

Is mining ready for prescriptive maintenance?

Predictive maintenance systems that can prevent costly asset downtime by catching component failures have become a reality in recent years as connected sensors are integrated into mineral processing facilities. But some companies are already looking to the next big evolutionary step in asset health monitoring - a system that does not just identify failing components, but also uses AI and machine-learning to recommend a long-term solution

By Craig Guthrie

Above: ABB's Asset Vista Condition Monitoring solution in use his 'prescriptive maintenance' system of the future will use Al to crunch data assimilated continuously from a diverse set of process and performance variables, and provide actionable recommendations.

For instance, predictive technology would alert operators that an equipment running with a varying bearing temperature is likely to fail. Prescriptive, on the other hand, would also tell them that reducing the equipment speed by a certain amount could double its lifespan.

While Industry players agree it is the next paradigm shift, they disagree on how close the concept is to becoming a widely adopted technology.

"Prescriptive maintenance might be possible in small and specific applications, but implementing it on a project-wide scale is 'blue-sky' thinking," says Vien Dang, product marketing manager at fleet management systems firm Wenco International. "It will take 5-10 years of intensive research and development before we get there."

The datasets are too young, says Dang. "All the contextual data needs to be better classified, and then there's the job of translating it from something that can only be read by a data scientist, into common language a technician can understand."

Brazilian software firm RIO analytics, which is working on predictive maintenance, says that important hardware and network advances also need to be made before prescriptive maintenance can become adopted widely in the mineral processing sector.

"To evolve towards broader use of prescriptive maintenance, we need first to have solid and scalable predictive maintenance platforms in mining. In reality, predictive maintenance is not fully established in this space", says Vinicius Oliveira, RIO's head of business development, who estimates that less than 1% of the industry is using predictive analytics.

"There is a lot of room for predictive to grow before there is a need for prescriptive. Also we would need much more robust IoT infrastructure in each of the industry verticals," adds Oliveira.

RIO's AI algorithms use AI to extend analysis of electro-mechanical behaviour, using existing sensor data and taking a cue from the vibration monitors that have been used since the 1970s.

The technology focuses on the dynamics of existing systems as well as structural integrity and the work the equipment is undertaking, for example the onboard power systems, electro-mechanical behaviour, and monitoring of vibration mechanics.

ALREADY THERE?

Engineering technology firm AspenTech has already developed a prescriptive maintenance solution that has been applied to mining. Its Aspen Mtell software uses machine learning to identify patterns that humans cannot see, with so-called software "agents" used to recognise normal and abnormal behaviour of assets and the specific patterns of degradation.

Rather than just spotting potential failures, the solution can inform asset management systems on when to service equipment, or advise operators to make process changes to avoid the degradation, damage, and the required maintenance.

"Novel techniques such as Mtell have opened eyes in mining and much more is coming," says Michael Brooks, global director of asset performance management solutions at AspenTech.

"The advent of cheaper sensors and instrumentation with wireless transmission means mineral processing and mining will begin the same evolution in automation and analytical solutions that's already happened in more contained industries."

However, he cautions that the industry is still in a "learning period" and says some players in the market are claiming prescriptive "based on either guesswork or doing more what-if analysis – neither of which are prescriptive".

DIFFERENT APPROACHES

Leading global technology company ABB says prescriptive maintenance in a more applied form – using diagnostics and analytics to find a solution - is also already achievable in modelling solutions such as its Asset Vista Condition Monitoring product.

However, it says this requires taking a more practical approach rather than relying on Al.

"ABB builds models that resemble a digital twin, but which are built from an asset management perspective. Each component is exploded, and examined to see how a part can fail. A signal is assigned to every sensor or variable related to the asset being monitored", says Eduardo Ingegneri, product manager for Asset Vista.

Ingegneri said their solutions leverage ABB's deep domain knowledge of the components, whether from simple parts to much more complicated uses such as in cone crushers and conveyor belts, when it comes to recommending the right solution.

"For this type of prescriptive maintenance, it is only necessary to analyse a short time-frame of data," said Ingegneri.

Using machine learning or AI to prescribe a solution, given the current penetration by IoT, is hard for equipment that is very reliable, as there are simply not enough anomaly data events to work with.

"ABB has worked on this [AI and machine learning for predictive] and continues to, but the main issue is the quantity of anomalies that we need to use machine learning. "It will take 5-10 years of intensive research and development before we get there -Vien Dang, Wenco International"



Mike Brooks, global director of asset performance management solutions at AspenTech



The average metals plant contains thousands of assets capable of collecting and storing valuable data on their actual condition

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The average ► A normal piece of mineral processmetals plant ing equipment can last for years without any issue. How can the system learn a failure process at this stage, if it has never failed?" he asks.

DECENTRALISED FUTURE

Ingegneri said another barrier to wider adoption of predictive maintenance has been the availability, cost and life-span of many sensors that are on the market.

"More than ever now, we are able to convert physical qualities into electronic signals that we can track and process on our devices. But sensors need to be cheaper, more reliable, and last for longer, even in harsh environments."

He adds that there needs to be a deeper hardware integration between the digital world and physical machinery.

"Some sensors come with preprocessing capabilities, but there needs to be more of this and an increased capacity to transmit data quickly and securely. Vibration analysis sensors that require highdefinition signals cannot just be fed straight into a control network – they need to be pre-processed".

So-called 'edge computing', or decentralised processing power, could achieve this. In mining this will take the form of hardware located physically near an object, which will aggregate information from sensors, analyse it, and only then transmit data.

Edge computing is used to process time-sensitive data, while

cloud computing is used to process data that is not time-driven. Besides latency, edge computing is preferred over cloud computing in remote locations, where there is limited or no connectivity to a centralised location.

"Because AI models are evolving so fast – the next step that industry will take towards Industry 4.0 must be edge processing," says Oliveira.

OPEN PLATFORMS

The growing number of solutions and the plethora of sensor options has also led to concerns that the sheer amount of data could become too complex and at times conflicting, creating a challenge for even the most technologically advanced mineral processing operations.

"The mining industry has historically had many departments, so information can often be siloed. Now with the entry of AI and machine-learning, the customer wants access to all data, in a single source of truth," says Barry Henderson, head of strategic alliances at Eclipse Mining Technologies.

"This is a big problem for the industry," says Henderson, whose firm has developed SourceOne, a vendor-agnostic collaborative platform.

"We are going to see a larger push by mining companies to have software solutions across the value chain that present data in a homogenised form, as more and more data is being generated, but customers aren't necessarily getting the insights they should."

MULTI-VARIATE ANALYSIS

Another important step in achieving wider adoption of prescriptive maintenance will be increased use of multi-variate analysis - the observation and analysis of more than one statistical outcome variable at a time - and improved recording of results across different timeframes and dimensions.

The use of wider, contextual and historic data in predictive could even eventually remove the need for manual checks, with operators able to create newer, more efficient processes and servicing regimes. Proponents of prescriptive maintenance say current vibration systems only notify an operator when a component already has damage, which is too late.

"Both multi-variate and temporal analysis are needed so we can examine for minuscule changes in one variable at the same time as many minuscule changes in lots of other variables, and with measured offsets in time" said AspenTech's Brooks.

"These are measured in explicit patterns that humans cannot see. Humans see only three dimensions well and only a little over time – something happens and if you do not see the response in seconds you have lost it ... A machine with 50 sensors that is using machine learning can look at 51 dimensions, where humans only do three. This means patterns can be detected with very fine resolution and much earlier."