

SCOTTY, BEAM ME UP!

WEARABLES AS EFFECTIVE RISK MANAGEMENT ASSETS IN MINING INDUSTRY

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Miners and mining operations continue to work under potential hazards, despite health & safety regulations that vary across the globe. Proper risk management and safety analysis suggest preparedness how to deal with risks. But safety training is more than just practice: it offers insights on improved processes and regulations. Wearable transponders play a crucial role in gaining such insights during training. They also prove valuable in avoiding, mitigating and warning of hazards in real work scenarios.

HEALTH & SAFETY REGULATIONS IN MINING VARY ACROSS THE GLOBE

Health and safety in the mining industry have always been an important aspect of operations. In these Covid times, health became probably the most discussed topic in our societies globally. The resulting disruptions of economic activities triggered talks, strategies and concrete actions on how to strike a balance between the safety needs of the population and the well-being of economic life. This balance is, and always was, at the centre of mining operations – the health and safety concerns of miners and the return on investment for operators.



Underground mining

Safety standards vary greatly across the globe (1). The highest standards being in Europe, North America and Australia, in stark contrast to some parts of Africa or Asia where mines lack the most fundamental safety infrastructure and procedures.

To improve safety and working conditions, advanced safety standards have been made mandatory with the help of the Mine Safety and Health Acts (2, 3, 4, 5). The International Labor Organization ILO (6), the International Organization for Standardization ISO (7) and the OHSAS add to the breadth of international health and safety regulations for the mining industry.

Health standards include preventive measures (e.g., the black lung program), regular health checks and the mandatory usage of protective devices (e.g., respiratory masks). They also regulate the usage of materials and tools within the mine, approval requirements

for explosives, hydraulic fluids, and electric lamps, communication systems, dust and methane detectors, and vehicles. In addition, safety regulations also describe the necessary training of miners and mine rescue teams in safety-related matters.

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HOW TO COPE WITH RISKS AND HAZARDS: PREPAREDNESS AND CONTINUITY PLANNING

Despite national and international regulations, mining and quarrying is still the sector with the highest level of work-related health problems in the European Union (11). On the positive side, mining has “only” the seventh-highest total number of fatal accidents at work in the EU and continues to improve its records.

On a global level, the health and safety issues in the mining industry are much worse. The non-existence of regulations causes thousands of fatal incidents per year. However, the existence of safety regulations doesn't by itself prevent accidents, even on a smaller scale. The Department of Mineral Resources highlighted this by commenting that *“very few people have accidents for which there is no procedure in place, and we have a significant degree of accidents as a result of people breaking rules, ignoring rules, or simply not knowing about them...”*



Research in the industry showed (9), that rules and regulations are well intended, but not always helpful. Management and regulators should not produce more rules and descriptive safety plans as they won't resonate with the workforce. Instead, fewer rules, but of higher quality create a better understanding among miners. The Swedish mining industry followed this approach in the early years of 2000 (10) and was focused on risk management.



Systematic reduction of hazards before they hit

The top priority in risk management is always to eliminate risks as much as possible and follows a three-level hierarchy of control approach. The first level eliminates the hazard and the associated risk and is the most effective measure of control (e.g., no holes in the floor where people work). If this is not reasonably practicable, risks should be mitigated by substituting the hazard with something safer (install guard rails). The third level acts as an administrative control to minimize the exposure to a hazard (warning sign or protective equipment).

The top risks in mining related to the health of miners are dust inhalation, constant loud noise, musculo-skeletal damage, thermal stress, and chemical hazards. Potential safety hazards include ground stability and rockfalls, mobile plant roll-overs, fire and explosion, loss of ventilation, the in-rush of water, entanglement in machinery, falls from height, injuries from handling heavy loads.

Over the decades, health risks have been reduced dramatically through the application of regulations. The probability of safety hazards diminished over time as well as new technology improved the construction, infrastructure, and operation of mines. Yet the road to zero harm remains far. The future of mining lies in more challenging environments and more difficult exploration, resulting in higher safety

risks. In one sentence: health and safety hazards will remain part of the mining business for the coming decades.



SAFETY ANALYSIS AND THE HUMAN FACTOR IN RISK MANAGEMENT

Safety analysis is the state-of-the-art approach to improve safety. It can be conducted in every phase of the mine lifecycle – from the planning stage, the construction phase, and the operational stage (12). During operations, for example, safety and risk analysis is used to check if tasks are conducted safely. The following approaches are used to identify and evaluate hazards in operational mines:

- **Hazard and Operability Study (HAZOP):** A systematic (and therefore time-consuming) approach for identifying hazards by questioning how each part can deviate from the intention of the design and its consequences. It also considers the causes and consequences of human errors.
- **Stop, Look, Analyse, Manage (SLAM):** Used by individuals, this tool identifies hazards and control methods for tasks.
- **Checklist:** Easy-to-use method to check compliance to standards and ensures common problems are not missed, but difficult to discover new hazards.
- **Fault Tree Analysis (FTA):** Based on a single fault, incidents are analysed backwards to identify the causes.
- **Job Safety and Environmental Analysis (JSEA):** This approach identifies hazards for single tasks, assesses the risks and applies insights into the development of work procedures.

As mining is geared toward more challenging and exposed environments and undertakings, mining operations become more complex and challenging (13). Interestingly, mechanization significantly increased the overall risk for accidents, but lowered the mortality rate (10). Still, nine out of ten accidents in mining are triggered by human activities such as operator errors and violations of regulations.

Considering these facts, safety analysis is only one part of the overall safety and health strategy in mines. It has been shown that the human factor is the trigger for most accidents in mines (10). The workforce argues that effective rules should provide only minimum standards, be simple and practical and flexible to work tasks (9).



Illustrated procedures, consistent and returning training and education, as well as an established safety culture, are the best ways to foster safety awareness and to reduce incidents in mines.

TRAINING IS MORE THAN PRACTICE: INSIGHTS THROUGH DRILLS

As with any management system, a continuous improvement process should be implemented by monitoring and updating the rules and regulatory subsystem at mines at regular intervals. Training is an important part of acquiring and enhancing safety-related knowledge and practical skills in emergencies.

In general, training (“drill”) on machinery or procedures aims to learn and master the desired outcome. The principal objectives of drills in mines are to train the behaviour of miners, to detect errors in

(operational and emergency) plans and to minimize the reaction time in case of unexpected events. At the end of the training, each participant should know the answers to “What must be done? What should be done? With what, and when, should it be done?”

Scheduled drills can be carried out after basic instructions have been given. Participants know that a drill will be held and are aware of the procedures. Every drill is an exercise that must be evaluated in the aftermath to deepen the effect of the training. Once scheduled drills have been carried out several times, unscheduled drills may take place. A thorough evaluation will reveal the status of skills and the weaknesses of the organization in performing the desired reaction.

Safety and emergency-related drills are not only important, but also very effective in teaching behaviour for a given scenario. Such scenario-based drills are common practice for example in the offshore industry and contribute to very high safety standards, and consequently to a low incident rate.

GOOD USE OF WEARABLE TRANSPONDER



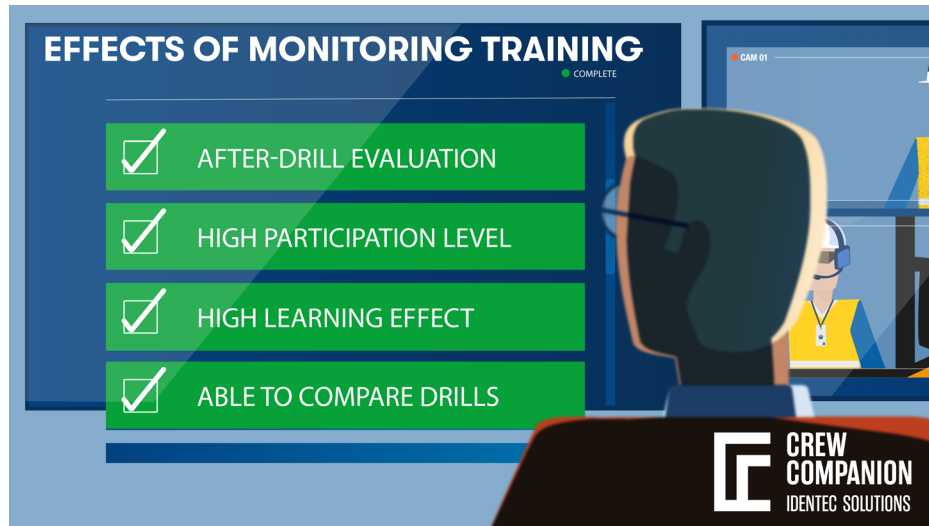
- 1: Access control: avoid hazards**
- 2: Reporting position: safeguard against hazards**
- 3: Route to safety: warn in case of hazard**

Evaluation of scheduled and unscheduled drills makes it possible to arrive at a critical assessment. It should be aimed at finding out whether the workforce involved could solve the task adequately and efficiently and how to improve the procedure in total.

“To drill [def.]: to impart (knowledge) by strict training, discipline or repetition...”

HOW CAN WEARABLES HELP TO IMPROVE SAFETY STANDARDS AND WHAT IS IMPORTANT TO KNOW?

To enhance the learning effects, drills should be monitored by electronic equipment. Video and other technologies are useful for explaining and illustrating the outcome of actions taken. As cameras are not available in all areas where drills are conducted, other monitoring devices would be helpful to deliver visibility. One alternative is wearables.



Wearables are transponders or tags worn on the body and transmit data like a heartbeat, body temperature or step count. The big advantage of wearables is that they display individual behaviour and reactions, preferably in real-time. In the context of mine safety, one of the most important drills is to teach behaviour in case of an emergency like a fire, explosion, water ingress or collapse of parts of the mine. Scheduled and unscheduled evacuation drills can be monitored by wearable transponders that transmit their positions at any given time.

Such transponders show positive effects during training:

- Emergency exercises are individually recorded for after-drill evaluation
- They increase the participation level because of the individual recording
- They improve the learning effect through the evaluation of

objective data

- They show improvements by comparing previous drills
- They also provide a realistic time and behaviour framework in case of a true emergency

“To enhance the learning effects, drills should be monitored by electronic equipment.”

ADDED-VALUE OF WEARABLE TRANSPONDERS: ACCESS CONTROL TO SITE AND VISIBILITY IN THE MINE

Position-broadcasting wearable transponders not only help to increase the value of safety training, but they are also valuable in showing the position of each miner in case of a real emergency. Following the above-mentioned model of 3 levels of risk management, wearables can be successfully deployed to mitigate the risks at all three stages:

Level 1 - Avoiding hazards at all: Close off areas and control site access. Wearables act as keys to mines in general, but also to certain areas (e.g., explosives' storage)

Level 2 - Safeguarding against hazards: Reporting the safe zone position of every worker in the mine in case of a scheduled blast.

Level 3 - Warning of hazards: In case of an emergency, a transponder indicates the current position and the route to safety.

These examples show that the safety, risk management and continuous operation of a mine are aligned. Wearable individual transponder systems not only save lives in case of an emergency, but prepare the organization for any eventuality, as drills are documented and comply with governmental, industry and international regulations. Mine operations can continue faster as reduced muster times mean work can be conducted closer to the scheduled blast time and resume more quickly after.

In all scenarios, everyone involved in mine operations can rely on a digital, real-time reporting system. Operators have the responsibility to answer questions about the whereabouts of their missing workers in an emergency as well as to act in a safe manner during regular

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GO THE NEXT STEP

Visibility is the key to safety in mines. Wearable transponders provide visibility in a reliable way - during operations, training drills and emergency. They are the cornerstone of your successful safety strategy.

If you'd like to learn more about wearable individual transponder systems, how they can be set up in a comprehensive safety concept and who is using them already in the industry, call us now on +(43) 5577 87387-0 or visit identecsolutions.com and look for Crew Companion.



BECAUSE IT WORKS

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