

The background image shows an underground mine environment. A large haul truck is in the foreground, partially obscured by a large, semi-transparent blue arrow pointing towards the right. In the background, a worker is visible near some equipment, illuminated by bright lights. The overall scene is dimly lit with a blue color cast.

A Guide to Selecting an Underground Task Management Solution



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This reference book is for existing underground mines, open pit mines that are extending their life by moving underground, and hybrid mines that combine both. It examines the challenges facing underground miners and the key players affected by those challenges. Our success stories explain how we're helping customers reveal best practices and pitfalls to avoid.

Whatever your role underground,
stay safe and keep shaping smart change.

INTRODUCTION

| Shaping Smart Change Underground

As mines push deeper beneath the surface for deposits, the need for better communication and collaboration increases. Complexities that may be easier to overcome above ground, require domain expertise and often non-scalable customized solutions, below. Data from a growing number of instruments, humans, and mobile assets needs to be outside the mine for analysis. But the network infrastructure and software to collect and process this data can become obstacles for true underground mining optimization and safety.

As the dominant planning, high-precision operations, and vehicle safety technology vendor in surface and pit mining, we have spent considerable time developing underground methods to meet these demands.

Your mine's ability to digitize processes and react to workflow changes in real time means optimized operations, and safer management of assets and fleet.

By digitizing, connecting, and optimizing your underground mine, you can avoid unplanned downtime and enjoy peace of mind in an uncertain business.



| Industry Trends: The 3 Most Important Trends Affecting Underground Mines

Digitization

Real-time task adherence is the ability for tasks and sub-level tasks to be automatically sent across a network from surface to the development and working faces, as well as haulage levels. Converging excel and paper-based processes to network-enabled workflows is the first step on the road to a connected mine. Mining relies heavily on: paper processes; both simple and highly complex Excel worksheets; and radio communications between dispatch centers and miners. Until digital transformation, and without mobile tablets or devices such as task checklists, mining will continue to depend on paper and radio communications.

Autonomous

Mines planning to be fully autonomous depend on software and hardware platforms being built and deployed, circulating exponential amounts of data between mine workings, engineering offices, and self-guided machines. Compared to open-pit mines, underground operations offer more opportunities for selective autonomous innovation. Mines can isolate a sub-level for work to be undertaken by a tele-remote operation or autonomous machine. Any customer taking the autonomous path will need a good communications infrastructure to support their autonomous vision.

Process Automation Controls

Mines are inundated with data at the expense of information. Process automation controls are a complex system of end-point sensors and machines producing data across the legacy networks. A fully scalable IoT platform begins with making an existing investment smarter, scaling only as fast as a mine's budget allows, and progressing by proving each phase pays for itself before embarking on the next milestone in an IoT roadmap defined by a mine.

SHIFT CHANGES

| Industry Needs: The 3 Most Important Challenges to Be Addressed Underground

Task and machine optimization

Underground mines face complexities (safety, fleet management, maintenance, UG infrastructure) that may be easier to overcome above ground, but require domain expertise and non-scalable customized solutions, below.

Manage exponential increase in data

Data from a growing number of instruments, humans, and mobile assets needs to be outside the mine for real-time analysis.

Locate and track humans and machines in a GPS-denied environment

Underground mines seek an affordable, scalable, future-proofed solution that can exchange data agnostically in real time; that is able to produce reports documenting progress in safety, productivity and cost controls.

| Industry Issues: The 8 Most Pressing Underground Issues

- 1 Mobile Asset Locations
- 2 Face and headings production activities out of communications
- 3 Downtime for unplanned maintenance
- 4 Electrical assets set to full on, regardless of mining shift phases
- 5 Data gaps for updating short-term planning tasks
- 6 Most assets and process control endpoints not on network
- 7 Short-term plan not shared with both planning and operations
- 8 Excessive or non-existent voice and data-comms links

KEY PLAYERS

| Challenges, Responsibilities and Considerations

Key players involved in purchasing a task management solution and their primary concerns

Any new UG fleet/task management solution will impact every aspect of an operation and touch everyone. Change management is vital to its successful implementation.



The following are key players who should be involved.

We've outlined a brief description of their roles, challenges and purchasing considerations.

KEY PLAYERS

| Corporate Management

Challenged with ensuring overall profitability while protecting staff and equipment, corporate management considers reduced costs and reduced risk when evaluating any new solution.

Concerns:

- Safety
- Production
- Return on investment
- Closing the gap between planning and operations
 - + Effect on production and revenue
 - + Stakeholders—risk of stocks being affected by reporting less than predicted
- By how much will costs be reduced?

Ask Yourself:

- How can the system be used to improve safety for operations?
- How much can production be increased after installation?

KEY PLAYERS

| Mine Manager, Mine Director

Likely the primary decision-maker to influence technology purchases, the manager is responsible for the productivity and safety of the mine and miners. The manager defines staffing and outlines project plan delivery. They ensure adherence to project goals and deadlines, requesting modifications when necessary. They evaluate the performance of assets and miners, and direct corrective actions when problems are detected.

Concerns:

- Safety
- Production
- Resource utilization—people and equipment
- Return on investment
- Closing the gap between planning vs. actual
 - + Production vs. revenue
 - + Potential for missing optimizations
- Use of analytics tools to help close gap between planning and operations

Ask Yourself:

- What is the current gap between planned versus actual?
- What are the expectations after the system goes live?
- How can equipment use be maximized?
- How can multiple teams manage task coordination?
- What are the technical requirements for WiFi?
- Will solution work with our current business analytics tools?

KEY PLAYERS

Production Manager

The Production Manager implements and monitors all drill and blast activities, evaluating performance while analyzing and monitoring all equipment. The manager initiates process improvements to achieve key outcomes. The manager supports mine procedures and work practices aimed at preventing accidents and injuries.

Shift Supervisor

The Shift Supervisor oversees miners and their activities, usually underground and traversing levels, ramps, shafts and passages called drifts and stopes, to observe task activities first-hand. The Shift Supervisor ensures miners accurately record mining activities, entering recorded data within the mine's platform to share with management.

Maintenance Manager or Fleet/Equipment Manager

Tracks activities performed by equipment and responsible for conducting maintenance. Identify potential opportunities to improve and avoid unplanned events.

Planning Manager (long-term and short-term planning)

Responsible for determining the best way to extract a resource quickly and cost-effectively. The Planning Manager develops and advances a mine, scheduling all mining activities to produce an optimized operation. The Planning Manager assists with compiling management plans to report on project progress and help determine project planning.

KEY PLAYERS

Miners and Equipment Operators

Miners often provide feedback to the mine manager, so it's important that any solution's benefits appeal to them. These are the front-line workers who rely on years of safe experience; are skeptical of new gadgets or processes; and need to be convinced that a solution makes their jobs easier, safer, faster and empowers them to increase productivity.

IT managers, health and safety managers, control room staff and dispatchers will also be affected by any decision to implement a fleet/task optimization solution.

Shared Goals:



Visibility of underground operations



Increase production



Costs saved



Operator productivity—increased working hours, less queue time



Safer Operation



Optimized equipment utilization—less machine maintenance downtime, staff-hours saved



HxGN MineOperate UG Pro combines tablet-hardware and software applications to manage underground fleet equipment and optimize production-time utilization in real time. It uses existing underground mine communications to transmit and receive data between mobile assets, miners, and the surface control center.

The platform tracks locations and movement, and monitors task-level activities, modifying miner and machine workflows in real time as the mine develops and advances.

UG Pro is the critical first step in digitizing manually captured activities.

| UG Pro Key Features

- Fully Integrated with short-term interval control scheduling, reconciled by productivity and completed activities.
- One source of information for planning and operation teams. Planners see production progress on their short interval software.
- Facilitate the shift change between operators and task progress on the equipment.
- Maintenance staff use UG Pro to track planned and unplanned maintenance activities.
- Off-the-shelf tablet.
- Reportability by phone apps and office applications.
- Standard SQL and time-series databases.
- Integrates with Hexagon solutions and external data.
- Reporting engine for modeling intelligent scenarios.
- Determine equipment activity dependency by Activity Scheduler.
- Monitor mobile assets
- Dashboards, tracking nodes and task communications.
- Reduced time lag in schedule updates.
- Handle new IoT protocols.
- Incorporate your own business intelligence and analytics tools.

Before UG Pro

Lack of visibility below the surface

Miners are paper-driven and radio-dispatched

Planning and operations rarely interact UG drills, LHDs (Load-Haul-Dump vehicles), gators, and haulage vehicles are poorly tracked

UG drills, LHDs (Load-Haul-Dump vehicles), gators, and haulage vehicles are poorly tracked

For safety, Operations spends considerable time monitoring achievements and locations via radio

Schedules lack flexibility and can't be updated if conditions change

Unplanned events halt or slow production

After UG Pro

- Miners are safer, connected, and tasks are updated in real time
- Effortless first step in digitizing mine checklists and tasks
- Reported gaps will help validate budget for automation strategy
- Being able to predict and react to onboard data reduces maintenance costs
- Tracking assets eliminates time wasted in identifying locations of people and fleet
- Update schedules in real time, improving task adherence
- Fleet performance is relayed to maintenance, reducing unplanned events

BY THE NUMBERS

| The UG Pro Difference

UG Pro integrates planning, operation and maintenance, allowing for better planning and execution. It means better equipment utilization and increased production. It's designed with microservices architecture which interoperates with third-party data, eliminating data gaps from highly proprietary sources.

**An underground
gold mine using
UG Pro:**



Improved utilization of equipment
significantly



Improved tasks around pre-start checklist
compliance

BY THE NUMBERS

| The UG Pro Difference


This proven platform contains a robust palette of native applications that can be modified and configured to any specific underground operations. These include time and task management, maintenance module, cell apps, business analytics, and Leica imaging and scanning tools for determining over-break (drilling and blasting larger segments than is necessary).

An underground
gold mine using
UG Pro:



6%

Decreased unaccountable task
wasted time by 6%



4.5 t/hr

Improved tons/hr from 35 t/hr to
39.54 t/hr in four months

SUCCESS STORIES

| Two Month ROI for Small Mine



Country:
Brazil



Mine Type:
Underground



Commodity:
Gold



Solution:
UG Pro

The Challenge

The mine is small compared to the company's other operations. So, minimizing operating costs is important.

The mine needed a system that would regulate its 24 ventilators, so the ventilation system would only run when necessary.

It needed to integrate with the underground fleet management system and with the frequency inverter to provide real-time guidance to dispatchers, informing them when to turn the system on and off, based on the mine's operation.

The Solution

The mine uses HxGN MineOperate UG Pro to manage underground fleet equipment and broadcasting time-utilization information. It communicates real-time information to dispatchers from remote areas deep below the surface.

UG Pro is integrated with the mine's fleet management system and its frequency inverter. The inverter is set

to a determinate rotate (0 to 100%), so even when the ventilators are on, electric power is saved by reducing production rotation. Two months after implementing these improvements, the mine achieved monthly savings worth double the investment in UG Pro.

Developed specifically for mines lacking underground data networks, UG Pro optimizes efficiency using tablets that store and forward critical information between supervisors and workers via network access points. Within the labyrinth of a commercial operation, digitizing all complex and simple mining tasks keeps data flowing. Visibility from mobile application dashboards ensures confidence in location and schedule adherence.

SUCCESS STORIES

| Truck Productivity Increased by 11%



Country:
Brazil



Mine Type:
Underground



Commodity:
Gold



Solution:
UG Pro

The Challenge

A mine employs two mining methods: cut-and-fill and longhole stoping. In 2011, to improve safety and productivity, cut-and-fill was largely replaced by longhole stoping (sub-level stoping and variations). Cut-and-fill is still applied in stopes with lower inclination, requiring the use of in-stope pillars in wider stopes.

2020 is targeted for full digitization so the mine required an integrated solution for digital transformation in a challenging gold mine environment.

The Solution

HxGN MineOperate UG Pro integrates with other Hexagon safety, fleet, and data visualization solutions. It also synchronizes with data from third-party vendors. It leverages secure IoT protocol messaging brokers to expand information flow with minimal obstacles. Upon implementation, the solution provided intelligent tools for quickly modeling different economic and production scenarios with confidence.

UG Pro monitors task-level activities, updating miner and machine workflows in real-time as the mine develops and produces ore.

In UG Pro's first month of deployment, production at the mine was 35.21 ton/h. Four months later, production was 39.54 ton/h, an 11% increase in fleet production.

The company defined business drivers and a set of systems, processes, and technologies were assessed against the company's current and future initiatives.

CONCLUSION

| A Complete Underground Solution

Strong communication is essential to a safer, more productive underground mine. UG Pro is a complete solution for task and fleet management, combining tablet-hardware and software applications to manage fleet equipment and optimize production-time utilization in real time.

UG Pro uses existing mine communications to transmit and receive data between mobile assets, miners, and the surface control center. This ensures supervisors no longer need to spend hours moving among locations to visually observe task completion, schedule adherence and resolving workflow issues.

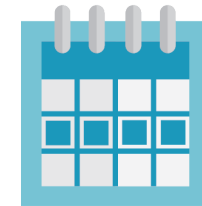
The platform tracks locations and movement, and monitors task-level activities, modifying miner and machine workflows in real time as the mine develops and advances.

It's the critical first step in helping mines to digitize manually captured activities.

Any personnel on the mine can have the production in the cell apps. It removes the process to go the control room for knowing the production, or miss communication by radio what is the production.



Time Allocation Tracking



Task Allocation



Activity Tracking

**Gain visibility below the surface with
HxGN MineOperate UG Pro**

[Request a Demo](#)

CONCLUSION

| Integrate Our Other UG Tools



HxGN MinePlan Engineering UG

Enables engineers to evaluate and design optimum stope shapes; and create UG mine designs and tactical activity-based schedules. Incorporates MinePlan 3D, Engineering UG CAD, Planner, Room + Pillar, Activity Scheduler Standard (Atlas) and Stope Optimizer.



HxGN MineOperate UG Foundation

Manages underground fleet equipment and optimizes production-time utilization in real time. Tracks locations and movement, and monitors task-level activities, modifying miner and machine workflows in real time as the mine develops and advances.



HxGN MineEnterprise Platform

An operational management hub that connects processes and data in a central place to support the management of your mine.



HxGN Survey & Monitoring

Measure high walls and perform real-time slope monitoring using radar, total stations and GNSS. Our GeoMonitoring Hub makes sense of combined measurement results with easy-to-use software.

ABOUT US

| Hexagon and Mining

Mining depends on precision, accuracy, and safety. Mines must find ways to integrate, automate, and optimize critical workflows for a competitive edge. Now more than ever, the industry must cut costs while improving safety.

Hexagon is the only company to solve surface and underground mine challenges with proven technologies for planning, operations and safety.

Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications. Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous — ensuring a scalable, sustainable future.

Hexagon's Mining division is helping to connect all parts of a mine with technologies that make sense of data in real time. Driven by professionals for professionals, our solutions are tailored to your needs and delivered on your terms — short term, long term, for the life of your mine.

Mining depends on precision, accuracy, and safety. Mines must find ways to integrate, automate, and optimize critical workflows for a competitive edge. Now more than ever, the industry must cut costs while improving safety.

Hexagon is the only company to solve these challenges with proven technologies for planning, operations and safety.

Hexagon's Mining division brings surveying, design, fleet management, production optimization, and collision avoidance together in a life-of-mine solution that connects people and processes. Our customers are safer, more productive and can make sense of their data.

Hexagon (Nasdaq Stockholm: HEXA B) has approximately 20,000 employees in 50 countries and net sales of approximately 4.3 bn USD. Learn more at [hexagon.com](https://www.hexagon.com) and follow us @HexagonAB.



Thank You

