Smartening Up Old Equipment with IoT

The IoT (Internet of Things) proposes that the Internet will link billions of everyday objects, so that these devices can create and share data through powerful, global cloud computing platforms.

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RESEARCHERS AT GARTNER, Inc. estimate that by 2020 there will be as many as 26 billion devices connected to the Internet. Such a promise sounds grand. But what effect, if any, will it have on maintaining industrial equipment? And why should maintenance managers care?

Maintenance and the Internet of Things

In terms of maintaining industrial equipment, the IoT means having the ability to instantly access data about the condition of industrial products, machinery and components from anywhere. In an unobtrusive way, managers can use the recent advances in wireless communication and data processing to gauge the health of their infrastructure.

Different industries will benefit in diverse ways from using the IoT for maintenance. Table 1 suggests some examples from the world of operations and maintenance, which could offer managers real advantages when using the IoT.

Another example is an IoT solution for retrofitting wind turbines, especially those in remote locations or extreme climates. IoT solutions in cases like these help prevent downtime and reduce the cost of energy.

In fact, the IoT offers a natural benefit for a maintenance manager concerned about the cost and time required to reach and service a wind turbine hub. Reaching these turbines, which are typically 80 meters (262 feet) above the ground and often in remote locations, can require maintenance technicians to travel an hour or more by boat or helicopter to reach the repairs.

Predicting Failure

The battery backup system in a wind turbine is part of the pitch control system that is found in the hub of the turbine (see Figure 1). A 2011 report by Reliawind and recently conducted research by Moog and DNV GL Research identified that the pitch system is the number one ranked component contributing to wind turbine failure and downtime.

The reason is that pitch systems are exposed to harsh ambient conditions inside the rotating hub, including extreme temperature, humidity, and vibration leading to lower reliability compared to other turbine components. Though pitch systems represent less than three percent of wind farm capital expenditure costs, they account for nearly a quarter of all downtime in turbines. While the battery is just one component in the pitch system, it has been found to be a factor, particularly in remote installations.

Finding a way to monitor the health of that battery in an existing wind turbine requires a retrofit solution. Moog engineers have worked with wind farm professionals to develop a solution consisting of dedicated, high-security monitoring hardware and flexible remote connectivity for a turbine's pitch control system.

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Figure 2: **Workers monitor the performance of flight simulators in a 24/7 training centre where uptime is critical and maintenance crews have a four-hour window to perform maintenance.**

This type of solution provides O&M managers with online monitoring of battery conditions for all turbines from a single desktop or mobile device. Once installed by a wind turbine technical expert a system like this can provide routine health assessments of individual back-up battery trays.

In addition to improved safety, less downtime and lower energy costs, a busy wind farm O&M manager will see the benefits of IoT in terms of convenient, secure access to wind turbines that include:

- Automated email and SMS alerts on battery health
- Integrated ordering of replacement battery modules and service visit requests
- Real-time monitoring for other pitch system errors and condition deterioration
- More rapid response and diagnosis by technical experts when there are problems

Better, Faster Diagnosis or Root-Cause Analysis

In the event a wind turbine has an unplanned outage, it is very common for maintenance crews to replace multiple components together during their site visit to increase the possibility of a successful repair, rather than performing a detailed diagnosis and full root cause analysis to determine exactly which component was really at fault.

This means that it is common for fully working parts to be returned for repair unnecessarily. With a health monitoring option like the one described here, maintenance managers have real-time root-cause analysis data on their mobile device and can be equipped with just the right replacement parts before they travel.

Even if you're not managing something on the scale of a wind turbine farm, there are still numerous benefits to IoT for typical operations and maintenance situations. For instance, in a flight training centre, remote monitoring can help maintenance professionals capture usage statistics, forecast spare parts usage and make better use of short maintenance windows. Once a manager has real-time data about a plant's motion control equipment, it becomes possible to consider a new level of predictive maintenance for today's industrial operations.

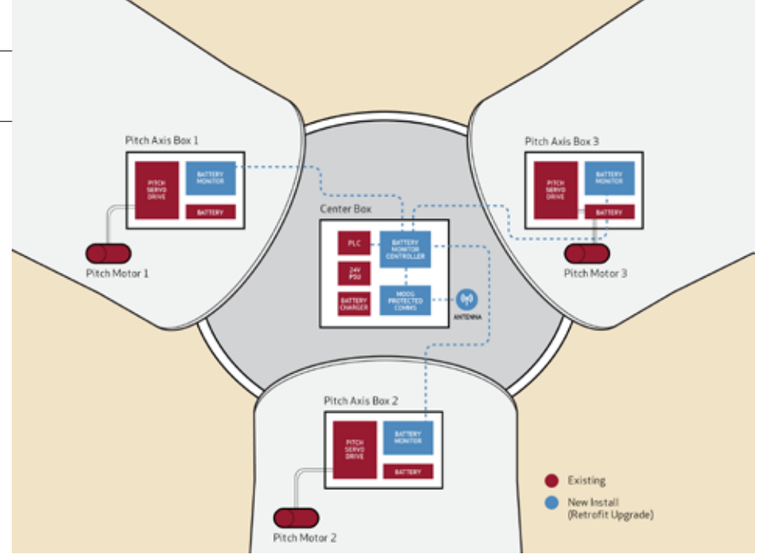

Figure 1: **Cross-section view of a wind turbine's blade and hub showing pitch system and battery backup system.**

Preparing Predictive Maintenance

The IoT helps process the data and give managers insight that was not previously possible. It moves maintenance away from a break-fix mentality. Predictive maintenance is a journey, though. It can take several years to go from a break-fix approach to preventative maintenance and, ultimately, predictive maintenance; it requires:

- A willingness to share data
- The patience to perfect the systems for collecting and processing that data
- The discipline to act on what's being collected

As maintenance managers prepare for the IoT, they will have to adopt a new mindset rather than a new skillset. Because of the low cost of IoT components and the ability to retrofit legacy equipment, there's much that can be done, even on older machinery. For example, a manager can place an IoT monitor on a valve and monitor activity (where the monitor will have no effect on the valve's operation).

They may capture temperature or vibration from a conveyer motor or robotic actuator, or may simply track cycle time variations on reciprocating equipment. Installing retrofit solutions and hardware upgrades like these will benefit the user directly, and can also augment a supplier's service offerings via extended warranty plans or holistic maintenance plans and site service.

Maintenance managers owe it to themselves to explore the potential of the information they can capture with the IoT. They should determine what more there is to know about their equipment and processes. Examining opportunities in this way will help them find the gaps in data and their missing knowledge. ■

IOT: SMARTENING UP OLD EQUIPMENT

IoT sensors on equipment can capture critical "missing" data and provide visibility into existing production processes – particularly where those processes include older equipment
IoT connectivity provides remote adjustment of settings, firmware or performance of machinery with possibility for repairs to take place 24 hours/7 days without visits into harsh environments
IoT platforms provide automated SMS or email alerts to end-users and technical service teams to flag when maintenance or intervention is required
Prediction of the remaining life of a product can optimize the scheduling of maintenance and allow customers to plan for repair downtime
Communication between similar products enables load balancing for increased lifetime
The automated detection of overload, improper use or warrantee-voiding operation of products benefits suppliers and users because machinery reliability is improved and operation is better tailored to the application
The capture of usage statistics and detection of operating patterns facilitates lifecycle analysis, forecasting of spares inventory and improvements to future product designs

Table 1: **Examples of IoT benefits in operations and maintenance.**