rig, to a system that works across Pit Vipers and adapts to varying ground conditions. To accomplish this we changed the interface from direct output actuation to setting real work targets like weight on bit, feed speed and torque and presetting those targets to the appropriate values for the drill bit. We also used closed loop control, so the system adapts the outputs to the correct actuation for the rig to achieve the setpoints, and we developed a drilling strategy which adjusts those setpoints to actual ground conditions."

Peter D. Miller
Product Engineer,
Rig Control Systems,
Atlas Copco

How much time did you spend developing AutoDrill 2?

"About 3 000 man-hours in the field over the course of three years, testing and talking to real users, and another 9 000 man-hours in development between field visits. Their experience and guidelines were very useful for us in the development phase."

AutoDrill 2

- **AutoDrill 2 can be used on all Atlas Copco's Pit Viper models and was launched for rotary drilling earlier this year.**
- **In Q4 it will also be available for hammer drilling.**
- **Worldwide field testing on site showed that AutoDrill 2 is faster than both manual and competitor automated drilling, that it has a considerably higher penetration rate and that 95 percent of the drilling time is possible without interaction.**

More bit.do/enablingautomationfacts