# Powertrains and predictions

**Len Eros, ABB Motion, USA,** shows how condition monitoring for powertrains is a good solution for predictive maintenance.

Pressure on the mining industry to make the development of new facilities financially attractive to investors is increasing. Ensuring a profitable operation by maximising productivity is certainly an important part of that process. Prospective ways to boost productivity include increasing production rates, reducing production costs or extending the lifespan of existing assets. The solution to these challenges lies in digitalisation, by integrating data and real-time optimisation of processes across the value chain.

From excavation to transportation to preparation, there is a perpetual need to drive conveyor belts, operate crushers, move or process material, run fans and pumps and a host of other critical tasks. Core to these tasks are powertrains connecting variable-speed drives (VSDs), motors, bearings and gearing. These powertrains are crucial components for

industrial operations. Given the significant impact of reduced productivity and increased maintenance costs, any unplanned shutdowns caused by equipment failure are very costly. Therefore, it becomes critical to keep a close eye on the condition of all electrical and mechanical equipment.

## Historical cost

Historically, the cost of remote powertrain monitoring restricted its use to the most critical applications. A comprehensive monitoring system required a sophisticated installation process, and in many cases, required contracting external specialists. The result was often a project that exceeded reasonable costs and was abandoned.

To avoid the high cost whilst having at least limited information on their equipment health, the industry often opted for annual or bi-annual vibration measurements. Traditional vibration measurement requires physically attaching a discrete-point sensor, such as an accelerometer, to the equipment to collect data. While this avoids high system installation costs, the long periods in between measurements increase the risk of machine breakdowns. There is also an increased safety risk when



Figure 1. Digital solutions that integrate data and real-time optimisation of processes throughout a mine can help boost productivity and reduce unplanned downtime.



Figure 2. Smart sensors (shown here as the white cylinder on the bearing) allow equipment to be monitored in locations which may be difficult or dangerous to reach.

maintenance personnel are working next to rotating equipment to collect the data.

## Digital powertrains and condition monitoring

Sensors have been widely used in discrete industrial networks to measure and report critical variables to a local controller for automation and control tasks. Today, the availability of cloud computing, data analytics and mobile data transmission has paved the way for low-cost, Internet of Things (IoT)-based wireless sensors. These sensors allow for permanent monitoring at a fraction of the cost of traditional condition monitoring systems.

ABB has developed a scalable, digital solution that integrates equipment data with cloud-based analytics along the whole chain of industrial equipment used in mining environments. These range from drives and motors to pumps, gearing and bearings. The solution allows plant operators to improve the performance, reliability and efficiency of their powertrain components which in turn improves system optimisation.

An essential element of the digital powertrain is its monitoring capabilities. Each powertrain – including all its components and applications – sends measurement data to the cloud, which is then visible to the operator on a simple dashboard. Powertrain assets that function correctly show up as green; yellow indicates something that needs to be checked, annd red means that there is something wrong.

This digital powertrain is a customisable approach that improves the uptime, safety and productivity of critical process equipment. Variable speed drives are connected via a cloud gateway, while the motors, mounted bearings, gearing and pumps connect wirelessly with ABB Ability™ Smart Sensors. These sensors measure key parameters from the surface of the equipment, enabling users to monitor operational variables and health indicators. This includes, for example, availability, number of starts, running conditions, temperature, current, vibration and fault events. As a result, maintenance can be planned according to actual needs rather than based on fixed schedules or unexpected breakdowns. In other words, maintenance becomes predictive rather than reactive.

Whether working with multiple applications or just a single one, the digital powertrain offers users a low-cost introduction to digital monitoring. For example, they may have a pumping system that consists of numerous motors and pumps, or an application that is simply a motor and two mounted bearings for a fan. Or, if they are already using a drive to save energy, they can add it to the powertrain to monitor all the assets. This IoT-based solution is the first of its kind to cover the whole powertrain with such extensive monitoring capabilities.

## Smart sensors

Failed bearings can lead to costly downtime, from both lost production and secondary damage. Keeping a check on bearing performance is therefore a critical task. Smart sensors for mounted bearings use the latest algorithms to

assess, manage and ensure performance of components. Smart sensor technology provides an early indicator of potential problems by assessing the condition of bearings from vibration and temperature information. Monitoring a bearing's vibration can pinpoint potential system problems. 80% of bearing failures are lubrication related, and a bearing 'running hot' can indicate proper lubrication procedures are not in place.

The sensor easily mounts to the bearing and communicates wirelessly via a smartphone or other device.  This replaces manually collecting data which can expose employees to safety hazards when they are working around rotating equipment or trying to reach bearings that are difficult to access. With traditional maintenance methods, the user has little visibility of when component failure may occur. The ability to monitor bearings remotely with smart sensors allows the maintenance team to safely get frequent health checks of the bearing without touching the equipment.

## A scalable solution

Scalable digital services for powertrains allow plant operators to tailor their service plan to fit their needs – either from a dedicated web portal or from a cloud interface into their system. It allows them to assess, manage and optimise powertrains without having to be physically present. The most important advantages are improvements in safety, production uptime, use of manpower and a reduction in unplanned downtime.

When it comes to infrastructure and increasing efficiency, operators can receive reports in real-time on reliability, usage patterns, power consumption and loading. This enables full transparency across all assets, and when problems arise, the data collected from the sensors can be shared remotely with powertrain experts. This makes it possible for them to rapidly analyse the situation and make immediate recommendations to solve the issue.

## Data is key

Monitoring the condition of their equipment helps customers move their maintenance from reactive to condition-based, meaning it is only carried out when required. If failure is predicted before the next planned maintenance operation, management can make a fully informed decision to take action and prevent an unplanned shutdown. In some cases, the condition-based maintenance service can indicate that the powertrain components are under less stress than normal and will last longer than expected. Therefore, regular preventive maintenance intervals can be extended to increase productivity and reduce costs.

The bottom-line benefits are highly focused maintenance activities that ensure the highest possible asset reliability and life. The analytics also help ABB to gain useful insight about specific support its customers may require as their operations become more digitalised.

## Case study

The rise of the IoT has created a surge of new interest in machine condition monitoring solutions, and several companies around the world are already using it for optimised equipment monitoring. The Bogdanka coal mine in Poland, for example, is making use of an innovative digital solution that comprises elements of artificial intelligence. The solution connects various systems included in ABB's digital portfolio, as well as other devices and services, culminating in an effective predictive diagnostics program.

## Conclusion

Implementing digital condition monitoring will ultimately result in faster and more cost-effective process and business improvements. With total visibility and optimisation across operations now possible, the coal mining industry is on the brink of its own digital revolution. $W_C$