ericsson.com/5g

5G business value

A case study on automation in mining

An Ericsson Consumer & IndustryLab Insight Report
June 2018

Contents

Methodology and assumptions
This case study is part of an Ericsson 5G for Industries series, in which we look more closely at the actual business values associated with introducing mobile connectivity.

Information, if not otherwise stated, is based on discussions and interviews with Boliden carried out as part of a study conducted in January–March 2018. Generally, the assumptions in this report are based on estimated typical values emerging from these discussions. For the business value calculations, these assumptions are likely to be on the conservative side.

About Consumer & IndustryLab
Ericsson Consumer & IndustryLab delivers world-class research, strategic design concepts and insights for innovation and sustainable business development. We explore the future of consumers, industries and a sustainable society in regards to connectivity by using scientific methods to provide unique insights on markets, industries and consumer trends. Our knowledge is gained in global consumer and industry research programs, including collaborations with renowned industry organizations and world-leading universities. Our research programs cover interviews with over 100,000 individuals each year, in more than 40 countries – statistically representing the views of 1.1 billion people.

Ericsson's industry collaborations
Ericsson is proud to work with multiple industries on 5G use cases to ensure we develop the right technology for real-world applications, and to help industries understand how 5G can accelerate innovation. Today we are collaborating with 22 industry partners to define the use cases for 5G technology.

In March 2015 we launched 5G for Sweden, a research and development program with industry and academic partners including Volvo, Boliden, SICS, Scania, Saab and SKF. The program applies telecoms technology in industrial processes, products and services. One pilot project has used 5G technology for communication and remote-control operations to find productivity and safety solutions in the Swedish mining industry, an industry traditionally considered to have a hazardous operational environment. The program has also established strategic partnerships with the main technical universities in Sweden, as well as a close cooperation with Swedish government and Vinnova, the Swedish innovation agency.

In September 2015 we announced 5G for Europe, a program to deliver research, innovation and industrial pilots enabled by 5G. Industries forming part of this project include transport and automotive, manufacturing, and energy and utilities. The 5G for Europe program spans 7 countries and 10 institutions.

In February 2017 Ericsson and Intel launched the 5G Innovators Initiative ($5GI^2$) in the US. $5GI^2$ will connect equipment manufacturers, technology companies, industry leaders and universities to test 5G network and distributed edge technologies, with the aim to accelerate the adoption of 5G wireless and infrastructure innovation. Honeywell, General Electric and the University of California, Berkeley are the first participants to join the initiative.

The next generation of mining

The mining industry is a hotbed of global economic activity, with revenues in excess of USD 500 billion.[1] To move millions of metric tons of rocks on giant machines requires minute precision, and any disturbance in the finely tuned flow of materials can have major consequences for the mine's operations.

Improving profitability in the mining industry requires working relentlessly on efficiency, transport and metal extraction to optimize the flow of ore. However, incremental improvements are facing diminishing returns, and the industry is gradually turning its attention toward automation as the next area of opportunity.

One prerequisite for automation is the introduction of better connectivity in general, including mobile connectivity, in the mines. In recent years mobile connectivity has been proven robust enough to deploy in the harsh mining environment without causing disturbances in ore production.

Boliden is one of the most successful mining companies in the world, with strong productivity and stock market performance. It has eight mines, and one of them, Aitik, located in the north of Sweden, is the largest open pit in Europe. With a number of partners, including Ericsson, Boliden has taken part in a research project to co-create the mine of the future.

In this case study, we explore the role of automation in the mining industry and uncover the business value of using 4G and 5G technology in the mine, in terms of both economics and sustainability.

Image source: Boliden

Key insights

1. The Boliden Aitik mine use case reduces costs by 1 percentage point through the application of automation, with communications being the key enabler. Carrying out drilling and blasting using automation shows an annual EUR 2.5 million net saving for the Aitik mine alone.
2. Although not the only option available, mobile communications fit the bill perfectly as a solution for mining and offer a major business opportunity.
3. As the telecommunications industry adapts its offering to specific industry needs and develops engagement models for the delivery of mission-critical infrastructure, the opportunity to add more value arises. 5G technology will deliver a significant improvement in functionality.
4. For telecom service providers, the next steps are to package an easy-to-buy, off-the-shelf commercial solution; build a delivery organization that responds to very strict Service Level Agreements (SLAs); and gain market awareness of customers' deployment challenges and ecosystem properties.

[1] Combined revenue from the 40 largest companies

Putting 5G to the test

Boliden has achieved major productivity improvements by implementing automation. This use case demonstrates the significant growth opportunity for both the mining industry and mobile telecom service providers.

The opportunity
Key features and benefits of mobile communications in the mine are coverage, reliability, low latency, better accuracy in positioning, high bandwidth, and the ability to run many devices, sensors or remotely controlled machines. When mobile communication coverage is offered, the mining industry will be one of the areas ripe for innovation through the development of mobile network-dependent applications.

The challenge
Aitik is an expanding mine. To get to the copper ore, lots of rock must be removed, and every year an increasing amount of rock is moved around in the system. Depending on where the ore is, the ratio of rock to ore varies; on average there is about 1 metric ton of rock removed for every 1 metric ton of ore.

Aitik's current annual production of 36 million metric tons of ore is to be increased to 45 million metric tons, and the rock removed will increase by just as much, if not more. However, given that a mine is a busy place, it is not a straightforward task to increase the number of huge machines required for rock removal, and maintaining the same equipment utilization only adds to the challenge. In addition, every blast creates toxic gases that need to dissipate before humans can enter the area and begin excavation.

The solution
Automated and remotely controlled machines provide a solution. Automated drill rigs (known as "Pit Vipers") can move from one drill hole to the next along a predefined path and perform repetitive tasks autonomously, in contrast to having a drill rig operator on site carrying them out manually.[2] If the task or movement is not predefined, the drill rig is equipped with cameras that enable an operator to control it remotely. Much of the time autonomy is sufficient; however, sometimes only humans can make a proper assessment (for example, during evaluation of rock conditions), and remote or even local assessment is then required.

Five drill rigs at Aitik have been retrofitted with autonomous operation and remote-control features. As the current connection bandwidth only allows for medium-quality video streaming, which limits the remote-control capability, this retrofit is limited. A couple of cameras, a control system upgrade for the older rigs and a communication module have been added.

7,000 hours per year

7,000 hours per year of drill rig operation could be achieved through automation, an increase of 2,000 hours or 40 percent.

Automating a drill rig could increase operating hours from 5,000 to 7,000 hours per year, in effect enabling Boliden to perform the same amount of blast operations with these 5 modified rigs as they could with 7 or more traditional rigs. This automation also eliminates the need for additional staff, service stations, parking areas, transport on busy access roads and dangerous staff transportation within the mine. As well as solving these logistical challenges, automation carries significant efficiency benefits, as Boliden can handle an increased number of blasts with similar equipment and staffing levels.

[2] 30m-high machines that drill 17m-deep holes in the rock, 50cm in diameter, which are filled with explosives. A hole blows 8x10x17 cubic meters of rock to pieces for subsequent transportation for further processing. Every blast is guarded with the highest amount of safety, and after the blast, dangerous fumes need to evaporate, and the site needs to be secured before any staff can start excavation work

Image source: Boliden

Enabled by communications
For fully autonomous, remotely controlled equipment, high-performance communications are needed.

The communication system used in mining today can handle simple, repetitive tasks in automation, such as drilling holes to certain specifications. The current technology being used for this in the mining industry is Wi-Fi, which is providing acceptable coverage and performance through careful rearrangement, pointing and dedication of Wi-Fi access points.

Boliden has installed such a Wi-Fi communication system to enable the use of drill rigs in Aitik. Although it has delivered a new level of productivity, the experience has not been flawless. Wi-Fi is not designed for the wide area outdoor coverage required by an open-pit mine like Aitik, and this solution also severely limits the addition of other automated machines.

It has been possible for drill rig connectivity to work as planned with Wi-Fi – bandwidth performance and latency have been manageable. Concerns around stability and the use of unlicensed/unprotected radio spectrum, including a recurring drop in Wi-Fi performance due to external spectrum conflicts, have been addressed through modification of the machine control system in a patchwork solution. By modifying the logic of the control circuit, automated emergency stops could be avoided. At the time of writing, the drill rigs are being commissioned for autonomous operations.

However, the mining industry in general and Boliden in particular do not want to stop their automation activities here. There are many more planned steps, such as complex drilling, automated trucks and automated planning and dispatch, where high-performance communications (for example, 4G and 5G) will be required to handle several 3D video streams and manage highly complex tasks remotely.

Mobile communications provide the edge
For autonomous operations, Boliden's communication system needs the ability to:

- Enable fully remote monitoring, involving very high bandwidth and low latency requirements
- Potentially carry many other autonomous and remotely controlled machines, of different brands and with different control systems
- Handle an ever-changing production environment and geography
- Maintain broad coverage for all corners of the mine where machinery or staff could potentially be located
- Track and coordinate mobile equipment fleets and many sensors and other devices within one communications network

A 4G mobile communication system would offer a secure, flexible and future-proof solution for Boliden. However, while 4G can support the current identified use case, only 5G can comfortably handle the most demanding requirements – bandwidth, quality of service, latency and positioning.

With high-performance communications, a whole range of safety and efficiency measures become available to the mine. While some applications only need to send minor amounts of data, others (such as fully remote-controlled machines) need the capabilities and capacity offered through mobile communications such as 4G and especially 5G.

Unveiling the value

By enabling automation, mobile communications present economic and sustainability value. The Boliden drill rig case is merely a taste of what is to come; the fully automated mine would multiply these benefits, as utilization levels of machinery like drill rigs and dump haulers break through previously unimaginable limits.

The economic value
Automation has meant significantly lower costs for Boliden, saving approximately 1 percent of Aitik's total annual costs. Carrying out drilling and blasting using automation enabled by mobile connectivity, rather than buying 2 more drill rigs, shows an annual EUR 2.5 million net saving for the Aitik mine alone.

Boliden believes that significant gains in productivity, quality and safety are attainable through the automation of more machinery, primarily trucks and excavators (see Figure 1).

The sustainability value
The next step in the rollout of automation is automated trucks, which account for approximately 95 percent of Aitik's fuel consumption. By increasing efficiency in this area, huge benefits can be reaped. Fully automated/remotely controlled trucks drive more efficiently, eliminating unnecessary breaks.

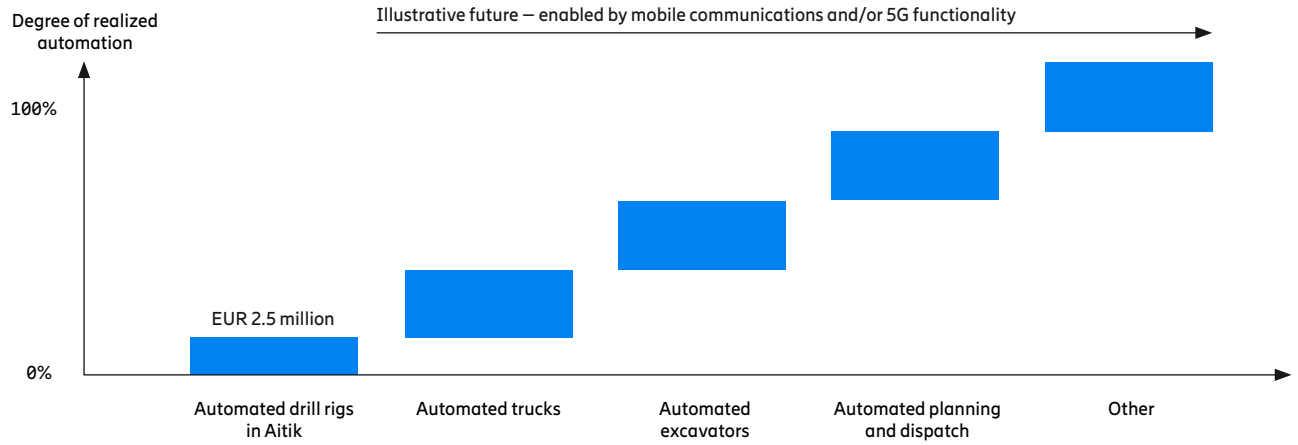
Smoother transport flow, steadier speed and less movement mean lower fuel consumption, and we estimate this saving potential to be in the range of 10 percent.

Such an efficiency improvement would reduce Aitik's annual emissions by approximately 9,400 metric tons of carbon dioxide.[3] Another advantage from a sustainability perspective comes from the reduced number of rigs and machinery, as impacts related to the production of these are lessened.

9,400 metric tons

An estimated 10 percent saving in fuel consumption corresponds to a reduction of 9,400 metric tons of CO_2 emissions at Aitik.

Figure 1: Yearly potential gains through greater automation of machinery



[3] Calculations and assumptions are described in more detail in Ericsson's sustainability appendix (document number 1/GFTB-18:001328 Uen)

A mobile telecom service provider opportunity there for the taking
In addition to the current subscription market, the opportunity in industrial applications such as mining could generate up to 36 percent of additional telecom service provider revenues by 2026.[4] For that potential to materialize, several challenges need to be overcome:

- **The market is developing fast:** Many communications technologies are vying to cater to industrial needs. Wi-Fi is already available and, in several mines, in service for certain types of less demanding use cases; the industry has decades of experience engaging with enterprise customers and acting on market changes. Although Wi-Fi cannot currently deliver everything 5G promises, that does not mean it will stay this way forever.

- **Engagement with customers is required:** Understanding how to engage with industrial customers in their core operations might be the greatest challenge. Critical operations have traditionally been controlled in-house, to avoid relying on suppliers to fix serious faults that halt production, so telecom service providers need to create trust and deliver certainty to customers.

- **Delivery models are changing from collective network performance to specific device performance:** Telecom service providers need to deal with zero-fault tolerance for each individual customer and sometimes each device. The implications for a telecom service provider's current way of working will be significant, if not transformative.

Though today's mobile communications solutions can already serve the majority of current use cases, 5G will enable the most demanding remotely controlled applications.

For telecom service providers, gaining a foothold in the industry segment will mean adapting to customers who are new to mobile communications and have specific demands. Customers will seek local solutions to data integrity, reliability of independent mobile coverage, security and superior performance (for example, in latency). Telecom service providers will need to meet strict and demanding SLAs, sometimes on a per-device basis.

There are many potential business models, but a connectivity-as-a-service model would be a logical choice, given the high reliability, large-scale paradigm and relative complexity of mobile communications. There is likely to be demand for other models, not least because Wi-Fi has educated customers in the ability to buy a system and operate it themselves. Licensed spectrum is a competitive advantage and one that should not be underestimated.

For telecom service providers, the tangible benefits of bringing 5G to mining are attainable today.

In order to address the large business opportunity telecom service providers need to:

- Package an easy-to-buy, off-the-shelf commercial solution
- Build a delivery organization that responds to very strict SLAs
- Gain market awareness of the deployment challenges and ecosystem properties affecting customers

[4] Ericsson, The 5G business potential – Industry digitalization and the untapped opportunity for operators, 2017

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

www.ericsson.com

Ericsson
SE-164 80 Stockholm, Sweden
Telephone +46 10 719 0000
www.ericsson.com

GFTB-18:001328 Uen