

Sounding an alarm on operator fatigue

Donna Schmidt reviews technology helping miners stay alert and work safer



A detailed look inside OpGuard

Everyone at some point has felt the heaviness of the head, neck and eyes after a long day. For miners, that may come from working many hours of overtime, a shift they are not used to, or any other number of reasons. The hazard of drowsy driving has been an issue of varying severity for the mining industry worldwide.

Recommendations for managing fatigue with a typical shift worker simply aren't realistic for most miners. A quick nap during the day and avoiding bright lights? Not likely for a haul truck driver on the owl shift for a second consecutive week.

Conversely, what has shown to be effective for fatigue management at mines has been the introduction of technology that either monitors for drowsy driving or prevents it from occurring. Consistent research is also conducted in this area. For example, the National Institute for Occupational Safety and Health (NIOSH) in the US has been working since 2017 to characterise mine-worker fatigue with a human factors system approach, or examining those factors which contribute to the fatigue and resulting negative outcomes.

"Currently, no science-based, actionable recommendations for fatigue management at US mines exist," the research group says.

"An authority is needed to lead important discussions and policy-making decisions on mineworker fatigue."

NIOSH's pilot project goals are two-fold: to develop a theoretical model of how fatigue in mining can lead to illness and injury, and to develop recommendations for a preliminary mining fatigue management system. Specifically, it is planning to investigate links between fatigue predictors and outcomes on a systems level, as well as interventions that can target various predictors and outcomes of fatigue.

The NIOSH work is ongoing – the pilot project will lay the groundwork for a larger, four-year project proposal that could impact the industry via a number of new strategies, management systems and interventions. In the meantime, there are also several other technologies already available now or nearing that status.

HEXAGON'S OP LEVEL

Hexagon Mining has an ever-growing line-up of systems focused directly on preventing worker fatigue. Its OpGuard product analyses operators in real time and provides immediate notifications when an event occurs that is classified as fatigue or distraction. Non-intrusive in its design, the in-cab infrared camera in the solution can watch continuously for movements like eyelid closure, facial and head movements, and other behav-

iours such as cell phone use or reading while a vehicle is moving.

If an event is detected by the sensor built into the machine's dash, an alarm is activated; both an audible speaker alarm and seat vibrator are available. The event data is also stored within the system and the video synced with the OpWeb Integrated Analytics software suite.

In addition to the benefits of increased awareness and the reduction in hazardous behaviours, OpGuard also can increase operator productivity and equipment availability.

According to Hexagon product manager Ryan Hawes, the solution was designed in 2010 and released to the mining community in 2012, and since that time the company has diligently worked to incorporate feedback from the field and release new software and hardware updates for OpGuard with the most beneficial improvements.

"The feedback has been outstanding," he says. "The community has seen tremendous results from the solution in assisting with changing operator behaviour related to fatigue and distraction."

OpGuard is available for all environments that are non-intrinsically safe and can be used both at surface and in underground operations. It has a multi-layer approach to management and elimination of fatigue: the first being the on-board defence, and the second in a peer review of event files.

The third is the use of the company's OpWeb capabilities to assess historical data in hopes of managing future condition management plans. Changes from this often include adjustments to optimise roster schedules, break times, haul routes, shift hours and more.

Hexagon's operations centre, a 24/7 resource, provides exception-based monitoring of the company's suite of Guardvant solutions and utilises OpWeb for accurate, independent analyses. It also provides customised monitoring plans for its ►

"The 'big brother' fear is real"

Readings on Eagle Industrial can be easily viewed by management from anywhere



“Analyses are done on board the vehicle by a computer – there is no human watching”

► customers and reviews, verifications and classifications of logged events for mines to review and keep for their records.

The company says it is always eyeing new solutions and improvements to the existing systems in its portfolio. It also promotes integration with other companies, Hawes notes.

“At the current time our focus is on integrating [OpGuard] with the entire HxGN product portfolio to provide better real-time data, analytics and business rules for our customers as part of the HxGN Life on Mine solution.”

As for what role OpGuard, and other products like it, could have on safety across the mining industry, he says that any proven technology has an extremely important place – with advances like collision-avoidance solutions one example of that.

“Any solution that is proven to assist operators while reducing safety risks and incidents has a big impact on the industry,” he says, adding that the trends Hexagon has seen to date have revealed a bit of a slow uptake in mining for the integration of these vital technologies. However, depending on the region, they are beginning to be more of a must-have for mines.

“We are seeing more and more mines make [OpGuard] a requirement for the operation to run,” he says.

Regarding the technology’s challenges, operator buy-in seems to rank at the top. With OpGuard, for example, by design there will be a camera pointed at the face of the operator at all times to analyse their facial features.

“The ‘big brother’ fear is real,” Hawes acknowledges, noting that there has previously been some hesitation by users. “But as operators see the results of the solution, buy-in actually comes from operators tell-

ing other operators why the solution is important.” He adds that all of the system’s analyses are done on board the vehicle by a computer – there is no human watching or performing analysis except for review after events happen.

Moving forward in this area, fatigue monitoring’s most crucial opportunities include reducing both the size and cost of the solution to allow its installation on all equipment, such as light vehicles and buses, and not just large pieces of machinery. The potential also exists for using the software in other applications, including real-time object detection for proximity protection.

PUTTING FATIGUE INTO FOCUS

Australian firm Optalert, which has developed its line of products around the mining, transport, automotive, neurology and pharmaceutical industries, recently revealed data that showed as many as 30% of professional drivers are at risk for falling asleep behind the wheel. While the figures stem from a survey of the transport industry, the application of a similar number to mining would be fair – and should ring some alarm bells.

The company addresses mining’s tired drivers with Eagle Industrial, which was designed for mining, rail and transport – industries which have constant heavy-vehicle operations. The system’s tablet, mounted in a vehicle and paired with the company’s wired or wireless glasses, computes a driver’s drowsiness score (JDS) and displays it to alert the driver to their risk of drowsiness.

Scores are also sent to Optalert’s real-time drowsiness monitoring system Fatigue Risk Profiler for real-time viewing and use by supervisors and managers. The scores are continuously measured and then updated

every minute. Multiply that by the number of drivers a mine site has and compiling this information can have a significant impact on drivers immediately, as well as provide longer-term advantages for an operation’s fatigue and risk management initiatives.

Optalert says the tablet is ruggedised for harsh environments. Automatic software downloads and installations remove the potential for a driver to be performing their work using an older version of the system. Gorilla Glass on the tablet’s front also gives a driver the information they need without glare.

Optalert’s glasses form the other primary element to the system; they use small LEDs built into the frames to measure eyelid movement 500 times per second. Those measurements produce the JDS score. The company says the UV-protection glasses can be adapted for prescription lenses, and have three shades for mining’s various driving conditions.

MONITORING IN ACTION

In May, Barrick announced that its pair of pilot projects seeking more information on combating workplace fatigue wrapped up at its Cortez gold project in Nevada, US, which extracts from the Pipeline and South Pipeline deposits as well as the Cortez Hills deposit.

Both month-long pilots examined drivers on the mine’s day and night shifts, with the discovery that day-shift workers hit their highest level of fatigue on the last day of their work week.

Conversely, the miner found that those on the night shift saw their highest levels of fatigue as early as their second work day, but it extended through to the last day of their work week.

With fatigue being a key risk to worker safety, the pilots were a proactive method of addressing the problem at Cortez.

Some signs of fatigue that may present themselves include slower reaction times, making more errors, or a marked reduction in cognitive abilities.

“Fatigue is a term used to describe a wide variety of conditions,” Cortez’s industrial hygiene specialist Justin Tueller says. “We summarise it as the feeling of being tired or weary because of insufficient sleep, lengthy periods of mental or physical work, or prolonged episodes of stress or anxiety.”



OpWeb can be utilised on numerous digital devices

Risk levels, he adds, can be influenced with the addition of other factors, such as the number of breaks, hours per shift, shift type and the number of consecutive shifts one has worked.

In one pilot, Predictive Safety, about 20 to 25 workers were administered two-minute examinations on tablets both before and after their work at the open pit. A sleep questionnaire was completed along with an alert monitoring test to calculate reaction time. From those results, an algorithm was created to produce a fatigue level from guarded/low to significant or high.

In the second SmartCap pilot, using technology from Australian-based SmartCap Technologies, haul trucks were connected via Bluetooth to operator-donned headbands. The same size group had their electroencephalography (EEG) readings monitored with the headbands, which fit in a standard hard hat, with a measurement of electricity emitted from the forehead.

Cortex officials recorded the EEG results, and they also appeared on a monitor mounted inside the trucks' cabs every 2-3 minutes. Drivers with high levels of fatigue would be notified by alerts; if three alerts were recorded without the driver taking a break, the system would flag this for a supervisor, who could then intervene and assess a driver's duty fitness.

"The projects helped employees self-manage their fatigue and

determine when they may experience a fatigue 'wall' ... seeing the results and acknowledging how their fatigue progressed throughout their shifts helped employees identify the most opportune time to counter fatigue by drinking a glass of water or taking a quick walk," Tueller says.

"Many participants have acknowledged an increased awareness when it comes to their personal fatigue management. This awareness will help minimise fatigue-related incidents."

Cortex is now evaluating the projects' data to decide whether they will progress with the implementation of the monitoring across the

site. If that occurs, the Smartcap system would be expanded to more equipment types, and the Predictive Safety testing tool could be used in the future at other divisions, such as the Cortez underground operations. Application of the tools at its Goldstrike mine could also be an option going forward.

BEING REACTIVE VS PREDICTIVE

Fatigue-related risk management company Fatigue Science cites a Caterpillar Global Mining study on a few statistics: it found that up to 65% of all surface-mining haul truck incidents were fatigue related. ►

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The integrated camera helps OpGuard consistently monitor for changes in a machine operator's eye movements ▶ It quotes another US study indicating that worker fatigue increases risk of death by 13%, and those who slept less than five hours per day were more than three times as likely to be injured than those receiving more than seven hours of rest.

Yet another study Fatigue Science obtained estimates that up to 20% of people suffer from sleep disorders like sleep apnea. The percentage of those working behind the wheel of a mining machine, unfortunately, is not known.

With these kinds of figures, it seems knowing all available options could be one of the keys to making improvements. Reactive technologies, or those technologies used to detect fatigue once the symptoms appear, currently make up a large segment of what is most commonly used in the field. These include EEGs, in-cab monitoring of drivers, psychomo-

Fatigue Science says Readiband, which has a 30-day battery life, automatically syncs when a worker enters the site

tor vigilance tests for alertness and telematics.

While absolutely valuable, Fatigue Science notes that less time is available for intervention when reactive methods are used. Also, getting to the root of why fatigue exists with a worker is not addressed with reactive technologies.

The company, which has placed focus on the predictive side of the metaphorical coin, says that using that perspective not only helps the safety of the worker but also their health. Its Readiband device – which looks like an exercise tracker band – collects and analyses a crucial element of the wearer: their sleep data.

Fatigue Science says the Readiband, which has a 30-day battery life, automatically syncs when a worker gets to their site, and the data captured is up to 92% accurate compared to a visit to a clinical sleep lab. It will not only reveal what the current level of alertness is, it can also predict what it will be in the future.

“Our core value proposition is we can give you the ability to see at what point you’ll be fatigue-impaired hours in advance,” sales director Jacob Fiedler previously told transport pub-

lication *Overdrive*. While some other systems can detect and detect well, they are not addressing the sleep pattern or informing the person how that can be improved. The only cure for fatigue is sleep.

The Readiband system was first developed by the US Army Research Lab with funding from the US Department of Transportation. As with many technologies that begin in other areas of industry, mining has been prudent to examine its application at its operations level.

Is the industry now open-minded enough to build on products that have brought success and saved lives elsewhere? It appears so, and that’s great news for all miners. ▼

