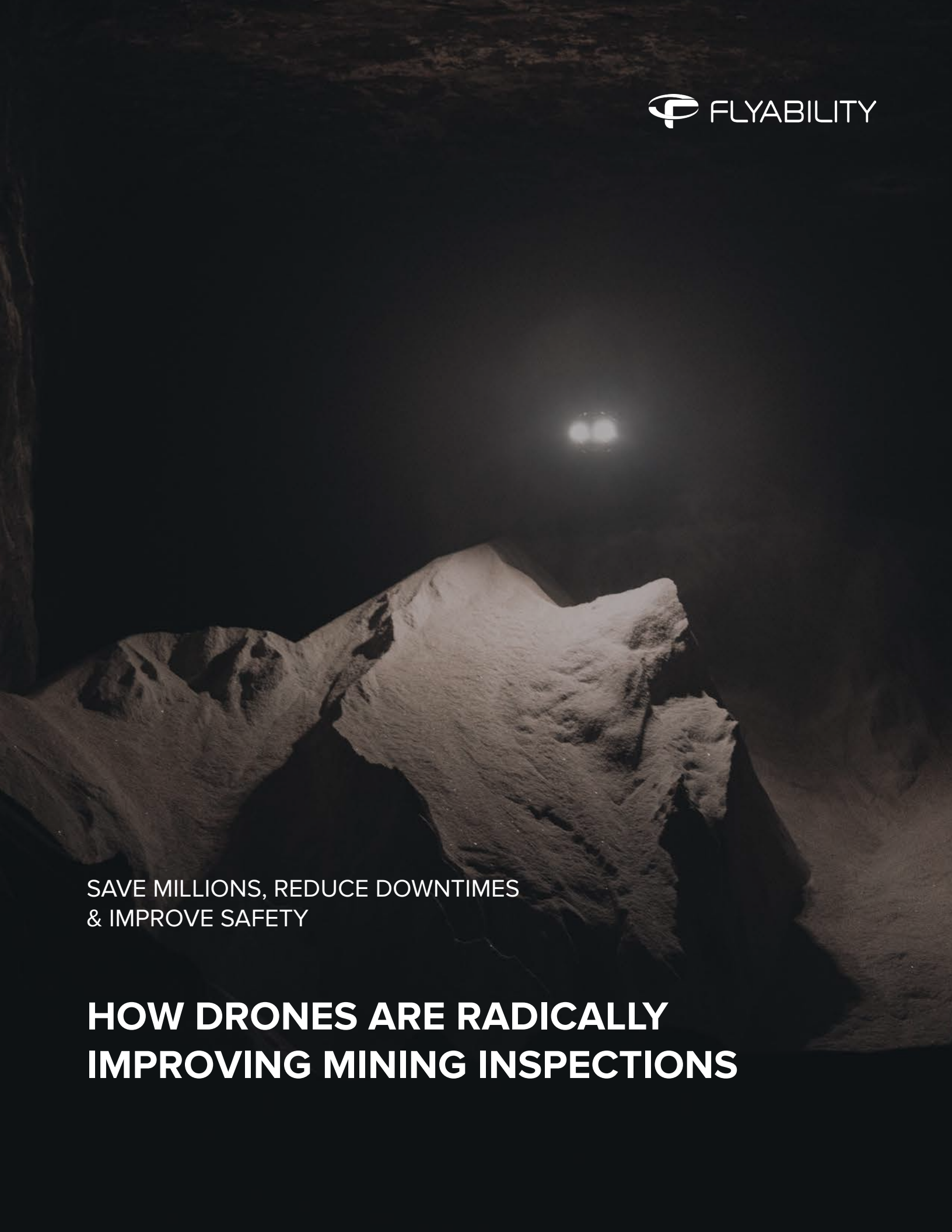


FLYABILITY

SAVE MILLIONS, REDUCE DOWNTIMES
& IMPROVE SAFETY

HOW DRONES ARE RADICALLY IMPROVING MINING INSPECTIONS

INDOOR DRONES
IN MINING

Accessing the inaccessible

Mines are hostile environments for humans. As a result, mining companies are turning to mining inspection technology that prevents humans from being exposed to dangerous situations. By choosing the Elios—a remote visual inspection (RVI) tool used to inspect confined and/or inaccessible spaces—mining companies have improved mining inspection operations by making them safer and more productive, while decreasing downtimes. The Elios gives mining professionals access to visual data from deep below the earth's surface in underground mines to the inner workings of a surface mine's processing plant equipment.

What Is a Mine Drone?

A mine drone is a drone that is specifically designed for or tailored for mining applications, like **stockpile measurement**, surveying, mapping, and inspections.

Mining is a hazardous profession, as worksite conditions can change instantly. Both underground and surface mining will present unique challenges and inherent risks.

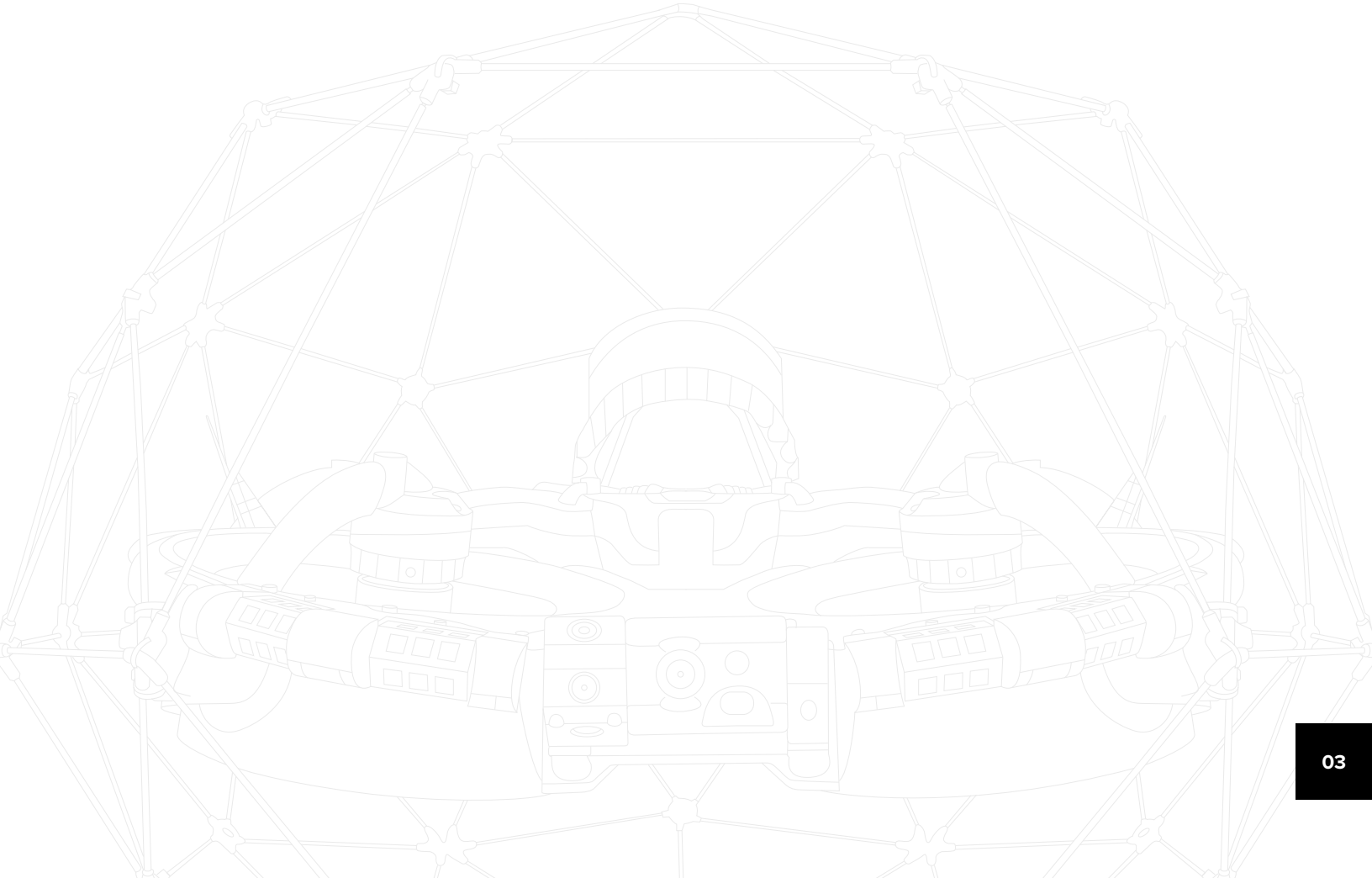
While drones will not eliminate every danger associated with traditional mining practices, they can be deployed to collect data in areas where humans are not allowed to enter.

6 Ways Drones Are Being Used in Mining

The mining industry has quickly adopted drone technology due to its ability to improve data collection, increase safety, and reduce operational expenses.

Here are 6 ways drones are used in mining:

- **Volumetric Monitoring**
- **Identifying Hazards**
- **Drilling and Blasting Assessment**
- **Mine Monitoring and Planning**
- **Mine Developmentand Exploration**
- **Processing Plant Inspections**



01

Volumetric Monitoring

Volumetric measurement is the science of calculating how much material is left in a stockpile of **overburden**, ore, or other mining materials. Due to the sheer size of stockpiles, it's challenging to get accurate volume reports using manual methods.

However, the integration of a mine drone allows for quick deployment with inexpensive and reliable volume data. Tracking variations in stockpiles is cost-effective and helps reduce unnecessary waste.

Using advanced volume measurement software, mine drone photos are compiled to create a 3D model. The algorithms behind these apps calculate based on the volume between the base layer to the surface.

Mining drones can also track how much material has been excavated from a particular area and approximate how much **backfill** would be needed to fill a **stope**. As more 3D models are obtained, it's easier to analyze data and see changes over time.

02

Identifying Hazards

Crumbling rocks, gas leaks, dust explosions, chemical byproducts, and underground environments challenge even the best equipment and miners.

By using Uncrewed Aerial Vehicles (UAVs) in mining, surveyors reduce these risks by removing humans from the inspection process. Remote monitoring improves on-site safety, saving time and reducing operational expenses.

In surface mining, stockpiles create sloped terrain that requires continuous stability monitoring. This data allows mine teams to detect early warning signs of instability and mitigate the issue to keep everyone safe while maintaining maximum efficiency with mining operations.

In underground mines, drones like the **Elios 3** can navigate dusty, wet, and rocky **ore passes** to locate blockages. In addition, the equipped sensors create photogrammetric models to identify fractures and other geological features.

03

Drilling and Blasting Assessment

3D models generated by mine drone collected data have multiple use cases, making them a cost-effective tool. Before drilling and blasting begins, a model can be created as a historical record check to analyze the after-effects of the work.

An updated version of the model allows miners to make data-driven decisions about potential hazards from drilling and blasting in the future.

04

Mine Monitoring and Planning

A mine consists of numerous moving components requiring systematic analysis and adjustments to achieve maximum efficiency and safety.

Mining drones are highly effective in the following areas:

- **Haulage road design**
  These roads are responsible for the transportation of mining materials from the worksite. The heavy traffic and equipment mean road conditions need to be assessed constantly. The data collected is also helpful in determining if improvements need to be made to the site infrastructure.

- **Equipment inspections**
  Keeping conveyor belts, crushers, grinding mills, and other vital components of the mine operation is crucial for low operating expenses and increased worker safety. Remote visual inspections via mining drones are a low-cost and safe tool for preventive maintenance. Some equipment, such as conveyor belts, can be visually inspected without disturbing the operation or production.

- **Worksite security**
  Security drones are becoming increasingly popular because of their quick deployment and the ability to cover a large area at record speed. The hazardous conditions at quarries, aggregate, and underground mines make mine drones excellent for protecting your investment. Having an aerial view is also helpful with coordination with emergency services if they are on the scene.

- **Environmental monitoring**
  Mining drones are a powerful tool in mitigating the environmental impacts associated with mining. For example, tailing dams at worksites hold hazardous chemicals. In the event these become unconfined, the effects could be devastating. Mine drones can monitor the stability of the dams to prevent leaks or runoff from the site.

05

Mine Development and Exploration

Developing mining operations is historically expensive and dangerous. Traditional methods required teams of miners to traverse into unknown conditions to conduct stability analysis, surface mapping, ventilation modeling, and detect hazardous gasses.

Instead of sending people into inaccessible areas, a mine drone can navigate tight spaces safely and more efficiently than any human could.

In underground mining, the Elios 3 is the only drone that can handle confined spaces with reduced visibility, poor air quality, and signal interruptions.

06

Processing Plant Inspections

Drones are used in on-site mining processing plants to inspect machinery. The benefit here is that drones can collect this data without stoping processing operations, keeping mining operations profitable.

6 Key Benefits of Indoor Drones for Mining Operations

In mining, big blasts are used to open up cavities in the earth—called stopes—for ore extraction.

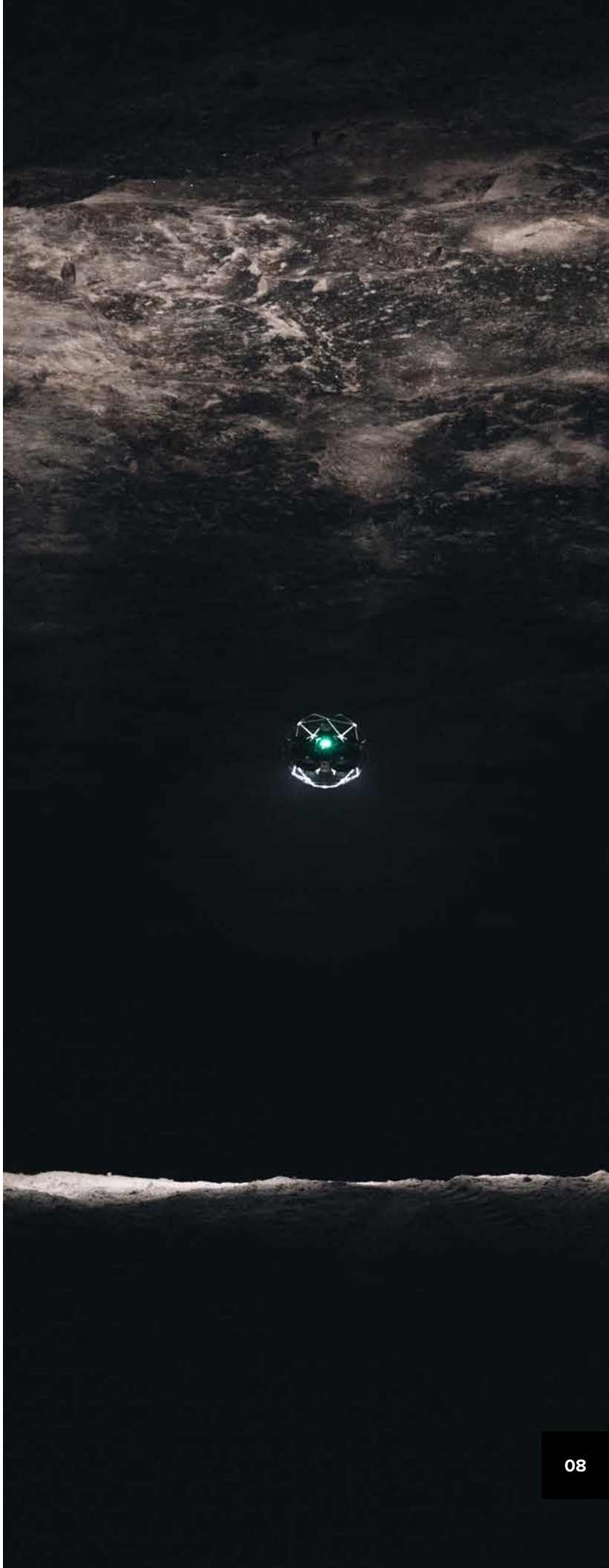
After blasting, a **stope** can be incredibly unstable. Loose rocks as big as cars could be hanging precariously within them, ready to fall at any moment.

Or not. The problem is, it's almost impossible to know.

If a borehole has been drilled into the stope, miners can lower an **inspection camera** into it, or use a pole to insert a camera.

These methods are limited, and can't provide enough data to perform safety assessments, locate ore that may have been missed in the first extraction, make determinations about the stability of the area, or determine the cause of an **ore pass** hang-up. This means that there is often a limited amount of information about the conditions inside a stope, making it difficult to know how to proceed with **backfilling** or other operations.

But **indoor drones** are changing all of this.



Mining personnel are using indoor drones to collect high-quality visual data inside stopes and other unstable areas.

They're using this data to create 3D models and sparse point clouds of mines, which help them better understand the conditions inside the area and ultimately improve their ability to make determinations about safety, stability, and remaining ore.

These improvements represent a potential step change for the mining industry, allowing mining operations to become safer, more efficient, and much more cost effective.

Here are six key benefits that indoor drones are providing to mining operations today.

- **Safety**
- **Savings**
- **Reduced Downtimes**
- **Access**
- **High Quality Visual Data**
- **Data Localization**

Safety

Here are the two main ways that indoor drones help improve safety in mining operations:

1. Extraction - Stope Inspections

Previously, miners simply couldn't enter a stope after a blast.

But using an indoor drone like the **Elios 3** to gather detailed visual data of the area, miners can now perform safety assessments that allow them to make an informed decision about whether a stope is safe to enter or not.

2. Processing - Mining Equipment Inspections

Extraction is only the first step in a mining operation. Processing raw ore is the important next step that follows extraction.

Mining operations rely on heavy duty industrial equipment for this processing work, and that equipment needs to be periodically inspected.

Common mining assets used in processing ore include:

- **Stockpile feeders**
  Ore drops through these holes in the floor (i.e., the stockpile feeders) onto conveyor belts, which carry the raw material to the mills for processing.
- **Ball mills, SAG mills, and crushers**
  These are all used to grind the raw materials for further processing.
- **Flotation cells**
  Large tanks where minerals are extracted using a process called froth flotation.

A traditional inspection of mining equipment begins with inspectors performing a security protocol and putting on protective clothing. (The environment is so hazardous that even the process of suiting up appropriately can take a significant amount of time.)

For the stockpile feeder and mills, inspectors work as quickly as possible because these areas might have falling debris and are very dangerous to be in.

For the flotation cells, inspectors have to enter a **confined space** and erect and stand on scaffolding, exposing themselves to both the dangers of confined space entry and the dangers of working at height. These tanks are used to store noxious liquids and chemicals, which can present further safety hazards to inspectors in the form of trace fumes.

For the crushers, inspectors have found that they are almost impossible to inspect using manual methods. Many mill operators will just wait until something breaks inside a crusher before performing maintenance instead of conducting preventive inspections and maintenance work.

Using an indoor drone to inspect mining equipment removes all of these risks to the inspector.

By using an indoor drone to inspect mining equipment, inspectors don't have to enter confined spaces, be exposed to falling debris or traces of noxious fumes, or stand on scaffolding at potentially dangerous heights.

An indoor drone like the Elios 3 can fly through and around the stockpile feeder, mills, flotation cell, and even the crusher, collecting high quality visual data as it goes—data that is usually better than the data that could be collected manually.

Savings

Here are three ways that indoor drones help mining operations realize significant savings:

1. Extraction - Identifying Remaining Ore

By providing high quality visual data inside a stope, drones can help mining personnel identify remaining ore as well as other geotechnical areas of interest that might otherwise be missed.

These findings can represent huge savings for mining operations by helping them recoup more profit from an operation, as well as surfacing opportunities to expand extraction efforts.

2. Extraction - Protecting Expensive Machinery

Muckers are large, remote-controlled machines used to move rock and debris in mines. A single mucker can cost as much as a million dollars, making them incredibly valuable assets for mining operations.

By providing detailed insights into the conditions inside a stope, indoor drones can help keep muckers safe from falling debris, representing big potential savings for mining companies.

3. Processing - Reducing Downtimes

Inspections of processing equipment used in mining operations are not only dangerous, they're also expensive, mainly because of the downtimes they require.

Eric Romersa, co-founder of a Chilean mining inspection company called WS Data 3D, estimates that one hour of downtime for a mine costs about $100,000 to $150,000 U.S. dollars.

But using an indoor drone to collect inspection data instead of having inspectors collect data in person can mean that operations don't have to halt while the inspection takes place, allowing the mine to realize the savings that come with avoiding that downtime.

The economic benefits of using the Elios for mining equipment inspections are clear. Since the mine doesn't have to stop production for over an hour, the company sees an immediate savings of between $100,000 to $150,000 in production costs.

- Eric Romersa, Co-Founder of WS Data 3D

03

Reduced Downtimes

As we just covered, indoor drones can help mining companies save money by reducing the downtimes needed for inspecting their equipment.

But reduced downtimes also mean greater efficiency for mining operations in general.

Because indoor drones can quickly collect visual data inside of assets that are hard to access physically—like part of a mill, or the inside edge of a flotation cell—they can be used for quick spot checks.

Being able to quickly and regularly get visual data on the condition of an asset can lead to improved maintenance procedures overall, ultimately resulting in reductions not only of scheduled downtimes but also of unscheduled downtimes, which might take place due to equipment failure.

04

Access

Indoor drones can provide access to visual data collection that is almost impossible to achieve using any other tool or method.

It's important to note that this kind of access can't be accomplished by just any consumer drone—indoor drones are made specifically for operating in rugged internal conditions.

For example, the Elios 3's unique cage design allows it to collide with objects inside confined spaces and continue flying. Drones that weren't made for this kind of work, on the other hand, run the risk of crashing and falling to the bottom of the mine.

“

The Elios 3 is something you can take off the shelf and fly underground in one of the harshest environments that we work in. You can capture quality footage with the Elios 3. It’s safe to interact with, and it has a nice cage that protects it from hurting people, objects, or itself.

- Ryan Turner, Geotechnical Engineer for the Barrick Gold Corporation

”

05

High Quality Visual Data

As we mentioned in the introduction, a common practice mining personnel use for collecting visual data inside stopes is to hang a camera through a borehole, or attach a camera to a pole and slide it through a borehole in order to see what is going on inside a stope.

These approaches aren't ideal, both because the coverage they provide within the stope is quite limited and because the visual data they yield is often of a relatively low quality.

But using an indoor drone, mining personnel can fly into a stope and take high quality images and video of anything they want.

The Elios 3, for example, provides high definition 4K video and high quality images, along with stabilization and unique lighting features to let pilots hone in on important details in the imagery they capture.

These images can provide insights for operations, engineering, survey, and safety departments within a mining operation, which can then be used in the ongoing development of the stope.

Drone data can also be used to create 3D models, which can further help mining personnel to understand the conditions inside of a stope.

"

The quality of the data from the drone is better than the quality that you get with a person. People need to get in and out quickly [but] with a drone you can stop and make a more detailed visual inspection.

- **Eric Romersa, Co-Founder of WS Data 3D**

"

06

Data Localization

Inspector 4.0 is a new software from Flyability made just for inspection experts, which allows inspectors to localize their inspection data so they can know the exact location of a given point of interest.

For mining operations, data localization can be used to help personnel return to the specific place where remaining ore was seen during a flight, or to a geotechnical area of interest or a potential hazard that requires further investigation.

Improve Your Internal Inspections

Any industry that requires visual data collection in confined spaces can realize these three benefits—safety, savings, and reduced downtimes—by using indoor drones in their internal inspections.

Flyability was the first company ever to create an indoor drone in a cage for internal inspections. Our Elios 3 is the premier indoor drone on the market, and can help you improve safety, cut costs, and significantly reduce downtimes for your internal inspections.

Want to improve your internal inspections?

Schedule a free consultation and see how we can help. »