Water Equipment Show

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How digital powertrains improve condition monitoring to accelerate efficiency, predictability and safety

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Synopsis

A powertrain comprises variable speed drives (VSDs), motors, mounted bearings and pumps. This paper explores how digital technology is transforming the way the condition of mechanical and electrical components of the powertrain are monitored. Harnessing the power of digital puts the end-users, OEMs or maintenance teams in control of unplanned downtime, extending equipment lifetime, lowering costs, safer operations and increasing profitability.

Industry challenges

With the publication of its PR19 methodology, the Water Services Regulation Authority, Ofwat, set out its view of what is needed to ensure a resilient, long-term future for water. Plant resilience and asset health go hand-in-hand when it comes to keeping unplanned outages to a minimum while extracting maximum value out of capital equipment.

Unlike a typical industrial production plant which, although large, is generally confined to one site, a water company can have tens or hundreds of pumping sites remotely located throughout the country. Because of their location, maintaining the powertrain assets across these sites can be a major challenge.

However, the availability of cloud computing, data analytics and mobile data transmission has paved the way for the arrival of digital “smart” sensors. Such devices are changing the way in which pumping station assets are maintained. Now real-time condition monitoring, previously cost prohibitive other than for critical sectors such as aerospace, are at a price point that makes them accessible to the water industry.

Using data to manage asset health

Asset health is affected by thermal, electrical, environmental and mechanical factors, each of which can impact on condition, performance, reliability and life expectancy. Depending on the asset, health is assured through either reactive, scheduled or predictive maintenance.

Reactive maintenance

Reactive maintenance often occurs as the asset is close to failure or has failed. It can lead to unpredicted outages, resulting in extended downtime. The cost of this downtime can prove expensive through output loss, penalties for non-delivery or conformance, reputation loss and other related damage caused by the failure.

Reactive maintenance is, in fact, the most inefficient regime and often results in higher associated costs.

Scheduled maintenance

The most widely used asset management regime is scheduled maintenance, whereby assets are looked after on a time-based schedule. This results in planned outages that use pre-defined spare parts and procedures.

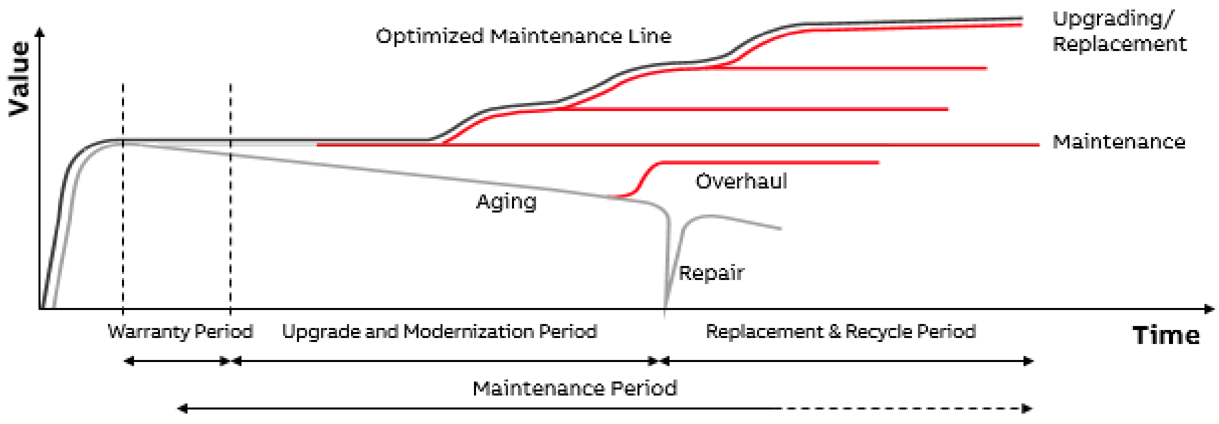
While scheduled maintenance keeps an asset in good working condition and helps to minimise unplanned outages, it can incur unnecessary costs where maintenance is carried out when it is not actually required.

Predictive maintenance

The ultimate in asset health management is predictive maintenance. This is achieved through condition-based monitoring where outages are planned based on the output from monitoring sensors. This leads to minimised downtime and avoids unnecessary service intervention and reduces spares costs. Maintenance teams can now be utilised more efficiently where and when they are needed.

By switching to condition-based monitoring, maintenance is optimised and a site can sweat its assets, extracting the highest possible value in terms of reliability, while reducing maintenance, loss and engineering costs.

How does condition based monitoring reflect on the value of the asset?



Digital powertrain

Being able to predict the operating condition of a powertrain is now possible with the availability of smart sensors, data analytics and cloud technology. The ABB Ability™ Digital Powertrain is one example of a system that brings together hardware, software and services to offer a deep insight into the condition and performance of all elements of a pump system: from variable speed drives (VSDs), motors, mounted bearings and pumps. For the first time all the assets that make up rotating electromechanical systems (the powertrain) can be viewed as a single system.

Each mechanical asset in the powertrain is fitted with a smart sensor. Data from the sensor is relayed back to the cloud for analysis before providing the user with a complete picture of how their asset is performing. Based on this intelligence, maintenance decisions can be made using real time information.

By using smart sensors coupled with data analysis, every component part of a pump powertrain can be maintained to work at its optimum.

Quicker route to remedy

Typically, if a pump suddenly stops in a water treatment plant it may not be clear which part of the pumping system is at fault. This may result in site operators contacting the pump OEM or their maintenance colleagues, who in turn may call the VSD supplier for example, contributing to extended downtime and costs. However, utilising digital powertrain technology, individual pump system powertrains indicate their current status by means of a simple traffic light system. Assets, like the motor, bearing or pump, that are functioning correctly are shown as green; amber indicates a warning condition and that something needs to be checked, while red indicates that something is either in, or heading towards, a fault condition. It is then possible to drill down in to any individual powertrain to identify the specific element that is at fault and so ensure that the correct engineers are contacted to enable a first-time fix.

Digital powertrain technology may have prevented the pump stoppage in the first place. Early indication of the issues would already have been given such that maintenance personnel could have intervened, proactively fixing the issue before an unplanned stoppage ever occurs.

Remote assistance

The deployment of digital technologies also allows a user to request remote assistance on a VSD for example. The VSD manufacturer can allocate one of its experts to remotely interrogate the drive, identify the root cause of any fault and either rectify it or offer best advice so that the on-site team can undertake the repair. This can save downtime, costs of an engineer visiting site and more efficient deployment of the in-house maintenance crew. If the motors, VSDs and pumps are located in hostile environments, surrounded by noisy machines, for instance, then remote monitoring has a beneficial impact on health and safety, removing the personnel from any potential harm.

Barriers to adoption

Cyber security

One of the concerns faced by all industries is that of cyber security. This is especially prevalent in the water industry since the introduction of the Networking and Information Security Directive (NISD) in May 2018. For some organisations this has brought about the integration of information technology (IT) and operations technology (OT) such that common standards and practices can be adopted.

Many companies still have little or no data integration across the value chain. Companies are coming to realise that addressing emerging challenges effectively, means transitioning to an environment which provides remote asset diagnostics, continuous automation and production optimization. This can only happen by embracing the Industrial Internet of Things, cloud connectivity and the smart sensors now available.

There are also many companies reluctant to use cloud technology and preferring on-premise solutions, adopting a “keep data within our gates” policy. This follows a “better safe than sorry” approach which, in effect limits the usefulness of the digital ecosystem.

There is also a paradox that while companies are nervous about connecting smart devices to the cloud via corporate networks, they appear more open to getting the data to the cloud for analysis via GSM modems, for example.

The fact is, the more data we get to the cloud, the better the modelling becomes – the power of data is in the history and this is particularly true when it comes to predictive maintenance.

Standardisation

Much of the data coming from sensors is not standardised or integrated across platforms. Moreover, ownership of, or access to, data between suppliers, operators and contractors is often uncertain. There is a lack of standardisation and, even when data is accessible, it is often too complex or large, obscuring any clear insights. Wherever possible, ABB adopts and adheres to well established international standards such as those set by ISO, IEC and Underwriters Laboratories (UL). Where these standards are ambiguous or too general, ABB develops internal standards that complement the international standards. Its control systems and digital services are built around open standards such as OPC-UA for digital communications, so interoperability between devices in multi-vendor environments is assured.

Culture mindset and talent

Technology and innovation often fail – not through lack of investment or weakness in the technology – but through a lack of cultural change. Tomorrow's digital worker must be engaged and prepared today. It is important that today’s workforce is training in new technologies and to help them embrace and adapt to new technologies and the changing demands of their workplace and roles.

Future opportunities

Digitalisation of powertrains will continue to directly – and positively – impact on the resilience of pump systems. There will be a realisation that cloud technology is necessary and its potential risks need to be managed to reap the benefits of digital powertrain technology. This cloud-based data can also be used to further optimise the wider process by giving deeper insight into plant performance when combined with other pump system operational data.