CAT® COMMAND FOR DRILLING

MAKING EVERY SHOT WORTH MORE

Cost-effective, high-precision drilling gets your whole mining value chain off to a good start. Cat® Command for drilling, a capability of the Cat MineStar™ technology suite, helps you achieve excellent results through drill automation—which will ultimately reduce operating costs and improve productivity. From predrill planning to blasting, Command impacts the bottom line all the way through the crusher and mill.

ENHANCED SAFETY

The autonomous system minimizes the risk of drilling into bootlegs that may contain undetonated explosive material. Improved containment of the explosive energy reduces the occurrence of fly rock and face venting of energy. The use of digital drill plans and remote operations enhances safety by reducing the number of survey and operating personnel needed on the bench.

IMPROVED ACCURACY

High-precision satellite guidance capabilities ensure that every blasthole is drilled exactly to the designed coordinates and desired floor elevation. The designed toe elevation is always met, regardless of surface variations, so each shot produces a smooth, level bench that saves wear and tear on tires, undercarriage and other equipment.

INCREASED CONSISTENCY

Automated drilling functions ensure consistent operation that maintains drill operation within ideal operating parameters, resulting in maximum bit life, reduced costs for consumables, longer machine life and lower maintenance costs. The machine never has an off day, performing at a level of consistency that promotes advanced logistics planning and improves sequencing of the drill operation in advance of digging and loading operations.

QUALITY FRAGMENTATION

The high parallelism of holes at the designed spacing provides a consistent specific fragmentation size as permitted by the rock strata. Targeted fragmentation improves diggability, which improves cycle times and fill factors for buckets and trucks. This better controls the need for additional rock breaking, and maximizes crusher and milling efficiencies.

INCREASED UTILIZATION

Cat Command automates the drilling cycle, enabling each operator to manage up to three machines. The system facilitates short breaks and quick shift changes while drilling continues, giving mines more working time and less idle time during every shift.

REDUCED OPERATIONAL COSTS

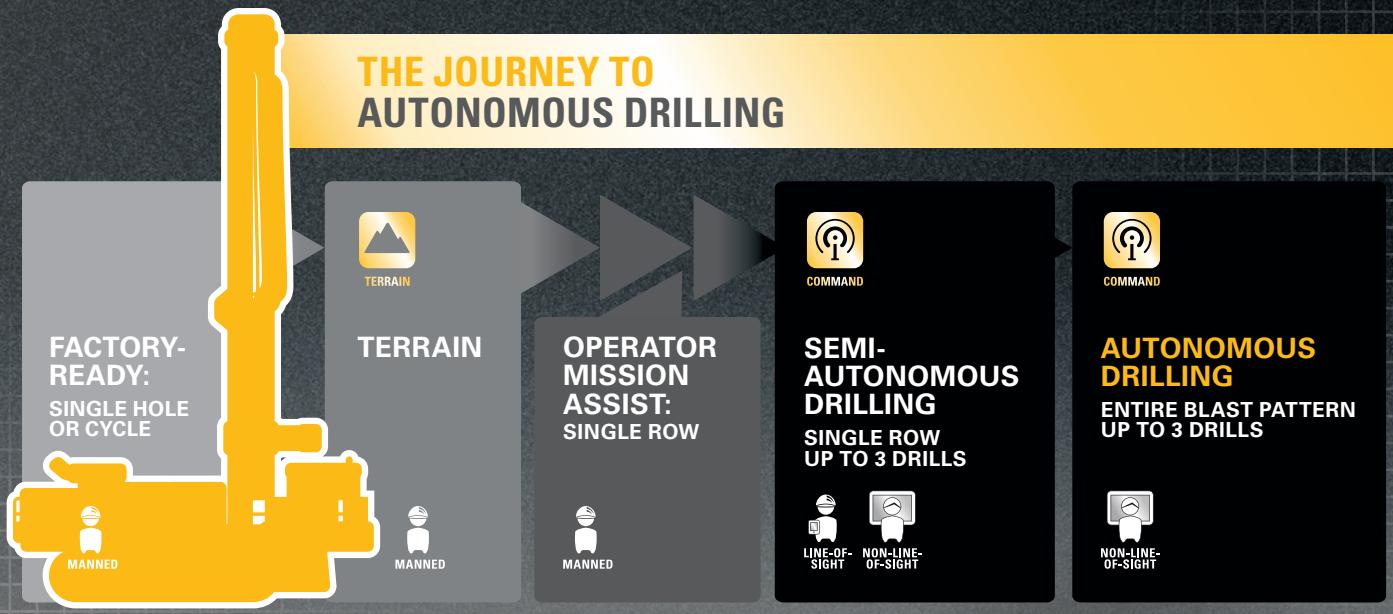
Because Cat Command allows one operator to manage up to three machines at once, labor costs are reduced. It also enables remote operations that reduce or eliminate the costs for operator travel and on-site housing. In addition, autonomous drill operations capture unused time at shift change and lunch breaks, resulting in greater drill utilization.

BLASTHOLE QUALITY

Automated drilling provides consistency to the planned design hole coordinates. Staying within optimum operating parameters results in quality holes that stand up without caving in. Holes are always drilled exactly to the target elevation, which eliminates wasted tool wear from over-drilling.

BUILDING BLOCKS TO AUTONOMY

THE JOURNEY TO AUTONOMOUS DRILLING



SELECT THE LEVEL OF TECHNOLOGY THAT BEST FITS YOUR OPERATION

Command for drilling offers a range of capabilities that let you configure and automate the drilling system to your budget and the needs of your site. Features and components serve as building blocks that allow you to easily grow and add features and capabilities at your pace.

TERRAIN FOR DRILLING

DELIVERING VALUE THROUGH DRILLS MANAGEMENT

A requirement for Cat Command for drilling, Cat Terrain for drilling uses state-of-the-art guidance technologies to help operators drill holes in the exact location and to the exact depth specified by the plan, resulting in smoother, safer and more efficient blasting.

Terrain for drilling enables:

- More effective drill utilization
- Decreased consumables
- Explosives cost savings
- Consistent fragmentation
- Increased loading productivity
- Smoother hauls
- Improved crusher throughput
- Reduced overall energy costs

Terrain for drilling increases efficiency by:

- Reducing or eliminating the surveying required to maintain staked blasthole patterns.
- Eliminating the need for the operator to leave the cab to search for drill stakes.
- Allowing the operator to precisely position the machine under any weather conditions, day or night, 24 hours a day.
- Minimizing periods when a machine is down waiting for a new or updated pattern to be manually surveyed.
- Minimizing pre- and post-blast survey to measure depth and collar elevations.
- Reducing over- and under-drilling via precise hole depth control, resulting in more even bench grades.
- Reducing blasting costs through improved loading instructions.
- Providing hole-to-hole updates that give operators real-time status of other holes being drilled on the same pattern, which reduces rework of holes being redrilled.
- Tracking consumables, which allows monitoring of bit, stabilizer and steels to ensure components are replaced as required, thereby reducing costs.

OPERATOR MISSION ASSIST

MAXIMIZING OPERATOR PERFORMANCE BY ELIMINATING VARIABILITY

Operator Mission Assist allows the operator to select a row of holes for the drill to navigate from hole to hole and auto-drill all holes in the selected row. The operator has to authorize the auto-tram to the next hole to ensure that the movement is safe and no equipment or personnel are at risk.

Operator Mission Assist:

- Increases productivity
- Improves compliance to plan
- Equalizes operator performance
- Improves consumable life
- Minimizes unscheduled maintenance
- Reduces operating expense

SEMI-AUTONOMOUS DRILLING SYSTEM
LINE-OF-SIGHT WITH A TABLET

MANAGING UP TO 3 DRILLS FROM A SAFE DISTANCE

Similar to Operator Mission Assist, the line-of-sight tablet allows for a single row mission to be controlled and monitored from a safe distance while it drills a single row. An operator can operate up to three drills at the same time.

Using the line-of-sight tablet, the operator:

- » Selects a single row of holes
- » Launches automated operation
- » Monitors drill status
- » Requests the auto-drill to reset or terminate

Proximity detection and collision avoidance are not required with physical fencing.

SEMI-AUTONOMOUS DRILLING SYSTEM
NON-LINE-OF-SIGHT

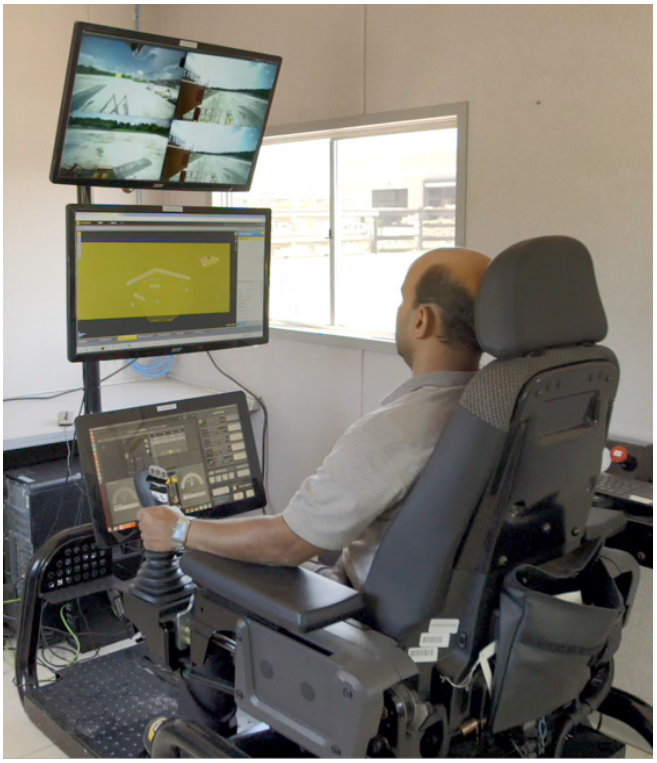
MANAGING UP TO 3 DRILLS FROM A REMOTE STATION

This semi-autonomous solution automates the entire drilling cycle for one row, including autonomous tramming, with the operator managing up to three Autonomous Drilling System (ADS) equipped drills from a Remote Operator Station (ROS).

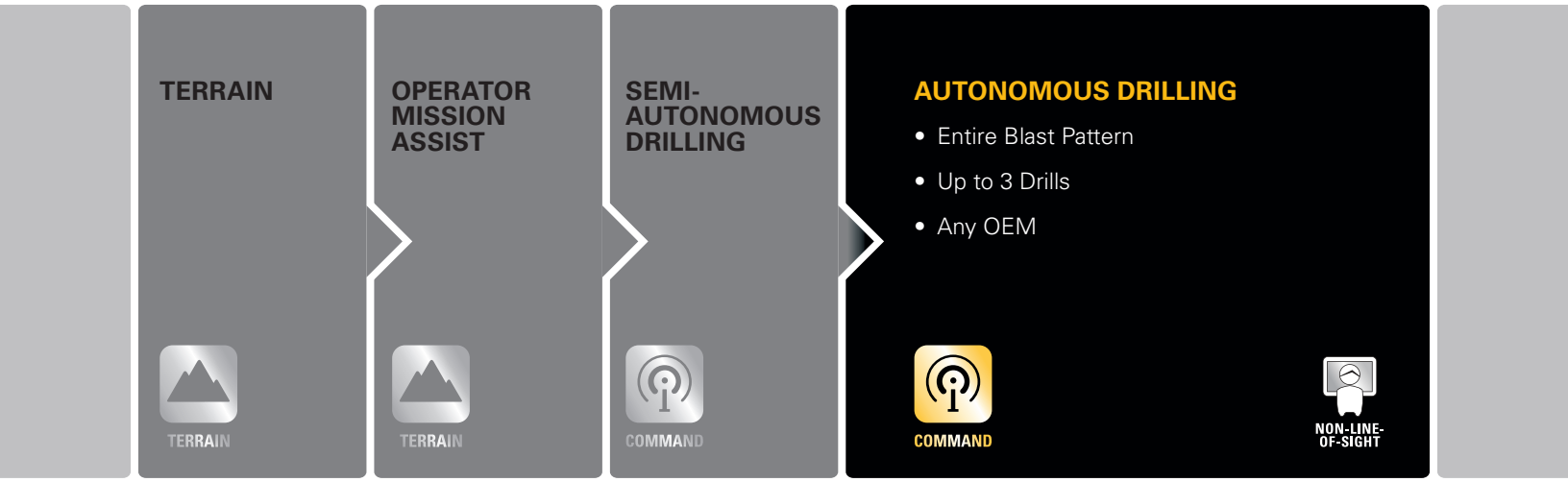
- Functions from a location on or off the property
- Provides site awareness with on-board vision
- Launches single row missions remotely
- Enables full autonomous drilling operation
- Requires manned support services

Semi-autonomous drilling from the ROS delivers a number of benefits:

- Accurate in-hole/bit positioning every hole
- Consistency in all functions of drill operation
- Explosives energy containment due to plan matching
- Improved drill safety and blasting safety
- Optimized asset utilization
- Improved rock fragmentation
- Improved OPEX
- Higher productivity



AUTONOMOUS DRILLING SYSTEM
NON-LINE-OF-SIGHT



MANAGING MISSIONS FOR THE ENTIRE BLAST PATTERN

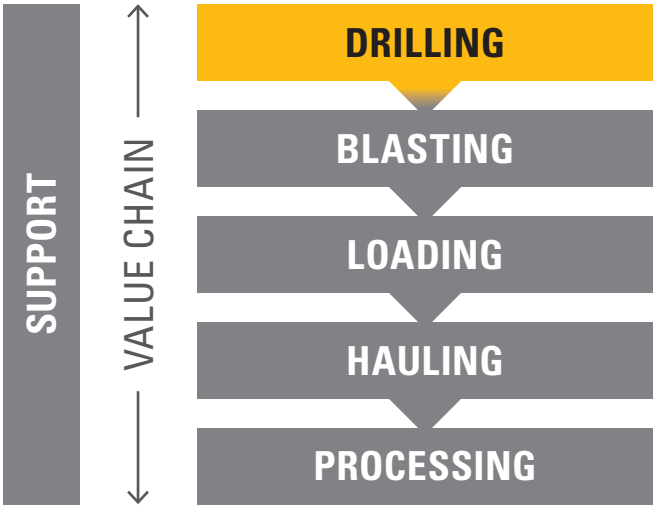
This solution automates drill cycles and tramming for the entire blast pattern. It enables one operator to manage drill operations across the mine site, working from a ROS located on-site or at an off-site command center.

- Rotary and down-the-hole (DTH) drilling algorithms
- Multi-row pattern drilling
- Reliable auto multi-pass (AMP) enabled
- Multiple drills enabled on large pattern
- Operator assigns hole sequencing
- Rows with crest holes are drilled in retreat from crest

Autonomous drilling delivers significant benefits across the operation:

- 20% per meter OPEX reduction in drilling
- $600K+ per-drill reduction in explosive costs
- 5%+ shovel productivity improvement
- Faster cycles
- Reduced maintenance
- Increased and consistent crusher throughput

CAPTURING UP TO 30% MORE PRODUCTIVITY ACROSS THE VALUE CHAIN



MOBILE MONITORING AND MISSION CONTROL

PUTTING SAFETY FIRST

One of the most important benefits of Cat Command is safety. Beyond allowing operators to work safely away from the drill, there are a number of other features that ensure the safety of everyone working in the vicinity of autonomous equipment, whether that's trucks, drills or dozers.

A key safety feature is the A-Stop, a hand-held device that stops all autonomous vehicles within about 300 meters (984 feet) with the push of a button. Drills equipped with Cat Command for drilling are fully compliant with the A-stop feature.

Cat Command for drilling enables remote monitoring of all mobile equipment working in the autonomous zone. It provides fleet overview capability as well as integrated security and tracking of machines.

CAT® MINESTAR™

Cat Command lets you apply the right level of automation, from operator assistance to full autonomy—so you can keep your people safe, your operation efficient and your equipment running.

Command is a capability set of the Cat MineStar™ suite of technologies for mining. MineStar technologies are integrated, scalable and work on all brands of equipment. They share data and integrate with existing machines, systems and technologies, and serve as the base of every customized MineStar solution.

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