

Innovation in mining:

A look at new products and processes shaping the industry

by William Gleason, Editor

Editor's Note:

In the September issue of *Mining Engineering* magazine a number of new products and processes that would have been featured on the exhibit floor of the 2020 MINExpo International trade show were included in

the printed edition. This Web Exclusive is an extension of that effort to highlight some of the new technologies that will help shape the mining industry for years to come and includes submitted case studies and press releases about new products.

Extending the life cycle of mining equipment

Repairing pivot lugs

by Gene Roberts and Rod Whipple, Nord-Lock Group

Whether it's a 360-t (400-st) haul truck or a Swiss watch, every machine with parts that pivot has to contend with friction and wear. A glance at the out-of-round bore of a lug on an ultra-class haul truck's steering system tells the story: The pivot pin was harder than the lug;

the softer metal has worn away and without corrective action, excess play in the joint will mean increasing loss of stability, safety and control.

The traditional preventive maintenance (PM) solution (after, in many cases, lancing and



cutting out the old pin) is to weld new metal into worn pivot mounts, rebore the lug, and install a new pin ... just like the one that wore out the bore in the first place. Next PM cycle, repeat. Time-consuming and costly? Sure, but that's the way it's always been done.

Today, however, pressures for lifecycle extension and downtime reduction have never been more intense.

So it's more and more difficult to accept conditions like these:

- An Arizona mining company found it was servicing drag-links on suspensions on its 23 Liebherr T282B haul trucks every 8,000 hours. That meant lengthy down time — a full 12-hour shift — for each machine, at an estimated cost of \$27,000 per truck.
- One Wyoming mining operation, with a fleet of 50 Cat 793B trucks, was servicing stabilizer link assemblies every 10,000 hours. Each service and repair logged 12 unproductive hours per truck. Analysis of the replacement process on-site put the total cost per pin at more than \$8,000.
- A mine in Michigan, operating 17 Cat MT4400 trucks, was sustaining five days of downtime per machine per PM cycle, as machinists welded and line-bored radius rods. A company official estimated downtime losses across the fleet at more than \$2.5 million per cycle.

In each of these cases, and many others, experienced maintenance teams put the blame for repeated, labor-intensive repairs on conventional pivot pins. Obviously, the time to look for a better pivot-pin technology is now.

But still we meet maintenance managers who don't realize the improved technology is already here. It's a smarter pin system that eliminates most wear and tear on lugs, once and for all. And it's been proven for decades in industries that depend on heavy equipment — like mining, construction, oil and gas, and forestry — across the United States and around the world.

Solution: a cost-effective system that stops pivot-pin wear in its tracks

What if damage-prone pivot pins were actually engineered for the job? What if they could:

- Slip into position just as easily as old-style pins?

- Adapt to out-of-round bores tightly enough to eliminate destructive play between parts?
- Distribute working loads evenly throughout the bore?
- And, as a result, eliminate pin-to-lug wear completely?

Previous examples are just some of the advantages of the Expander System, a cost-effective solution developed by the hands-on engineers at Nord-Lock Group. Want proof?

Here's what happened at the three mines mentioned:

At the Arizona operation, every haul truck's drag-link suspension depended on a total of eight pivot pins.

Excessive bore wear meant taking each machine down for maintenance every 8,000 hours. Lancing out the old pins, welding and line-boring, re-bushing, and pinning typically took a full 12-hour shift. When the mine ran a 15-month, 9,500-hour trial with Expander, the test truck showed zero movement or wear in the bores. Those results convinced the mine to install Expander pins on all 23 trucks in its fleet.

The Wyoming maintenance shop made the Expander System standard throughout its 50-truck fleet after a test showed massive savings on the stabilizer link repairs. Expander reduced pin installation time from a 12 hour shift to a single hour while simultaneously extending pin life from 10,000 hours to 50,000 hours. The mine has since added Expander Pins to the Rear Suspensions as well.

At the Michigan mine, conventional radius-rod repairs necessitated downtime that was costing \$30,000 per day, per truck. A two-man team of machinists was taking at least a week of 10 to 12-hour shifts to weld and line-bore each of 17 trucks. Adopting the Expander System dramatically reduced downtime and cost. With old-style pins, repairs on 17 trucks (at five days per truck) added up to 85 days of downtime. With Expander, projected productivity gains — not including substantial labor savings — total \$2,550,000 per cycle.

Smoothing the transition: moving up from conventional pins to the Expander System

The Expander System is designed for easy installation with ordinary tools. That's one reason maintenance supervisors report that the new technology is troublefree.

After making the change, our contacts in the field offered these transition tips:

- Follow the instructions exactly. “For example, Expander says to set the recommended torque, then run the machine through its full range of motion, and then double-check the torque to be sure everything is seating properly. On something like an excavator, after you put the machine back to work, be sure to check the torque one more time at the end of the shift. The only issues we’ve had were when the guys got too impatient — they just finished the install and away they went without checking the torque again.”
- Safety first. “Observe the procedures your operation has in place, including the simple stuff like wearing personal safety gear and making sure the equipment you’re working on is properly staged or cribbed or stabilized. You want to get the job out of the shop, but you want to stay in one piece yourself.”
- Find ways to be flexible. “In the mining industry, sticking to the torque schedule can be an issue. The machine goes out for 12 hours, comes back in, and then has to go back out right away. So we sat down and rethought our mine’s work schedule. Now the main job still gets done, and we get the most out of the machine and the new parts we’ve installed.”
- Insist on education and training. “It won’t take long, so make sure everybody who works on installation and maintenance has seen, or heard of, or used the new system. All the old skills still apply, but your people have to be aware that there’s a new device in the shop.”

Validated, versatile and field tested

Expander Systems have been field tested for more than 50,000 hours without a failure. We’ve developed more than 80,000 pin locations for a large variety of machine makes and models.

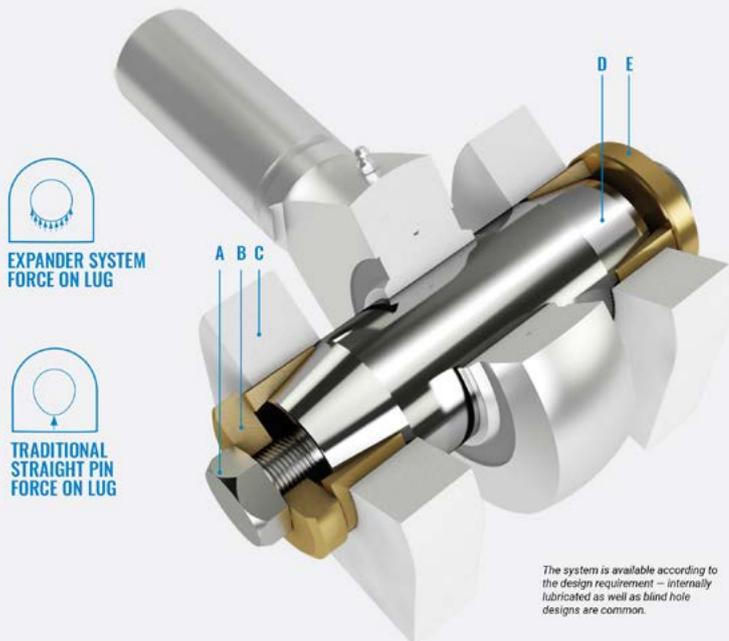
Expander Systems are used in new machines for best lifetime and high quality feel or as a repair solution during service, regardless of the application, big, small, large volume or one piece production we have the solution for you. With experience in designing systems for more than 80,000 applications our design teams in Americas and Sweden knows how to help

EXPANDER SYSTEM

Under torque, the tension washers push the expansion sleeves up the tapered section of the axle, locking the system into the lug ears and eliminating movement that causes pivot wear. The double-sided locking mechanism provides increased stability, security, and a backlash-free joint. Field installation, for reduced downtime and cost, is easy. For high-vibration applications, Nord-Lock’s special vibration-resistant washers are integrated.

The basic Expander System is a patented pivot technology with a design including:

- Tapered axle/pin
- Expansion sleeves and tension washers
- Fasteners



The system is available according to the design requirement — internally lubricated as well as blind hole designs are common.

How it works

A

When the fasteners are tightened, the washers press the slotted expansion sleeves up the tapered ends of the pin.

B

The sleeves expand to conform with wear patterns in the lugs and lock the system in place.

C

Expander System fits into the existing lugs without expensive welding and line boring.

D

Once installed according to instructions, the system locks solidly to both lugs for significantly improved stability.

E

Removal and reinstallation are equally easy, and comes with a lug wear warranty of 10,000 hours.



you achieve what you want with your pivots. All systems can be supplied with or without internal greasing and material certificates. We design and manufacture any size, diameter and length of pin. Our designs can be adapted to the needs of the application such as space constraints, single side mounting or flush mount. Special is standard for us — we do designs such as axial locking of bearing and have a vast experience in adapting for extreme environments or enhanced safety requirements. ■

About the authors:

Gene Roberts has spent more than 20 years supporting customers worldwide, through his work in product development, OEM business development, manufacturing, and sales. Rod Whipple is an industry veteran with 10 years of technical sales experience. He supports Expander dealers, representatives, and end users by providing physical and technical support in the field.

Raising the bar for connected mining operations

Automation and control technologies in smart mining

by Nathan Bland, Tom Dobiecki and David McLane, Burns & McDonald

A holistic and integrated approach to modernizing mining operations is the key to a connected, automated and controlled mining operation. Upfront planning and flexible project management help operations understand the supplier technology options and select the right course for maximum return.

The value of smart mining is on the rise. From underground and surface mining to modeling ore value and mineral processing, mining operations are being transformed by the deployment of new automation and control technologies.

While other industrial and manufacturing processes have implemented smart technologies over the past several decades, the challenges for mining are different.

Operating in remote, harsh locations and uncontrolled environments, adopting and deploying the right automation solution is difficult. However, faced with a growing demand for energy, minerals and metals — and ongoing pressure on cost and safety — the time is right for operators to overcome obstacles and carefully examine the potential for mining automation and control.

Excavating the possibilities

The mining industry is a matrix of complexities. From the variety of ore-bearing rocks to the diverse mining landscapes, every operation is unique. In recent years, the industry has experienced particular turbulence in fluctuating commodity prices, operating costs, production output, labor requirements and cash flow. Despite the many different operating environments and industry challenges, mining is a capital- and labor-intensive industry where automation and control offer tremendous promise.

Mining operations are broken into the distinct processes of exploration, mining, processing and closure. The right automation and control strategy targets productivity and efficiency gains, no matter where they might reside in the operational chain and offers the potential to bring together otherwise distinct and siloed processes.

Like the mining processes themselves, mining automation and control options vary and each one may not be optimal for every mine. Some mines benefit from deploying basic sensor technologies and the internet, while others leverage broad-scale artificial intelligence

and cloud computing for sitewide results. Automation is about acquiring the right data at the right time to deliver insight that drives decisions to add value.

Automation is possible for a range of mining operation processes:

- Cleaning, preparing and processing.
- Conveyors, crushing and grinding.
- Equipment and machinery monitoring.
- Exploration, drilling and sampling.
- Geological modeling, surveying using geographic information and positioning systems (GIS and GPS).
- Haulage, trucking and loading.
- Mine development and production.
- Transportation, shipping and pipelines.

The applications for mining automation and control are almost limitless and so is the confusion and uncertainty of where to begin. Working within a robust and growing market of smart mining equipment means an extensive array of suppliers and vendors offering sophisticated and often similar technologies and solutions. No matter the mine size, location or place on the technology adoption curve, mining operators can determine the right technology solution by exploring the reasons for change, defining the goals of the operation and developing a strategy that integrates automation for optimal return.

Starting with the end

Smart mining initiatives ultimately revolve around the ability to identify, track and monitor the flow of the ore to maximize recovery and optimize processing and delivery of products safely. These functions, however, operate in challenging and hazardous environments where the terrain is often severe, access points restricted and wireless networks lacking.

With so many elements to consider and a multitude of technological options to evaluate, project clarity comes from defining an overall project objective. The outcomes of improving efficiency, lowering cost and increasing production are often complementary in terms of outcome, but defining which is the goal of an automation project to help focus efforts and streamline decisions.

Putting technology options and proprietary systems aside, mining operators can determine the fundamental reason or outcome desired for a



project. Front-end planning that is collaborative across key stakeholders helps define the end-result that will serve as the touchstone for all project decisions.

Smart mine project goal clarity helps streamline technology evaluations that, in turn, can better facilitate project decision-making, planning, procurement and execution.

Connecting the mine

Key mining operation processes often work independently without the infrastructure, technology or communication capabilities to talk to each other. Integrated automation and control of the mining fleet helps systems work in unison to control costs, enhance productivity and increase awareness of activities for improved safety.

Many areas can be automated within mining. Using the project goal, operators can evaluate opportunities within the key operations to determine where automation will be beneficial.

Fixed equipment

The life of a mine is dependent on extracting and processing ore using mechanical equipment. Automating this fixed machinery not only increases safety, but also offers tremendous efficiencies that can help to maximize the output of a mine.

Upgrading material handling using proven automated conveyor systems helps improve

efficiency, reduce cost and increase safety. However, moving raw material with automated systems is just the start. Many operators are deploying automation and controls to get more value and insight into mining.

Online cross-belt analysis systems on conveyors provide real-time identification of the composition and quality of bulk raw materials as the material is conveyed. Avoiding time-consuming lab analysis, online analyzers not only determine the percentage of sellable product available but can also help distinguish the section of the mine where more valuable product resides. Real-time insight offers the opportunity to analyze mine samples and pinpoint where higher-value ore exists. Likewise, there is an advantage and differentiation of mining companies that can deliver quality assurance on the delivered product to buyers.

Mobile equipment

With strict government regulation and an emphasis on safe operations, autonomous mining machinery is a practical and beneficial use of automation for the mining industry. While the automation of mobile equipment has been used for some time in mining, implementation requires consideration given the infrastructure needed.

In addition to mining equipment, automation of mobile machinery involves a suite of technologies including robotic hardware,

software to convert equipment, computing power, radio and wireless communication and GPS tracking, and more.

Mobile equipment automation is available in several different formats:

- Driver-assisted technology enables a vehicle to sense where it is in relation to other objects to be able to precisely maneuver. Many machines are only partly automated, but this technology can serve as a transition to implementing a more sophisticated command-and-control platform using GPS for remote operation of a vehicle.
- Full automation utilizes autonomous control on more than one vehicle or piece of mining equipment. Full automation incorporates all aspects of the functioning of machinery, including such actions as steering, braking, and blade or excavator bucket control. Full automation requires an extensive investment but offers the potential for considerable productivity gains.
- Remote control equipment gives operators line-of-sight of operation as well as the ability to maneuver vehicles and equipment from a portable, radio-linked control box. This automated solution helps with tight spaces, including extended or deep cuts and underground longhole stoping, but still requires personnel to be within the vicinity of potentially hazardous environments.
- Teleoperated equipment is remotely controlled by an operator using sensors, software and cameras often utilizing a handheld control or joystick. Teleoperation, also known as teleremote, gives operators a better view of surroundings to maneuver and removes personnel from hazardous areas.

Proactive equipment maintenance

Mining utilizes a broad array of heavy equipment — vehicles, drilling machines, conveyors and processing systems — all of which have hundreds of components and moving parts working in harsh conditions. With an emphasis on safety and lowering operating cost, mining operations cannot efficiently rely on personnel walking through sites to visually inspect when machinery may need attention.

Using embedded sensors and remote connectivity, machinery performance

indicators such as pressure and vibration are monitored to alert operators of issues or attention required. Predictive maintenance monitoring and analytics are automated functions that provide real-time machine health data, so that problems can be intercepted before dangerous or expensive failures occur.

Temperature sensors, for example, can be installed to track motors, drives and bearings of machinery that allow for early detection of potential failures. Control systems can also be configured to interpret data from the electrical distribution system to track amperage against tonnage passing on the conveyor. Similarly, monitoring the load of the conveyor motor can control the variable speed drive to extend the life of the equipment. Ventilation systems with temperature monitoring and control provide critical real-time data to maintain requirements for minimum air flow and maximum temperatures, while providing automated oversight of energy consumption to minimize costs.

Exploring a new way forward

With so many operating components, technology and supplier options, the complexities for mining automation projects can seem impossible. However, reducing the exposure of people to hazardous environments, lowering costs while raising productivity, increasing sustainability and reducing maintenance variability are benefits that make exploring automation a worthwhile effort.

For successful integration of automation and control in mining, the traditional approach to project management is not enough. Mining automation projects require an agile project methodology that develops clear goals and utilizes the necessary controls but is also capable of incorporating project iterations through a rolling wave of planning to address unique operating criteria.

Successful automation projects need a holistic view, during both the upfront planning and execution phases, that identifies the proper infrastructure and systems needed. A complete view of the end result helps identify the proper infrastructure and systems required to deliver a connected, automated and controlled mining operation.

Processes need to be improved and balanced across the mine to realize the benefits of automation; otherwise, the improvements risk being only incremental and the results largely underwhelming. ■

Digital transformation;

Six steps to reducing risks and roadblocks in digital initiatives

by Jeff Botsch, Consulting Services Manager: Mining, Metals & Cement, Rockwell Automation

There's no question that the mine of the future is digital – with connectivity, data and digitalized processes driving results like greater productivity and enhanced safety.

The more pressing question is, when will this future arrive for you? And when it does, will it be too late?

Today, mining lags behind other industries when it comes to implementing digital initiatives. A recent Rockwell Automation survey found that only one in 10 mine executives said they have implemented at least one digital transformation initiative – compared to more than one in five in other industries.

Mines present no shortage of challenges for digital transformation – from remote and harsh locations to technical and security challenges to the new skills that are needed in the connected mine. But with the right strategy, you can create digital initiatives that are meaningful to your business and manageable in their implementation.

Roadblocks slow the journey

For the last two years, digital effectiveness

has been one of the top three business risks for mining and metals companies, according to EY. But a wide range of factors can slow or stymie your journey to the connected mine and your ability to capture value from it.

It could be that your digital strategy doesn't support your overall business strategy or specific market needs. When this happens, you can become too focused on the technology itself and not on what the technology should be doing: solving your business problems.

Equipping your workforce with the right skills is another challenge. Digital technologies can redefine roles in your mines and require entirely new types of workers. At the same time, just finding workers to fill skilled positions can be difficult, as experienced workers retire and create an industry-wide skills gap.

You may also struggle with deploying new technology. For example, if you develop custom software in-house, you may find it's difficult to maintain and expand across your operations.

A rigorously developed strategy can help guide your digital transformation, so you stay focused on achieving better business results



rather than solving problems along the way.

What you need

Achieving smarter mining through digital transformation is a journey. And that journey requires a pragmatic strategy with six key steps:

Conduct an operational assessment. You may have a vision for where you want your mining operations to one day be in terms of connectivity, analytics and production capabilities. But just as important as knowing where you want to be tomorrow is knowing where you are today.

An operational assessment will help you understand the current status of your operations and the gap between the current status and the desired results. The assessment looks at how your operations run and the full suite of IT and production technologies that are used to keep it running.

Verify corporate alignment. Digital transformation isn't about changing your technology infrastructure. It's about changing your business to improve things like safety and environmental performance, operating efficiency and your bottom line.

This is why your digital strategy must align with your corporate strategy – and is ideally part of the corporate strategy. First, define your business vision as well as the strategy and objectives you have for bringing that vision to life. Then you can develop a digital strategy that supports these efforts.

Build a business case. Each digital initiative should have its own business case. And each business case should clearly define ROI and how a new technology will address a current problem or challenge.

Common business cases in mining include optimizing equipment usage to reduce operating costs, anticipating equipment failures to reduce or avoid downtime, and using greater connectivity and mine visibility to help protect people.

Define your business architecture. Once you've defined your business cases, you can start turning them into actionable objectives. The first thing you need to do as part of this process is define your enterprise in terms of governance, people, processes, technology, partnerships, strategic goals and capabilities. This assessment shows how the organization works today and stands as a reference point to how it will change as a result of digital initiatives. An enterprise-wide approach will prevent the creation of isolated initiatives or "pet projects" that cannot be applied

in other areas or expanded.

Specify a technical architecture. Only now – after you've identified your business problems, made cases for solving them and outlined the business architecture that you'll solve them in – can you define your technical requirements and products.

There are some crucial decisions to make at this stage. For example, proven and scalable digital solutions can be less risky than homegrown solutions, because they can expand over time and support multiple initiatives. Also, some digital solutions like advanced analytics platforms embed machine learning at the device level. This can help you achieve outcomes like better mine visibility with less reliance on hard-to-find data scientists.

Develop a digital roadmap. Finally, you can create a roadmap for implementation. This involves not only charting a course for when and where you'll implement each of your digital initiatives but also how you'll sustain them and continuously improve results over time.

As you plan your initiatives, remember that this is a journey. Everything doesn't need to happen at once. It may make the most sense, for example, to implement your initiatives incrementally, with each new initiative helping fund the next.

The benefit of experience

This six-step strategy can help keep your digital initiatives focused and moving through careful analysis, planning and understanding of your business needs. But there may still be aspects of your digital transformation where you need help.

You may not have experience, for example, in areas like integrating siloed systems or standardizing data. Or you may struggle to find time and people internally to see your transformation through.

That's why the right partners are essential. They can bring valuable expertise from other digital transformation projects to help you identify and build business cases for your digital initiatives. They can also help you get the most value from concepts that are still new to most mines, like digital twins, predictive analytics and connected workers. And they can help apply best security practices to protect people, processes and intellectual property from cyber threats.

With the right strategy and partners, you can find the success in your digital initiatives that so many others in mining are still searching for and set a new bar for what's possible in your operations. ■

Innovative products for mining;

A look at what you would have seen at MINExpo

Every four years, the global mining industry gathers in Las Vegas, NV for MINExpo, the largest trade show in the industry. Hosted by the National Mining Association (NMA), MINExpo is a celebration of the technologies and equipment that power the industry.

In May, the NMA made the difficult decision to postpone the 2020 MINExpo to 2021 because of the COVID-19 pandemic.

In anticipation of next year's expo, *Mining Engineering* is pleased to take a current look at some of the innovative companies that had planned to showcase their services and equipment at the three-day, 2020 exhibition.

More product releases are available online at www.me.smenet.org

Benetech Inc. has announced the availability of its patent-pending MaxZone Plus system for bulk material handlers who need to solve belt conveyor load-zone issues where time and budget constraints exist. Benetech created the MaxZone Plus system to help operators stay productive without chute redesign and complete change-out. The system acts as an efficient belt conveyor load-zone chute that keeps material flowing while reducing transfer point spillage and dust through center loading. Components include adjustable side-flow control plates as well as an adjustable loading spoon for proper, smoother center loading of material onto the loading belt. Removable side panels allow height adjustment according to belt conveyor load zone requirements.

The MaxZone Plus system can also be used to help with silica-dust mitigation issues commonly found in mining at the secondary, tertiary and recirculation conveyor transfer point locations. Ease of service and reduced maintenance requirements, along with superior performance characteristics, add to reliability and production goals being met or exceeded.

www.benetechglobal.com

Cementation. When constructing the Kidd Mine D #4 Shaft winze project for Falconbridge, Cementation used a winze to split the shaft into two sections that could be worked simultaneously, thereby fast-tracking the construction schedule. Another innovation was the successful application of large-diameter bored raises in hard rock, giving options for different configurations to mine planners. With

Cementation's adoption of rotary, vertical drilling equipment, the vertical alignment accuracy of bored raises improved to the tolerances required for hoisting plants, allowing borehole hoisting systems in large-diameter raises for high-capacity hoisting.

At AuRico's Young Davidson Project,

Cementation bored a 5.5 m diameter x 1,550 m deep (18 ft diameter x 5,085 ft deep) shaft in three legs. At the end of the second leg was an intermediate loading pocket to allow for early hoisting before the final leg was completed. Using a friction hoist and rope guides, the plant is operating at 8 kt/d (8,800 stpd). The company has also patented an injection hoisting system for moving material within a shaft without the need for conveyances. This allows for smaller openings and operation at a lower energy requirement.

In 2019, Cementation acquired Terra Nova Technologies (TNT), which provides materials handling design and supply for the mining and bulk materials industries. TNT widens the services offered to include mobile stacking systems, overland conveyors, crushing and screening plants, in-pit crushing and conveying.

www.cementation.com

Columbia Steel's latest repair-link design provides customers with a strong, mechanical solution to dragline chain downtime. No welding or special tools are required. Depending on individual wear, the link can be removed during routine chain maintenance and reused as needed. The link uses a positive-lock, snap-ring system for quicker, simpler repairs compared to friction-style assemblies.

Worn out end-link bushings can be replaced in the field, instead of the shop, with Columbia's swivel-ball design. The patented swivel-ball design uses a unique anti-rotation tab that keeps the offset bushing in position, providing more



Columbia's patented swivel ball bushing.

Innovative Products



Eriez HydroFloat uses a novel aeration system to disperse fine bubbles into a fluidized-bed environment.

wear material where it is needed most. Benefits include: no welding or machining required, easier maintenance for less downtime, movement in connection helps improve wear life, and the repair-link design fits all standard chain, including Columbia's TwistLink.

Columbia also offers hundreds of patterns for improved crusher replacement wear parts for gyratory, cone, jaw, hammer mill, impact and roll crushers. Product engineers specialize in designing crushing surfaces to handle oversize material and reduce recirculation. Columbia alloys and Xtend Process hard-facing overlays are tailored to meet the levels of impact and abrasion that crushers encounter, resulting in better overall plant performance.

www.columbiasteel.com

Derrick Corp. has introduced its new G-Vault polyurethane interstage screen for carbon-in-pulp/carbon-in-leach and resin-in-leach/resin-in-pulp processes at gold-recovery plants. Due to the abrasion and blind resistance of the polyurethane material, the new interstage screen reduces maintenance by eliminating the frequent washing and unblinding procedure required for stainless-steel, wedge-wire screens. G-Vault screens are available in a variety of sizes, with screen apertures ranging from 500 to 1,200 microns.

The G-Vault interstage screen is a direct, bolt-in replacement for the existing wedge-wire screens but allows re-use of the operating mechanism. The retrofit involves replacing the wedge-wire screen with the G-Vault screen and then lowering the module back into the tank. The G-Vault offers a significantly higher open area than wedge-wire screens — in some cases more than 20 percent. Combining the wear resistance and nonblinding characteristics of Derrick's polyurethane, the G-Vault screen produces the same micron consistency as wedge-wire screens with reduced process interruptions and extended intervals between cleaning cycles.

The G-Vault is composed of several independent screen sections retained in a 304-stainless steel cage. The use of replaceable screen sections reduces maintenance costs by permitting replacement of only a heavily worn section, rather than an entire screen. Field testing has demonstrated that G-Vault screens can reduce maintenance and attendant costs while increasing throughput. And while the initial cost is higher than wedge wire, the G-Vault can produce a favorable return on investment for mine management due to its significantly lower maintenance costs.

www.derrick.com

Eriez has designed its new HydroFloat separator for coarse-particle mineral concentration, delivering the capacity of a density separator while maintaining the selectivity of a flotation device. Using a novel aeration system to disperse fine bubbles into a fluidized-bed environment, the HydroFloat separator significantly increases the selective recovery of coarse particles by applying flotation fundamentals to gravity separation.

HydroFloat can be applied to coal, iron ore, industrial minerals, base metals and sulfides. Applications include coarse recovery in split-feed flotation circuits, tailings scavenging and flash flotation in grinding circuits. The separator is an aerated fluidized-bed (or teeter-bed) separator. The synergistic effect of combining flotation with gravity concentration results in an outcome that cannot be achieved by either approach alone. Air bubbles dispersed by the fluidization system percolate through the hindered-setting zone and attach to the hydrophobic component, altering its density and rendering it sufficiently buoyant to float and be recovered. The use of the dense phase, fluidized bed eliminates axial mixing, increases coarse particle residence time and improves the flotation rate through enhanced bubble/particle interactions. As a result, the rate of recovery is high for both fully liberated and semi-liberated particles.

HydroFloat separators improve coarse particle recovery through increased bubble/particle collision rates, increased bubble/particle sliding time, increased residence time, decreased mixing, decreased turbulence and detachment, and decreased buoyancy restrictions.

www.eriez.com

FGX Septech, LLC a leader in manufacturing and supplying the dry (pneumatic) coal separators. The FGX technology uses air rather than water to beneficiate the run-of-mine coal. The FGX process is also effective

in beneficiation of other minerals, such as, trona, oil shale, etc. For some minerals, it is an excellent step for pre-concentration of mined minerals. Currently, there are more than 2,200 FGX pneumatic coal processing units operating throughout the world. FGX machines are capable of processing from 9.1 t/h (10 stph) to 450 t/h (500 stph) of the run of mine coal. Pilot-scale testing is provided free of charge, at the client's site for feasibility study. Currently there are four commercial scale units operating in the United States. It is one of the most economical and environment friendly green technologies.

www.fgxseptechnic.com/

Flottweg decanter centrifuges are a real alternative to traditional processes. Decanter centrifuges are increasingly finding their way into modern mining processes due to their low cost, low freshwater usage and low space requirements as well as their contribution to environmental protection.

Tailings are still frequently stored in large settling basins or sludge ponds and are a burden on the environment. The process water bound by the tailings remains unused. With modern dewatering solutions, mining residues can be treated economically and the process water that they contain can be recovered. This saves both space and cost and is environmentally friendly.

The storage of tailings in sludge ponds is increasingly being replaced by the storage of dewatered tailings. Mining companies store the dewatered sludge on the ground. This complies with statutory regulations in most countries. In hard-to-reach and confined storage regions or in earthquake-prone areas, it is particularly advantageous if the tailings have been dewatered. This minimizes environmental risks and space requirements. The cleaned process water can be recycled. Mine operation costs are significantly reduced.

www.flottweg.com/

STM-Screen two-mass vibratory screens use **General Kinematic's** proven two-mass, natural frequency drive design. The design is load-responsive and capable of longer material retention. Dual in-board vibratory motors eliminate expensive belts, shafts and bearings. The patented modular design uses a center spline to increase structural integrity and allows for easy assembly and disassembly for quick transport and installation.

The STM-Screen has an average service life five times that of a brute force model. Maintenance labor hours and parts costs are lower, and screening capacity can be increased



Hitachi's EX1200-7 excavator.

by up to 40 percent. The longer retention time allows for an optimized material separation, as fines have more time to drop out. Equally important is the ability of the screen to process at a higher bed depth, without sacrificing throughput. A higher bed depth at the screen feed end spreads out across the width, while the increased retention time processes the specified tonnage.

The two-mass design utilizes the weight of opposing forces running 180° out of phase. During material surge conditions, common in mining operations, the added weight that hits an STM-Screen does not cause it to dampen out, it picks up in stroke as material surges. This consistency of stroke ensures that there is no loss in screening efficiency. Material surges on competitive brute force screens dampen the stroke and diminish screen efficiency.

www.generalkinematics.com

Gorman-Rupp has introduced an integrally mounted diaphragm priming assembly as an option on select 10 mm (4 in.), 150 mm (6 in.) and 200 mm (8 in.) Prime Aire pump models. An alternative to the venturi/compressor priming system on Gorman-Rupp's priming-assisted pump models, the diaphragm primer delivers up to 1,700 L/m (60 ft³/min), a vacuum to 9.1 m (30 in.) and is rated for temperatures as low as -9.4 °C (15 °F).

With fewer components, the new primer offers reliability and increased efficiency, as well as higher lifts. Reversed air flow and thinner valves help any liquids entering the primer to escape easily compared to similar systems. The new primer's single-bearing housing has fewer leak paths and alignment issues compared to dual-bearing housing alternatives.

For applications moving stringy solids or other clog-prone materials, Gorman-Rupp now offers the Eradicator self-cleaning wearplate in PA Series pumps as a dependable solution

for handling solid waste. This new wearplate incorporates notches, grooves and a lacerating tooth that help break up stringy materials and pass them through the pump without impacting performance or interrupting service.

www.grpumps.com

Hitachi's new EX-7 Series line of mining excavators includes the EX5600-7, EX3600-7, EX2600-7 and EX1200-7. All are available in North and South America.

With the EX2600-7, EX3600-7 and EX5600-7, customers can choose from a Cummins or MTU EPA Final Tier 4 (FT4) engine option. For nonregulated countries, customers can choose from a Cummins or MTU engine option that features fuel consumption optimization (FCO) settings that contribute to improved efficiency. For example, the Cummins FT4 engine on the EX3600-7, which has FCO technologies but uses diesel exhaust fluid (DEF), features a four percent net fluid savings. The MTU FCO engine without DEF features a seven percent net fluid savings as compared to the previous model, the EX3600-6.

The smallest of the EX-7 Series excavators, the EX1200-7, features a bucket capacity of 7 m³ (9.2 cu yd), a 4.5 percent increase. Equipped with optimized swing control, the new machine also has an improved hydraulic system with a flow-regeneration valve to reduce power requirements from the hydraulic system and engine, lowering fuel consumption and improving pump life.

www.hitachiconstruction.com

Innovative Wireless Technologies Inc.'s Sentinel Uniti System, which is composed of the Sentinel Uniti Node and power supply, was approved by the U.S. Mine Safety and Health Administration (MSHA) for use within gassy areas of underground mines. This approval means that the system can now be used to support rapid section moves, enabling teams to quickly advance communication and get production data to the surface in real time. The 2.4 GHz Wi-Fi connection to the network provides the ability for underground IP connectivity. This streamlines operations for accessing machine manuals and remote technical support (i.e. Zoom or FaceTime with vendor technical support), sending pictures or videos of broken equipment, or ordering repair parts on location.

Previously released for nonintrinsically safe environments in 2019, the Sentinel Uniti Node is a multifunctional device that combines IWT's high-data-rate (HDR) technology, Wi-Fi access point, voice communication, text and tracking

in one robust package for a reliable, wireless network. Software-configurable to support various levels of functionality, the system is offered as: HDR and Wi-Fi only; HDR, Wi-Fi, and text/tracking/sensor data; or, HDR, Wi-Fi, text/tracking/sensor data and voice. Expandable functionality means customers can add capability as their needs evolve.

www.iwtwireless.com

Keller companies Bencor, Case Atlantic, Case Foundation, Hayward Baker, HJ Foundation, Keller Canada, McKinney Drilling and Moretrench have joined and rebranded to Keller. Operating as one company with the most complete portfolio of services, Keller combines experience and resources to safely provide innovative geotechnical solutions, especially those involving multiple techniques.

Keller's expertise offers solutions to a full range of subsurface challenges faced by mine operators. It delivers design-build solutions that include environmental ground water cutoff, ground freezing for mine shaft access, earth retention for slope stability, dewatering, and vertical drains for draining or consolidating tailings. Keller has completed mining projects around the world. As a widely used method in modern large-scale mining operations, heap leaching is a cost-effective ore extraction process. The company's patented, vertical drainage system for heap-leach piles or tailings ponds prevents slope failure and allows subsequent percolation to reach deeper into the pile for an increased ore yield, and the drainage system provides significant improvement of leachate circulation.

www.keller-na.com/mining

MacLean's 2018 acquisition of an underground research and development facility in Sudbury, ON, Canada has provided MacLean with the ability to develop and test new underground mining vehicle technologies completely in-house. The MacLean Research and Demonstration Center is an ideal setting for putting mining-vehicle innovation theory into practice, with a 300-m (1,000-ft) decline at an average grade of 15 percent, branching into multiple headings and testing areas.

Prior to pandemic travel restrictions, the facility was used for bolter testing and training on the company's battery electric 975 Omnia scissor bolter. While trying out a number of new and in-development features on the unit, MacLean engineers saw first-hand and in real time how their designs interact with the operation of the bolter, and several small fixes

were more easily identified than they would have been in an above-ground shop.

In addition to making the product development innovation process much smoother, the controlled environment of the Research and Demonstration Center provides a perfect training environment. Mobile equipment operators are able to more rapidly achieve a level of familiarity with new product features and safety protocols, while video capture throughout the process can build a library of high-quality training videos to help MacLean demonstrate the proper operating procedure to trainees before they even get underground.

www.macleaneengineering.com

Malmedie has introduced a new line of retrofittable torque limiters called the ITL series. Based on American Gear Manufacturing Association coupling sizes from 1-7, the new ITL series of torque limiters is an insertable component that will mate to the standard buoyancy compensation device of the existing coupling flanges, thus creating a torque-limiting coupling out of the installed coupling hubs. The ITL series uses standard Malmedie torque-limiter technology that is a ball-and-detent type of protection. This allows for nearly infinite adjustability and minutes to recommission without the need for any new parts. The new ITL series is available with the auto-resetting capability (ARC) technology as well. ARC allows the coupling to automatically reset after a peak torque event with only a slight reversing of the drive line components.

Malmedie planned to launch the ITL series at MINExpo 2020, and it also planned to show its full line of barrel-type drum couplings, which have been the cornerstone of the company for more than 60 years. The TTXs series of couplings are most often used on long-travel, overland conveyors at the drive pulleys. The couplings' design allows for both torque transmission and radial load support in a small, compact component that results in the reduction of drive-train components or support pedestals/bearings.

www.malmedie.com

Martin Engineering now offers a belt-cleaner-position indicator that monitors the blade and tracking and reports remaining service life. The intuitive Martin N2 Position Indicator (PI) monitors primary belt cleaner blades, notifying Martin service technicians and plant-operations personnel when retensioning or replacement is required or when abnormal conditions occur. The PI can be part of a new installation or directly retrofitted to existing

mainframes that use the company's replacement blades. Managers and service technicians can quickly access information on any networked cleaner via cell phone.

With approximately 1,000 operating systems currently in service, the technology has been embraced by bulk-material handlers in a range of industries and applications. Designed by the engineering team at Martin's Center for Innovation, the N2 Position Indicator is produced solely in company-owned facilities to ensure the highest standards for quality control.

Martin offers the equipment, monitoring service and batteries free of charge to qualifying customers. The company will also support the PI components and provide customer alerts without cost as needed, with mainframes and tensioners replaced free for users of Martin belt cleaner blades.

Position indicators can be mounted anywhere from 3 to 800 m (10 to 2,625 ft) from the cellular gateway, and the robust, sealed construction means it is virtually immune from damage. The system does not require a cellular line for each PI, instead communicating via radio frequency from each sensor to the gateway.

www.martin-eng.com

With Pitram, **Micromine's** fleet management and mine control system, the Fresnillo PLF is improving its Saucito and Fresnillo operations - a project with more than 465 years of history. The two mines produce approximately 37,000 koz of silver and 108,000 oz of gold annually.

The Pitram real-time solution allows data capture and review, as well as its management during each shift. In this way Fresnillo does not have to wait until the end of the shift to make improvements in its production.

In operations like Fresnillo, which are extensive and complex in which more than 1,800 employees and more than 3,500 contractors work, the savings in time and cost are very significant.

Pitram records equipment, people and material information to provide a global view of the mine's state and productivity. The quality of the information collected by Pitram allows the team to identify opportunities to increase production, reduce costs and improve project security.

Pitram has functionalities such as Material Management and Shift Planner that are essential to increasing production yields in the mine, as well as offering processed information that allows for making more accurate decisions.

In addition, the Materials Management module includes a metadata functionality,

Innovative Products



Wirtgen introduced the 220 SM 3.8 surface miner in 2020.

which allows geologists to understand the flow of materials in a more accurate way. Users can record grade and stock notes in real time.

www.micromine.com

Whether by surface or underground mining, millions of tons of material must be moved in order to extract targeted raw materials or minerals. Tunnel-boring and cleaning machines, conveyor systems, bucket-wheel excavators, special vehicles, material-grading and separating systems are often in service 24 hours/day for years. **Pintsch Bubbenzer Engineering** has been meeting the special challenges set by the specialty manufacturers of these machines, systems and vehicles and is in close cooperation with the manufacturers of mining equipment. The company is constantly providing solutions to operational and safety braking challenges.

Recently, Pintsch Bubbenzer launched a new, environmentally friendly electric wheel brake — the BRBe — for mining applications, electric overhead traveling cranes at ports and steel mills, and for other heavy-duty applications. The BRBe is currently available for moving machinery or cranes with wheels from 500 mm (19.68 in.) to 1,000 mm (39.37 in.) in diameter and wheel flange widths from 160 mm (6.29 in.) to 254 mm (10 in.). It is also suited to paper-mill logging cranes, mobile harbor cranes, steel mill outside service cranes, stacker and bulk-storage cranes.

www.pintschbubbenzerusa.com

Precision Pulley & Idler (PPI) has launched a new conveyor cover product line. Conveyor covers help to protect conveyed material, as well as protecting the environment against dust and noise. Covering the product helps producers avoid losing material due to wind and also

reduces the amount of wear on a conveyor belt due to weather conditions. Safety and cost effectiveness are two important demands in the industry. PPI conveyor covers are one product line that increases both. With limited suppliers currently in the market, PPI recognized this opportunity to offer conveyor covers as a way to better serve its customers' needs.

The product is available in full (100 percent) 180-degree and three-quarter (75 percent) 135-degree styles in standard 1.2 m (4-ft) long sections. Covers are made from galvanized steel to protect against corrosion and the elements. Conveyor covers are a complementary product line to the quality conveyor components already offered by PPI.

www.ppi-global.com

Presto Geosystems partners with engineers and owners to solve soil stabilization problems in all aspects of mining operations. Presto's Geoweb geocell system is a proven 3D structure that provides cost reduction in site access, underground and haul roads, slope reclamation and water and stormwater management.

The Geoweb system creates a stable road surface, significantly reducing rutting/maintenance and improving cycle times. Unlike 2D geogrid systems, the Geoweb solution allows use of local fill and bridges soft subgrades with a single layer. For slope reclamation, the Geoweb system provides long-term erosion control of slopes, and allows slopes to be designed steeper than when material is unconfined. The Geoweb system supports a variety of infill materials, including topsoil/vegetation for sustainable vegetation, aggregate (waste rock) for permeable slopes and concrete for hard-armored slopes.

For water and stormwater management - Aggregate armoring of channels with the Geoweb system allows for the beneficial reuse of waste rock material. Confinement in the Geoweb system allows a smaller particle size to resist the same design flow conditions as unconfined rip-rap 2 to 10 times greater in size. This is a big economic and schedule advantage, since rip-rap is expensive and time-consuming to place.

www.prestogeo.com/applications/mining/

Sandvik Rock Tools has launched a new digital solution: My Rock Tools – Analyze. This mobile application is designed to help customers improve their rock tool performance through analyzing failure and discard reasons.

Digitalization is one of the most significant developments in the mining and construction

industries for decades. Sandvik is proud to be at the forefront of this process and is now launching a new digital solution for its rock tools customers. The new solution is an application specifically designed to conduct failure and discard analysis and provide advice and guidance in a customer report – all remotely. The aim is to determine the root cause of the failure or discard reason of the rock tool, prevent it from happening again and to help improve future performance.

“Sandvik Rock Tools suite of digital solutions serves our customers in a number of ways, and we are now very happy to be able to add My Rock Tools Analyze in order to offer easy-to-use remote support for failure and discard analysis. With it, customers can ultimately increase productivity and profitability by using the analysis results to improve their drilling operations,” said Charles Macfadyen, Digital Solutions, Rock Tools Division, Sandvik Mining and Rock Tehcnology.

The application is easy to use: customers receive an invitation from Sandvik to log in, download the app (available both for iOS and Android), provide some key product information, take a few photos of their worn out tool and then send it to Sandvik for analysis and feedback.

“A big part of Sandvik’s DNA is continuous improvement in close collaboration with our customers, and My Rock Tools Analyze does precisely that, in a user friendly, fast and remote way. We truly believe that this will help our customers and us both in the short and long term,” said Macfadyen.

The My Rock Tools Analyze application is available for all Sandvik Rock Tools customers and can now be downloaded in App Store and Google Play Store.

www.rocktechnology.sandvik

Around the world, **SmithCo**’s custom side-dump mine trailers are solving the toughest challenges in the mining industry. The Mining Double Tub Series and Mine Tipper side dumps can haul nearly any material and are more versatile than traditional haul trucks. By dumping to the side, they also have greater stability and efficiency. The custom mine trailers make opening satellite mines more feasible because they require a smaller footprint than other trailers. Each trailer can hold up to a 100-t (110-st) payload and SmithCo trailers are already hauling gold ore, coal, iron ore, copper concentrate and bauxite at mines around the world.

With a focus on customer service and



expert engineering, SmithCo can tackle any mining industry issue.

www.sidedump.com/products/mine-trailers

SynTerra is a professional group of engineers, geologists and scientists with a reputation and proven background for achieving its clients’ project objectives. In January 2019, ECSI LLC and SynTerra Corp. combined their operations. The transaction was characterized as a unification of client-focused firms. Experience, culture and vision for the future were in sync. The expanded company is ideally suited to serve clients throughout the United States.

SynTerra personnel have a history of supporting the Appalachian coal mining industry especially through its engineering and surveying services. As the coal industry declines, SynTerra has turned some of its attention to beneficial post-mining land use projects, which include the development of solar energy generation on reclaimed mine lands. Owners of former surface-mined lands now have the opportunity to continue to generate revenue through an alternative source of energy production. Furthermore, with the promising research into gleaning rare earth elements from coal-mine waste, SynTerra is at the forefront of ensuring energy independence for the Appalachian region. SynTerra has worked with solar developers, large land-holding entities and governmental agencies to study and soon implement viable solar energy production on former surface-mined lands.

www.synterracorp.com

Vega’s MiniTrac 31 uses radiometric technology to overcome challenges and provide accurate measurements that operators can

My Rock Tools - Analyze, a mobile application from Sandvik.

rely on for decades. The density measurement of slurry in a pipeline is critical to operational efficiency. Too many solids can lead to a blockage followed by an extended shutdown for repairs. With too few solids in the slurry, the mine loses efficiency. Operators use a density measurement to maximize the amount of solids moving through the mine.

Vega's MiniTrac 31 provides an accurate and highly reliable measurement independent of the measured medium's viscosity, conductivity and chemical properties. The radiation used to make the measurement has no effect on the material it passes through, ensuring safe functionality. The MiniTrac 31 is the smallest, lightest and most modern radiometric density system available. Its compact size gives it a significant advantage in mining applications. The small unit is ideal for narrow spaces and areas that are difficult to access. Furthermore, the sensor's lightweight detector system calls for reduced mounting requirements, saving valuable space.

The MiniTrac 31's encapsulated electronics allow the detector to last longer than similar products even when subjected to thermal shocks or vibration. Finally, process temperature has no influence on the device, as it electronically compensates for changes in heat. This product is made for difficult applications.

www.vega.com

Vermeer's T1255III Terrain Leveler surface excavation machine (SEM) delivers precision extraction practices for surface mining operations. With the ability to choose between a single-side direct-drive drum that can cut an 80° high wall, and a chain-drive attachment capable of cutting along a steep vertical wall, the T1255III produces less noise, dust and vibration than drill and blast surface mining methods. This precision mining method can also help mining operations increase production by excavating reserves they couldn't otherwise get to because of blast restrictions, air quality regulations or urban encroachment.

Deployed at the Atacama Minerals Chile mine, considered the driest place on earth, the T1255III delivers a more efficient and effective method of extracting iodine-laden caliche. Mine officials have said that with precision mining, they can produce consistent material sizing to reduce the need for primary and secondary crushers, large loaders, and haul trucks — and

the permits often required to transport materials. Additionally, and of significant importance, no permits for blasting are required, and the end material is transportable by regular highway trucks.

The T1255III is equipped with the Vermeer SmartTEC control software that displays the status of critical elements of machine performance and alerts the operator for recommended control adjustment. Optional GPS technology can be used to create a mine-by-line plan that can be uploaded, and then the machine will automatically cut to the plan. There is also an optional dust suppression system that features an enclosed cutting head with two large vacuums that pull dust into baghouses and drop it beneath the machine — reducing the dust entering the air.

www.vermeer.com.

The **Wirtgen 220 SM 3.8** is an intelligent machine for surface mining solution that has demonstrated its exceptional value at mines around the world, including the Bhubaneswari coal mine. This powerhouse with an operating weight of 58 t (64 st) is propelled by a robust Cummins diesel engine with an output of 708 kW (949 hp). Thanks to high-pressure injection and intelligent engine management, the engine is highly fuel efficient. And the diesel tank's capacity of 2,300 L (608 gal) makes it possible to operate the machine around the clock with only one stop to refuel per day. A cooling system with a demand-driven fan speed also helps to reduce fuel consumption and reduces noise emissions. The 220 SM 3.8 is designed for mining all types of soft rock. This is particularly evident in the design of the 3.8-m (12.5-ft)-wide cutting drum. The high, narrow holder bases on the drum ensure that the material flows smoothly while requiring minimal energy.

Mining with Wirtgen surface miners also offers considerable financial benefits. The flat surfaces created during the mining process serve as stable roadways that facilitate fast truck haulage. This increases the transport capacity of the entire truck fleet. The quality of the road surface reduces wear and tear to truck tires, frames and suspensions, allowing the operators to use standard trucks. The resulting reduction in transport costs helps mining companies reduce production costs.

www.wirtgen.com ■