CAT® MINESTAR™

AUTOMATION

TAKING COMMAND OF
YOUR MINING OPERATION

FLEET   TERRAIN   DETECT   HEALTH   COMMAND

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Mining has always been a challenging industry. The the cost of extracting materials, working in remote work areas, productivity requirements and constraints, keeping people safe, and the challenge of physically reaching the reserves have always been factors in the mining business. But over the years, we have developed innovative solutions and new technologies that help us overcome these challenges and address the increasing urgency of responding to economic cycles and sensitivities as well as population growth.

In the last several years, the industry's focus has shifted from producing as much ore as possible to carefully controlling the cost of getting that ore out of the ground. Miners are focused even more intently on capital reduction, and even though revenues and costs are getting closer than ever before, miners continue to bring more and more product to market—further decreasing commodity prices.

As miners look for solutions to address these challenges, they are finding one game-changing way to have a major impact: automation. Automation has proven to be the most effective way to control costs and variability—as well as increase safety and productivity.

The Pathway to Autonomy

Today, technologies and process advancements make it possible for you to go well beyond automating a single piece of equipment. With each passing year, new advancements automate more and more phases of the mining cycle — with the possibility of a completely autonomous mine site in the future.

But an autonomous mining operation is not something you can build overnight. The journey to autonomy is made up of a number of building blocks, in the categories of guidance, automation and autonomy.

- » Guidance: An operator still has full control of the machine, but is taking action based on information provided to them through some type of user interface.
- » Automation: Part of a machine or subsystem duty cycle has been automated or can be carried out automatically, but the operator is still required to run the other functions of the machines.
- » Autonomy: Humans are removed from the entire machine or subsystem duty cycles.

At all levels, automation helps make operations more predictable and consistent, while also keeping as many people as possible out of hazardous areas. The result is enhanced safety, improved production and increased efficiency. In this paper, we'll take a closer look at how automation benefits a mine site in these areas.

ENHANCING SAFETY

Automated operations offer the potential to improve safety in a number of ways, no matter the type of mining application.

Collisions & Equipment Damage

Automation reduces the risk of machine-related incidents by removing operators from the machine and reducing the number of people on site. But even guidance technologies, which require operator interaction, can improve mining safety. For example, proximity awareness for manned operations increases visibility and provides a number of anti-collision technologies like cameras, sensors and alerts. It also reports operator behavior, such as speeding or traveling into prohibited areas.

However, automation and full autonomy add the capability to eliminate these behaviors entirely, making it possible to create pre-programmed zones that regulate speed—or keep machines out of certain areas entirely. The potential for operator mistakes or equipment abuse is reduced through automation and removed entirely with full autonomy. Cat automation and safety systems offers multiple layers of protection and redundancy to keep people safe.

Operator Fatigue & Distraction

Fatigued and distracted operators pose one of the biggest safety risks in the

mining industry. Long shifts, hard work, and late hours can reduce operator effectiveness and alertness to levels comparable to being intoxicated at the wheel. In addition, operators have been observed looking away from the road to check cell phones, send messages, or even read books while running a machine.

Removing the operator from the machine entirely eliminates the risks that come with fatigue and distraction. But even the addition of remote control can reduce fatigue by removing the operator from physically taxing conditions in the cab. Semi-autonomous technologies allow an operator to control multiple machines from one comfortable location, increasing productivity and further reducing the risk posed by fatigue or distraction.

Hazardous Conditions

No mine site is completely free of hazardous conditions. From noise, dust and vibration, to the risk of tripping or falling while climbing on or off the machine, to soft floors and falling rocks — equipment operators can be exposed to a number of potential safety risks. And while every machine and process are designed to protect operators from these conditions and more, the surest way to guarantee operator safety is to remove them from the machine entirely. A remote-controlled or completely autonomous mining machine can continue to work productively no matter what the conditions are, with no risk to an operator.

Operator Skills

Operator abuse of a machine is rarely intentional and can often be attributed to a simple lack of necessary skill. It takes training and experience to operate a mining machine, and inexperienced or unskilled operators can be a safety risk. Guidance technologies like blade control and auto spot can reduce the amount of training it takes for an operator to become proficient on a machine, which allows them to focus more on safe operation while maintaining productivity. As an added bonus, these technologies can reduce variability and improve production.

Remote control and semi-autonomous machines are built to operate within defined parameters, which makes it less likely for an operator to abuse the equipment, while a fully autonomous machine completely eliminates operator abuse.

INCREASING PRODUCTIVITY

Miners may be focused on costs more than ever before, but productivity still remains a top priority. Automation technologies can help improve productivity in a number of ways.

Reducing Variability

Process variability is one of the biggest mining costs today—and one of the hardest to quantify. Inconsistency in any form can have a dramatic impact on productivity, whether it's an inefficient shift change, a slow cycle or a long lunch break.

The more we automate machines, the less opportunity there is for variation in the operation. Any automated work cycle will be carried out consistently and reliably. The more automation, the less variability. Automated machines don't need to stop for breaks or shift changes. They produce consistent results that are easy to manage and measure.

Unscheduled Repairs

Unscheduled repairs are the enemy of productivity. They cause increased downtime, higher maintenance costs and reduced fleet availability. Automation can significantly reduce unscheduled repairs because an automated machine will not ignore health events and warnings. There is no risk of operator-induced incidents like overspeeds and shovel buckets colliding with the tracks. Removing these factors increases machine availability and drives increased production.

Utilization

Many mine sites measure utilization simply by the number of hours a machine runs, whether it is idling or working. We prefer to think in terms of effective utilization—how much time the machine is spending being productive. Automation can greatly increase effective utilization. By removing the need for shift changes, breaks, and waiting for operators when machines become available in the middle of a shift, automated machines are able to get to work as soon as they become available and continue working without stoppages. Similarly, an autonomous machine cannot get lost or drive too slowly as a result of misinterpreted assignments.

Operator Skill

Operator skill can be the difference between a productive shift and an unproductive one. The same machine can be highly efficient or significantly inefficient depending on the skill of the operator at the controls. This isn't a problem for automated machines. They don't get tired or distracted, and they always work in the same way and consistently. No matter how many days or hours in a row an automated machine works, it cannot become fatigued. It will always obey its assignment and always operate at maximum productivity.

WORKING REMOTELY AND RETAINING PEOPLE
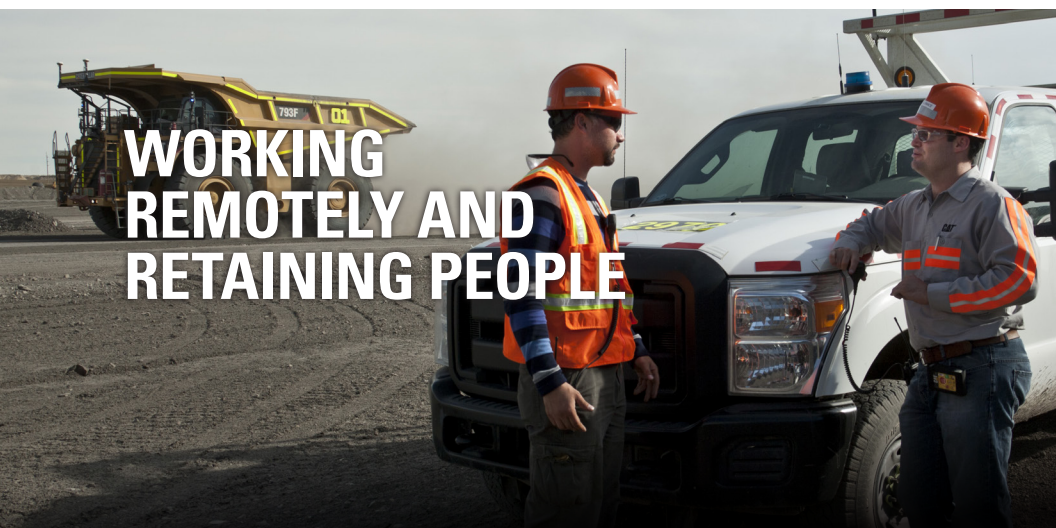
One big challenge the mining industry faces today is working in the increasingly remote and locations where new reserves are found. Sites are getting farther and farther away from cities and infrastructure, and it can be a challenge to retain employees who are asked to spend extended periods away from the comforts of home.

This is a broad topic and there is certainly more than one way to address it, but automation can have a significant impact by making it possible for mines to produce ore without requiring equipment operators and controllers to be on site. Allowing them to work away from the mine site removes the need to transport the workforce, increases the number of potential workers, and allows those workers to spend more time at home with their families.

Having fewer people on site also reduces the need for camp infrastructure, simplifies the logistics of travel and supplies, and reduces overall costs for personnel at the mine. The expanded labor pool also results in lower labor costs and a more stable workforce. Automation can even reduce the need for training by simplifying operator tasks.

REDUCING COSTS THROUGH AUTOMATION

Today's mining companies are looking at investments in automation and autonomy as a way to lower overall costs and improve safety. While these can be large investments, they also provide an opportunity for miners to control their costs in a number of ways.

Taking small steps. By building toward full autonomy in steps and leveraging building block technologies, miners are better able to plan out their expenditures and have tighter control on their investment. This allows them to reduce individual investments or postpone expenditures to meet their cost reduction goals.

Improving regulatory conformance. Thanks to its consistency and predictability, automation makes it possible for mines to avoid the costs of environmental or regulatory compliance issues. For instance, if an operator at a molybdenum mine incorrectly dumps acid-producing rock on the waste stockpile, there is a significant cost to identifying and retrieving that material. An autonomous machine would never make that mistake.

Reducing machine accident costs. There are always costs associated with equipment accidents and the resulting downtime. But if an operator is not involved, either because a machine is remote-controlled or autonomous, the costs of that accident are significantly less. There will be less downtime due to investigation, and more importantly, there is no risk that an operator will be injured or killed.

Increasing revenue-to-cost ratio. The increased productivity delivered by autonomy helps miners move the top line — increasing their revenue-to-cost ratio. By increasing utilization of existing equipment, improving productivity within that time, and reducing the variability of the whole operation, automation can increase overall production and ultimately lower costs.

Reducing expenses. Automated equipment needs a smaller labor force and less infrastructure. And less equipment abuse results in reduced maintenance and service costs.

Conclusion

The last decade has seen an explosion of technologies, and with each passing year these technologies become better at helping mine sites become safer and more productive. Integrating automation technologies into your mine site today will deliver significant cost reductions while serving as the stepping stones to your journey to full autonomy.

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