# SURGING THROUGH THE DIGITAL ERA

**Demetre Harris, Sandvik Mining & Rock Technology, USA,** explores how technology has changed and improved mining operations.

One must admit, humanity has come a long way since using the stars for navigation, Egyptian cubits for measuring length and carrier pigeons for wireless communication. Concurrently, Sandvik Mining & Rock Technology has come a long way since 1997 when the company acquired Tamrock Oy.

One of the earliest fit-for-purpose drill rigs, the DC120 series rigs, originally known during their release in 1988 as the Tamrock Commando series, utilised technology available in the 1980s to transform surface mining as it was known. The DC120 series increased performance and productivity by providing a solution capable of reproducing the work of five professionals with traditional hand drills. Utilising some of the earliest versions of Sandvik TIM measuring system, these rigs utilised radio remote controls to assist with hole inclination and depth with automatic alignment of the feed.

## Introduction of data

Data changed the world as it was known. The introduction of the 900 MHz band and the global positioning system (GPS) to the mining sector during the 1990s and IEEE 802.11 wireless technologies in the mid 2000s transformed the industry.

Despite the slow adoption rate of advanced technology within the mining sector in the 1990s and early 2000s, the benefits of technology were recognised. In June 2019, RTI International reported within their Economic Benefits of the global positioning system (GPS) study that by 2017, cumulative adoption of GPS in the mining sector reached 75% – up from 4% adoption in 1995. The report goes on to state that productivity gains from GPS can increase overall mine productivity upwards to 21.1% and decrease labour requirements by 13.5%, depending on organisational expertise level. By 2017, it was also estimated that the mining industry saw over US$1 billion net productivity gains due to benefits from GPS.

Now that the mining industry has tasted the fruit of technology, an irresistible thirst to continue implementing the latest technologies has developed. To satisfy the demand and push for excellence, Sandvik launched the iSeries family of top hammer, down the hole (DTH), and rotary solutions to providing its customers with innovative technology improving productivity and efficiency; but more important, increasing safety and limiting operational costs.

## Accurate, efficient, safe solutions

Now the mining sector is entering the post-digital era. Data availability in mining is at an all-time high, enabling mining

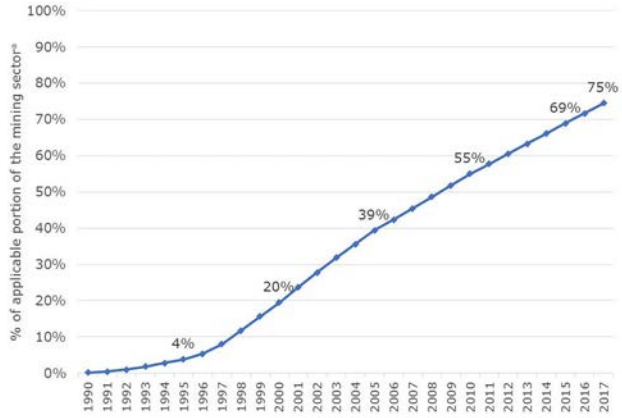


Figure 1. Cumulative adoption of GPS in the mining sector between 1990 – 2017. (Source: RTI analysis of expert interviews).

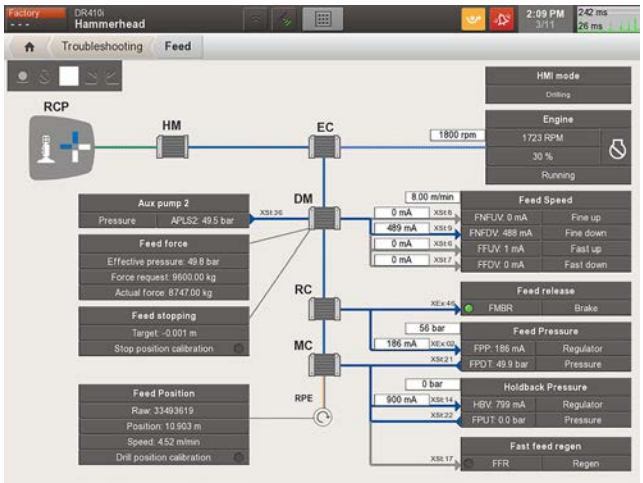


Figure 2. Sandvik's TIM3D high-precision navigation solution (driling interface).

organisations across the globe to develop digital transformation strategies to improve their operations.

The use and availability of technology has not only changed how the drilling activity is carried out within the industry, but also how it is measured. The introduction of technology has extended how key performance indicators (KPIs) such as utilisation, efficiency and availability are measured. No longer are operators limited to visual checks or ex post facto measurements of performance but are instead now able to utilise instantaneous measurements to provide feedback for corrective actions during drilling operations. The company's solutions leverage the availability of viable data to increase safety and drive productivity in all facets of the drilling operation from production and maintenance to planning and blasting.

## Improving operations through technology

At the forefront of improvements enabled through data is the precision and accuracy made available through GPS and sensor technologies. The company's high-precision navigation solution, TIM3D, provides operators with visual guidance and positioning with precision between ±10 cm. The solution provides drill and blast engineering departments the capability of uploading drill patterns with target elevation, spacing, and angles from their planning applications directly to the TIM3D onboard operator interface.

Once positioned and tightly coupled with the sensors and components installed on the drill, the navigation solution provides operators with the ability to drill either to a set elevation or a specific depth. The sensors on the drill measure the actual depth of the bit as the driller progresses through the terrain providing the operator visual measurements and the tools necessary to drill a hole to the designed elevation.

In addition to depth indicators, iSeries drill rigs come pre-equipped with sensors capable of monitoring fuel and water levels, rates of penetration, pull-down pressures, bit air pressures, rotation pressure and revolutions per minute (RPMs) as the hole is drilled. This measurement while drilling (MWD) data is then transmitted to Sandvik's OptiMine® for Surface with Driller's Office solution, providing drill and blast engineers the ability to strategically analyse pattern profiles and create blast sequences utilising an optimal amount of blasting material avoiding excess usage and lowering blasting costs.

As well as providing data-rich solutions, the drill rigs product family extends the capability of the company's technology solutions with its AutoMine® equipment automation and teleoperation systems. This system offers automation to the industry for each phase of the autonomy journey from onboard automation to tele-remote operation and ultimately drill fleet automation.

Automine Onboard automation includes functionality to auto-level the drill rig prior to drilling any hole, saving operators time and increasing efficiency by removing the need to manually level the drill. The auto-mast algorithm provides operators executing angle drilling the security that the correct angle will be utilised based on electronic sensors without the need to rely on manual indicators. Lastly, auto-drill functionality operates in two modes: locked drilling and

automated drill to target depth or elevation. The functionality provides insurance that each hole will automatically be drilled to the correct depth/elevation. AutoMine Onboard automation functionality is available on drill rigs without TIM3D with the exception of auto-drill to elevation.

When the two technologies are combined, the automation provides mining operations the capability of drilling each and every hole to plan. Combined with MWD data, blasting activities are able to maximise the efficiency of scheduled blasts by ensuring that each charged hole is at the correct depth with the correct powder factors necessary to fragment the rock in the particular area, properly maintaining ore and reducing waste dilution. This is done by providing blasting engineers the relevant MWD data of the drilled pattern. With this information, the blasting engineers can properly set powder factors and modify the blasting sequence to increase efficiency of the blast using a minimum amount of product.

AutoMine Tele-Remote and Fleet solutions remove operators from the mining environment, increasing equipment utilisation and providing the capability of operating multiple rigs from a single Tele-Remote station. A mining applications engineer for Sandvik, estimated up to a 34% overall equipment effectiveness improvement based on utilisation and consistent productivity through analysis of a manually operated DR412i iSeries drill rig compared to a tele-remote operated DR412i drill rig.

Mining organisations all understand that a successful blast with appropriate fragmentation of material increases efficiency not only with the blasting process but also with regards to load and haul. This is achieved by reducing the number of overloads or bucket damage due to properly fragmented rock; ore excavation and processing, by reducing material dilution through controlled blasts, as well as crusher throughput, by increasing the feed rate of the crusher due to better fragmentation. This all begins with the drilling process and ensuring that holes are drilled at the correct location as planned.

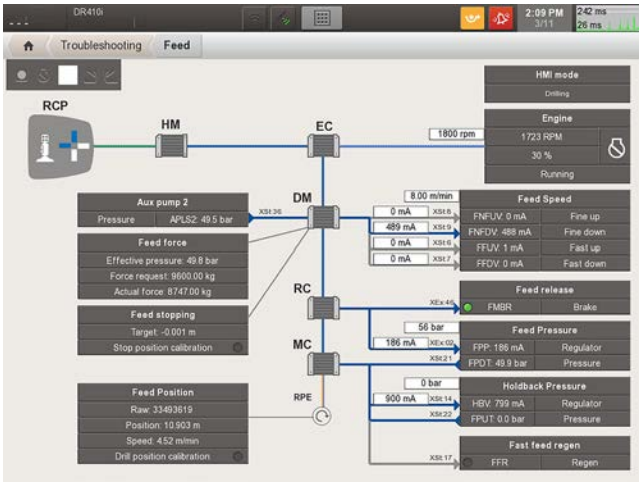


Figure 3. Sandvik's TIM3D real-time diagnostics and troubleshooting display (feed system).

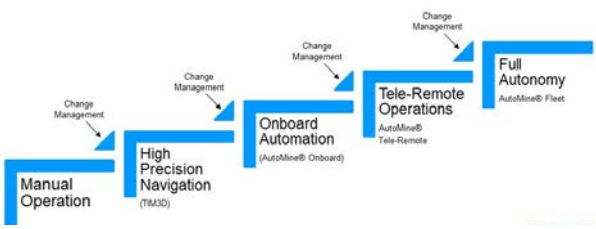


Figure 4. Sandvik's technology adoption progression plan.

## Advance troubleshooting and event logging increasing drill availability

Often mining solutions focus primarily on improving productivity and equipment utilisation. Maintenance improvements are equally important for mining operations. Sandvik understands that it is impossible to efficiently operate equipment if it is not available. Therefore, in addition to innovative engineering design, the company provides maintenance professionals with the tools necessary to improve equipment availability.

Equipment availability begins with informing the operator of the current condition of the drill rig. The intuitive design of the onboard high-precision navigation solution provides the ability to define the level of access available for each user. Drill operators may be given access to basic troubleshooting items such as GPS positioning and quality to ensure accuracy.

As for maintenance specialists, the company understands that it is imperative that they have additional access and controls to diagnose problems before taking drill rigs out of production. Their upgraded Sandvik Intelligent Control System Architecture (SICA), provided with all iSeries drill rigs, offers quick access to instantaneous parameters related to all components of the drill from dust collectors to engine components. Maintenance operators can review machine logs and events from the date of user logins to equipment warnings and errors. This data can then be downloaded along with error codes for further review without the need of a special laptop or diagnostic software.

The onboard solution also allows maintenance professionals the capability of troubleshooting major system components without the need of tools or wiring diagrams. With the push of a few buttons, the maintenance specialist can diagnose sensor issues, read actual parameters of the drill while it operates and highlight components operated outside of specifications.

Sandvik has found that by providing operators and maintenance professionals the correct tools with quick access, it is able to positively impact maintenance processes overall increasing availability and allowing the drill rig to do what it does best: drill.

## The technology curve and change management

One of the primary factors contributing to the slow adoption rate of technology in mining when it was first introduced in the 1990s is change management and operational readiness. Implementing technological solutions changes the way that mining operations execute day-to-day tasks. Of course, technology improves efficiency, productivity and safety while limiting costs, but processes must be changed or amended to ensure that the correct procedures are in place in order to realise the success that comes with proper execution of technology solutions.

Sandvik takes a phased approach to deploying technological solutions based on the readiness of its customers, their

personnel and their mining operations. In addition, the phased approach differs for every customer. Some customer's see benefit in deploying MWD analytics before tele-remote operations, where other operations are located in dangerous environments and may want to capitalise quickly on moving the operator out of dangerous mining conditions.

It is important that the mining industry understands the processes, technologies and management necessary to developing and implementing technological solutions. Each stage of the procedure involves specific processes, technology and expertise necessary to reap the benefits of new technology.

An example is the movement from onboard equipment operations to tele-remote operations. Removing the operator from the drill rig to a safer environment is the primary objective increasing productivity and utilisation. However, the transition from operating onboard and operating remotely requires planning. New processes must be put in place for the operator to understand how the shift should be carried out. The nature of the pre-operational checklist changes where the operator now will rely on sensors and onboard cameras to complete the check vs physically accessing the drill. For some operations, pre-operational checks may occur during fuel changes or water refills. In addition, depending on the location of the remote station, the pre-shift safety meetings must also be adjusted to take into consideration remote operators. For most operations, the manner at which shift changes, lunches and breaks are taken will be modified. The process of maintaining the units will change and the expertise involved with maintenance will also change. Maintenance specialists must continue maintaining physical drill components in addition to IT professionals maintaining network connectivity and GPS availability. Ultimately, the adoption of technology does not occur overnight and involves insurance that pre and post implementation processes are put into place along with relevant training. The change management process differs from operation to operation based on current systems, processes and expertise in place to ensure a speedy adoption of the newly implemented technology.

## The new beginning

The future of data generation and analysis in the post-digital era is limitless. As more and more data become assessible, the challenge will no longer be how to access the data but rather how to make sense of the data. Data analytics will become the next phase of the technology evolution and systems will be put in place to utilise data to optimise automation and pre-emptively detect and prevent costly failures. Sandvik plans to be in the forefront of the technology evolution by continuing development of its automation and analytics solutions to offer their customers peace of mind. Despite the changes in the industry, one thing has not changed: people and companies will continue to follow the stars developing innovative solutions and technology savvy processes to elevate the industry to ensure efficiency, production and safety for the years to come. GMR