Steve Thomson, Orica, Australia, explores how wireless technology can improve the safety and productivity of mining operations.

The era of wireless blasting has truly arrived, delivering quantifiable benefits across every mining segment, including improved safety, operational flexibility, and increased ore recovery – all of which are key industry drivers. In September 2017, Orica executed its first wireless production blast using WebGen™, a fully wireless initiating system. Since then, more than 1400 blasts have been fired around the world.

Step-change technology, such as WebGen, provides the industry with an opportunity to think differently and change the existing processes. Early adopters have gained significant experience and insights that are enabling brand new and innovative mining and blasting techniques.

Orica has partnered with its customers over the past few years to explore where wireless blasting can deliver significant efficiencies and improved outcomes compared to
conventional wired systems and processes. The following case studies illustrate how wireless technology has kick-started a new era of innovation and progress in mining.

**Glencore Ernest Henry Mine, Australia**

Ernest Henry Mine (EHM) is a 6 million tpy copper and gold sub level cave operation located near Cloncurry in North Queensland, Australia. Attracted by the safety and operational benefits of wireless initiating systems, EHM had its first wireless production blast in February 2018.

The early production blasts met all expectations, however, EHM was quick to realise that current design philosophies were not taking full advantage of wireless blasting, and initiated a project with Orica to explore opportunities to improve performance even further. The project team proposed 23 applications which could be redesigned to deliver better operational outcomes for the site and prepared a systematic execution plan.

The list of mining activities that have been reworked at EHM to fully exploit wireless initiation includes:

- Improved primary draw: eliminating lost holes/rings.
- Improved primary draw: firing rings individually at intersections.
- Improved primary draw: firing rings on curved drives individually.
- Improved primary draw: fire multiple rings multiple individual slots for available void.
- Reduced dilution: full width slot firing multiple individual shots.

The application in focus here is the ‘full width slot firing’. The slot was established in waste, followed by multiple widening shots to achieve full design width. The modification was to install the slot in ore and achieve full width by pre-charging with WebGen and firing successive widening shots as the void becomes available. The result was significant – a reduction was achieved across development requirements, the unit cost of drill and blast/tonne of ore, waste that is mined, and improved working capital. This approach saw a reduction in drive development of approximately 4.5% and increased ore recovery of up to 75 000 t per level.

**Barrick Hemlo Mine, Canada**

Hemlo Mine is a large gold mine operated by Barrick near Marathon, Ontario, Canada. In 2019, Hemlo approached Orica and Manroc to identify opportunities for improvement using wireless blasting in their Alimak mining operation, with a particular focus on safety and productivity.

Alimak mining is usually performed in small repetitive cycles, from the bottom access drive to a top sill drive. The size of an Alimak blast is limited by the free face and the available void. Through a series of workshops, the team developed the blind Alimak retreat (BAR) concept. The mine was able to use WebGen to eliminate the void limitation by creating a blast design that optimised burden and spacing, as well as timing and sequence, allowing well-defined portions to be taken at the appropriate time.

The Alimak stope was pre-loaded in a single pass, but broken into five sections with the wireless initiation system, providing flexible blast management through the process, and the ability to merge and increase blast sizes based on results. With just 3 days of loading, Hemlo was able to achieve 7 weeks of blasting, freeing the Alimak crews to move on to the next stope.

The outcome of this project was a 40% improvement in productivity through decreased cycle time and faster mucking rates, improved ore recovery from 65% to more than 90%, and increased safety by eliminating numerous re-entries and hook-ups while stripping rail and logistically simplifying the operations process. This collaboration has led to Orica’s full-time technical presence on site since the end of 2019, with several more projects currently in the plan.
CMOC Northparkes Mine, Australia

CMOC Northparkes Mine (NPM) in New South Wales, Australia, uses a combination of block caving and sub-level caving mining methods to process 6.5 million tpy of ore. The primary goal was to significantly reduce the exposure risk to employees and equipment from brow loss and rework. The risk was high due to the pre-conditioned ground and poor ground conditions near the existing cave, which were proving to be a roadblock to achieving optimal performance from the sub-level caving operation. Increased drawpoint availability and improved cave flow performance translated into a substantial benefit. Crew exposure was reduced by 75% and redrills, shotcreting, double ring firing were eliminated, and cave flow improved by 15%.

Wireless technology enabled the mine to increase its primary draw and eliminate redrills. This offered the best opportunity around being an industry leader in mine design and mine construction for future block cave mining.

Nexa Resources Vazante Mine, Brazil

Vazante, owned by Nexa Resources, is a 1.5 million tpy zinc-lead operation in Minas Gerais, Brazil, using sub level open stoping (SLOS) and vertical retreat mining methods. A project team comprised of operations and Orica technical specialists were asked to improve stoping cycle time by reducing interactions in ore through wireless blasting. The concept evolved was to pre-charge the stope and pillar in a single pass with WebGen and then blasting in blocks without the need for re-entry. The pillar would then provide a safe location for tele-remote mucking while significantly reducing tramming distances.

Using the new mining methods, the stope was blasted and mucked without the need for rehabilitation and re-entry. Once the stope was emptied, the pillar was blasted in the next shift. This approach provided 12% of the site’s annual production in one month. It also reduced the exposure of people and eliminated rehabilitation time, thus reducing cost. The faster cycle time allowed mucking ore before stope stability degraded significantly, which decreased dilution from 27% to 20% and recovery from the pillar increased from 80% to 88%.

The use of this technology and partnership helped the mine to recover an island rib pillar, which is a pillar kept in the open stope for dilution control. After all the ore from the block was extracted and the pillar had completed its purpose, the pre-loaded holes were successfully initiated remotely.

The mine went through a series of improvements in the evolution of blasting technology with Orica, whereby the mine is currently using wireless detonators. All encoded signals were sent through the rock with the safety protocols to fire the blast being followed.

These case studies demonstrate how the introduction and adoption of WebGen can help enable the mining industry to break new ground in safety by introducing new ways of mining, fresh thinking and supporting the industry’s drive towards safer and more efficient mines of the future.

The next wireless initiating systems

The next generation of wireless initiation systems, WebGen 200, is set for commercial release in 2021. The system applies digital technology to allow advanced reprogramming and digital inventory management, offering mine operations an integrated user interface with improved quality assurance. Built with encoding capabilities and...
enhanced security, the reliability of each blast is further improved with the new generation detonators designed to endure even greater shock resistance. These significant product improvements and new features will support further innovative and more complex mining operations.

WebGen 200 will arrive in four product variants, opening new markets, applications and opportunities including surface operations and enabling the first stages of automation of blasting. There will be two primers specifically designed for surface mining applications, one of which is designed for extreme blasting conditions.

Applications in surface mining will see improvements in on-bench safety, lightning risk reduction and faster bench turnover, as well as new mining techniques of driving over loaded benches and multi stratum blasting.

Mechanised development charging unit

Orica and Epiroc have successfully developed Avatel, an industry-driven semi-automated explosives delivery system. The prototype is currently undergoing trials.

The advanced mechanised development charging system, enabled by WebGen fully wireless technology, addresses the last stage of the cycle in underground development operations that has yet to be automated. Today, physical wired connections are still a main feature in underground development charging, which is one of the riskiest areas in an underground mine.

The Avatel has been designed to provide a step change in safety by removing the need for wired connections and human exposure at the face. Instead, the full charging cycle can be completed by an operator from within the safety of an enclosed cabin, several metres away from the face. The unit is also expected deliver significant efficiencies and improvement in productivity to customers in the underground mining segment as it is capable of charging amid poor ground conditions or seismicity, accelerating heading turnover and access to ore.

The system is equipped with a suite of advanced technologies from both Orica and Epiroc. Beyond its wireless blasting capability and industry leading ammonium nitrate emulsion process body – HandiLoader, that is capable of string loading, its automation functions are powered by LOADPlus Underground, a smart control system that enables an operator to seamlessly manage the critical charging, inventory, and tracking functions.

Furthermore, the unit will be integrated with SHOTPlus Tunnel, an intelligent blast design software that enables a blast designer to produce and export site specific loading parameters to the charging control system for accurate and repeatable execution of the blast design at the face.

Giving support to all its functions and capabilities is Epiroc’s machine-to-machine carrier, the physical platform and body of Avatel, known for its proven reliability and performance in face drilling. The rig control system (RCS-5) is also a key technology that will allow the operator to digitally guide the booms based on as-drilled or design data.

Conclusion

Artificial intelligence and advanced machine learning capability will interpret real-time data to design even more predictable blasts. As operations become more digitally connected, more workflows will become fully automated.

As mines go even deeper, and ore becomes even harder to reach, ongoing advances in automation, digitisation, wireless blasting technology and data analysis will deliver not just better returns but also better environmental and social outcomes.