Todd Schools, Emerson, USA, explains why top performing mines are ranking asset criticality to deliver targeted reliability.

PLANNING FOR SUCCESS

Today's mining business environment can be extremely challenging. There are constant pressures to mine, process and distribute product at the lowest possible cost, while still operating a safe and environmentally friendly workplace. One way that best-in-class mining companies are addressing all of these pressures is with a constant focus on technology that improves the reliability of mine equipment.

However, simply recognising the values of reliability is not enough. To make the best of the current mining environment, many organisations are turning to predictive maintenance on critical equipment in order to ensure reliability of the assets that are required for day-to-day production. When an organisation applies a relentless focus on collecting and analysing predictive maintenance data, asset health degradation can be seen in its infancy and resolved on a planned basis before equipment failure.

To fully realise the value of this technology, it is essential to focus on strategic placement of predictive maintenance data collection tools to provide a clear, holistic understanding of asset health. By ensuring that predictive monitoring technology is rolled out in a manner that is customised to the specific needs of mining operations, reliability teams can deliver higher availability of critical assets, ultimately leading to increased production, safety and environmental stewardship.

Shovels are typically critical, remote and expensive to repair. They are ideal candidates for continuous monitoring.

Focusing on the critical

Organisations that are successful with moving from machinery health management based on preventative maintenance to predictive-based maintenance begin with a strong foundation in understanding asset criticality. Knowing how each asset contributes to the risk of unplanned downtime is critical to building a holistic maintenance strategy. Having hundreds of non-essential data collection points throughout the mine offers far less benefit than targeting the individual assets that have the highest criticality and have higher failure probabilities. Detailing the criticality of each asset and its probability of failure gives reliability teams a firm understanding of the risk to the mine posed by an individual asset. Once the risk is understood, a maintenance strategy can be developed and implemented to mitigate that risk.

Once equipment criticality is clearly understood, the knowledge helps drive deployment of resources and technologies to monitor equipment health. The most time and effort should be focused on the assets that are the most critical and have the highest likelihood for failure. When efforts are focused on the most critical assets, predictive maintenance plans will have the greatest impact on the reliability of the mine.

Monitoring critical assets

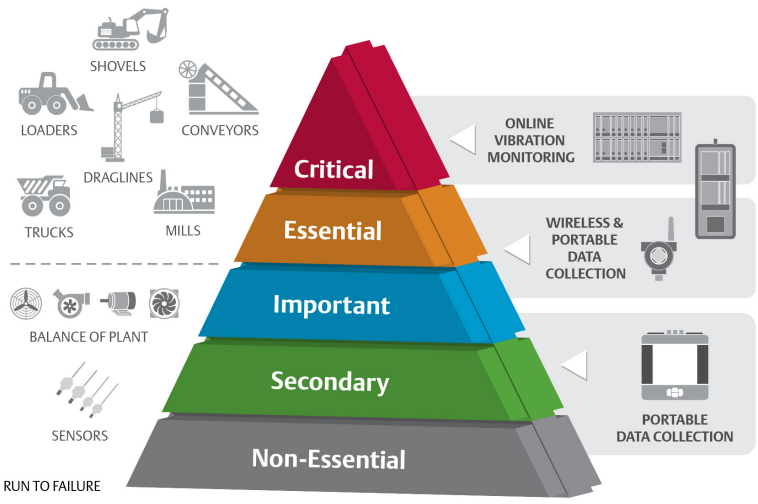
Once equipment criticality has been determined, reliability teams need to focus on how the mine will deploy technologies in a way that will enable a clear understanding and sharper focus on the most critical assets. There are a range of machinery health management technologies available for use at the mine. For the most critical assets, online monitoring is the best approach; it will provide a clear understanding of equipment health on a near real-time basis. An online machinery health monitoring system would typically be deployed on the mine site's most critical assets. In most mines, this would include:

- Conveyors.
- Draglines.
- Shovels.
- Crushers.
- Ball and SAG mills.
- Turbomachinery.

Online monitoring is critical for these pieces of equipment due to the nature and design of the mine. Each of these pieces of process equipment is used around the clock. Due to the magnitude of each of these equipment types, mines typically do not keep spares on hand. Therefore, if failure occurs, shutdown or slowdown of the process is nearly guaranteed. Also, due to their size, repairs are often time consuming. For example, downtime for a typical shovel in a copper mine can cost around US$35 000/hr. One unexpected downtime event that lasts for 12 hrs can cost the site US$420 000 in lost opportunity alone.

In some cases, a mixture of technologies works best. Conveyors are often among the most critical pieces of mine equipment but, though they perform one task, the devices must be considered as complicated systems with lots of components of varying criticality. It would be prohibitively expensive to try to monitor all of the components of a conveyor with an online monitoring solution. However, this does not mean that the mine should forego monitoring the conveyor. Finding the right combination of monitoring technologies for this critical system is the key.

Of all the conveyor components, the drive is the most critical and would need the added security of online monitoring to ensure that no event is missed. The criticality of individual idlers is low compared to the drive, so a combination of wireless monitoring and a regular thermographic walk down would be acceptable for these components. This combination of technologies and activities can save reliability-focused organisations millions of dollars per year on their conveyors alone.



The above diagram differentiates assets by the typical site distribution of criticality (from critical down to non-essential) and shows the typical technology deployed to monitor equipment health using vibration analysis.

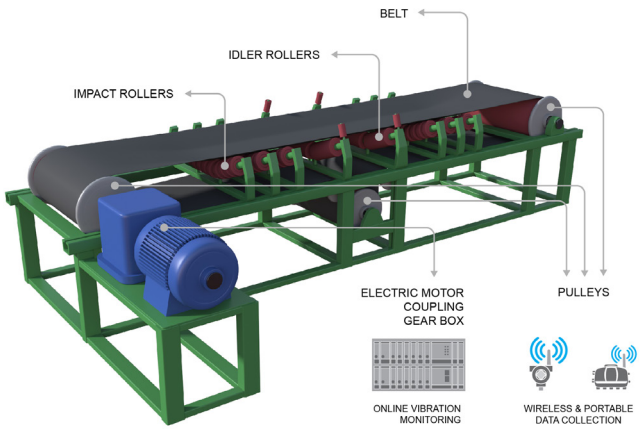
Keeping an eye on essential assets

Assets that fall into the essential category should also be monitored. Motors, pumps and other balance-of-plant equipment are perfect for a portable route-based approach for vibration monitoring. Additionally, some assets are ideally suited to wireless technologies, as they are often deployed in hard-to-reach locations, such as cooling towers, aerators in flotation basins or holding ponds.

While important, secondary and non-essential equipment needs to be regularly maintained, these assets do not always require predictive maintenance solutions. Because failure of these devices will not cause downtime, safety or environmental concerns, they can generally be monitored using regular preventative maintenance sweeps.

Focusing on specific solutions

Examining specific solutions in depth makes it clear that predictive



The ideal monitoring solution for a conveyor system includes a number of different sensing technologies.

maintenance solutions can provide the return on investment necessary to justify their place in the modern mining industry. Draglines, shovels and conveyors, are three places where breakdown is common and where service interruptions result in significant cost for operations. By bringing these devices into the predictive maintenance programme, organisations avoid significant interruptions and a great deal of lost revenue.

Mining solutions: draglines and shovels

Draglines and shovels are typically some of the most critical assets at a mine site. Emerson's solution for draglines and shovels is the continuous monitoring of the hoist, swing and crowd drives and gearing using a continuous online monitoring solution with PeakVue™ technology, giving personnel the critical ability to filter out traditional vibration signals and focus exclusively on impacting. This focus on impacting serves as a much better indicator of overall asset health on pumps, fans, motors or any other type of rolling element bearing machine.

Typically, draglines and shovels are remote and taking manual readings presents safety concerns as these large pieces of equipment are constantly moving. In addition, manual data collection is slow and impacts the mine's ability to move product during collection windows that can last an hour or more. Continuous monitoring with PeakVue technology allows repeatable, trendable data collection.

Business case: Downtime on a shovel at one US copper mine costs US$35 000/hr. Data collection alone saves around 1 hr/month or US$420 000/yr. One save on a hoist transmission gear can save 14 hrs of unscheduled downtime or US$490 000 for one event. At the high levels of cost for repair and lost production due to downtime, return on investment for a shovel vibration solution occurs in less than one year.

Mining solution: conveyors

Conveyors are also typically some of the most critical assets at a mine site. Emerson's solution for conveyors uses a blend of technologies and strategies. Drive components are monitored using a continuous monitoring solution and PeakVue analysis for near real-time detection and thorough analysis of any issues. Idlers are monitored using a combination of wireless monitoring technologies and regular infrared thermographic scans.

Business case: Downtime on a main pit conveyor that transports ore from the pit to the processing facility can easily cost US$250 000/hr of downtime. Continuous monitoring of the drive components can save a site millions of dollars per year. With high costs for repair and downtime, the blended predictive monitoring solution on a conveyor should show return on investment in less than one year.

Mining solution: general programme

Though not all equipment requires continuous online monitoring, many non-critical assets are still strong candidates for predictive maintenance. The business case is clear for the inclusion of essential assets in a structured vibration programme. Emerson's solution for monitoring a variety of essential assets includes using online vibration monitoring with PeakVue technology where necessary, allowing reliability engineers to focus on impacting in assets, supported by wireless vibration monitoring and regular route-based vibration and temperature monitoring.

On average, top performing organisations include over 76% of assets in their vibration monitoring plan to achieve their high results. For this data to be implemented and used to drive mine reliability, the following must be considered:

- Organisations must choose and deploy the right technology or solution for each mine asset.
- The data gathered must be consistently collected, reviewed, saved and acted upon.
- The right personnel with the right training should lead the effort and review the data.
- There must be a system of continuous improvement in all aspects of the vibration programme.

Conclusion

Operating a modern mine requires more finesse than ever before. Production, safety and stewardship must often be balanced on a knife's edge. However, with changes to the marketplace have come advancements in technology that make day-to-day operation safer and more efficient than ever. As mining organisations are tasked to do more with less, they are realising that the reliance on reactive maintenance that has been the trend of the past will not deliver the low costs, high safety and environmental stewardship that are required to thrive in the current mining environment. To deliver a more productive future, plants must embrace targeted, strategic rollout of predictive maintenance solutions that will deliver a holistic, criticality-centred picture of mine health. WC