Decreasing costs and increasing productivity and profitability in challenging times

by Tim Snyder

It's no surprise that many within the industry are facing innumerable and complex challenges – lean and inexperienced workforces, aging equipment, geographically dispersed assets, harsh environmental conditions, data overload, false alarms, environmental regulations, and tightening capital constraints – to name a few. At the same time, oil and gas companies are being pressured to decrease costs, while increasing profits and improving reliability, availability, safety and overall productivity. The demands can seem insurmountable.

One need only look to industry leaders – the supermajors – for better ways to meet these challenges. Progressive supermajors are facing them head on and succeeding with the help of advanced predictive-analytic technology. They're going beyond their old and limited tools and progressing to a new level of analytics and diagnostics. With predictive analytics, they're detecting impending equipment and process problems well before they happen. They're focusing scarce maintenance dollars and manpower on preventing problems, and at the same time, they're reducing risks. They're safely and efficiently extending maintenance intervals, reducing unplanned outages, decreasing the length and expense of planned outages, avoiding the exorbitant costs of large and catastrophic failures and environmental consequences, and increasing their equipment life spans. In short, they are maximizing operations while keeping equipment operating at peak efficiencies.

In doing so, they're better able to meet demands for increased reliability, availability, productivity, safety and profits. And, they're doing so without risking more expensive problems down the line. All this – without major capital infusions and without increasing labour costs or subjecting their staffs to difficult software or uncomfortable cultural changes.

How predictive analytics works – real supermajor examples

Predictive-analytic solutions look at pumps and compressors as full systems, which include pressure vessels and heat exchangers both before and after the equipment, plus auxiliary equipment, such as seal oil flush systems.

Below are three examples of problems detected early by predictive analytics. These scenarios illustrate how supermajors are able to reduce damage and optimize their maintenance, rather than incur unplanned and potentially hazardous shutdowns and all their costly consequences and risks.

Dangerous seal failure averted

In a hot oil system with a cooled seal flushing loop, SmartSignal predictive-analytic solution was able to detect an imminent seal failure by modelling and monitoring the expected temperature of the buffer fluid. The first indication of the impending failure was a deviation of five degrees Celsius versus the predicted value. This provided an early alert to ensure that the spare pump was in fully operable condition. Nine days after the first alert, the seal flush temperature jumped 25 degrees and the equipment owner switched pumps. When the maintenance staff removed the seal, they found it heavily fouled with coke, and they judged that failure was imminent (Figure 1). By taking the pump out of service before seal failure, the owner prevented spilling any oil and prevented the leak from possibly igniting, as can occur in hot oil service.

Figure 1

Early warning of rider band failure

In another example of early warning, predictive-analytic technology detected equipment damage in a reciprocating compressor and prevented the damage from growing to a full failure.

Looking inside a reciprocating compressor, SmartSignal analyzes both thermodynamic performance and mechanical condition. For mechanical condition, SmartSignal compares patterns of bearing metal temperature, valve cover temperatures, gas temperatures and pressures, and piston "rod drop." Equipment engineers use rod drop to measure the amount of wear in piston rider bands and to enable machinery-protection systems that prevent metal-on-metal contact.

In the case of the reciprocating compressor, SmartSignal was able to provide six months early warning of the rider band failure. The equipment owner decided to use a scheduled turnaround as the opportunity to inspect the cylinder and piston. Figure 2 shows what the owner found: pieces of rider band embedded in the piston face.

Figure 2

Based on finding the debris in the cylinder, the owner pulled the piston and found that the rider bands had shattered into many pieces (Figure 3). The owner believed that there was a high probability of a serious failure had the unit started without repairing the rider bands.

Figure 3

Limiting hurricane damage and preventing a major production loss

Two hurricanes struck the Gulf of Mexico nearly back-to-back in 2008 causing production facilities to shut down for an extended period. Often when equipment restarts after this kind of shutdown, there will be damage, as was the case for this natural gas fueled engine. SmartSignal detected a change in bearing metal temperature on the #4 bearing during re-start after the hurricanes. The equipment owner quickly recognized the potential failure and shut down the engine.

After changing out the main bearing liner, the owner restarted the engine and observed normal operating conditions. By recognizing the minor damage to a bearing liner, the equipment owner prevented a possible crankshaft failure (and fire risk) and avoided an extended outage that would have significantly affected gas sales.

Building competitive advantage through increased reliability

These examples of early detection of equipment and process problems were all made possible by SmartSignal's proprietary, predictive-analytic technology. Unlike other tools that use generalized models, SmartSignal develops models for each individual piece of equipment. And, unlike all others, SmartSignal understands and detects both equipment and process problems and their interactions – across all OEMs, a wide variety of failure modes, and all critical pieces of equipment. These, combined, allow for unequaled early and accurate detections of impending failure.

SmartSignal's predictive-analytic technology is successfully being used in over a dozen major oil and gas installations around the world – upstream, midstream and downstream – on reciprocating and centrifugal compressors, gas turbines, pumps, steam turbines, turbo-expanders, piston engines, blowers, motors, heat exchangers, reactors, distillation columns, fired heaters and more. And, it's being used by over 300 power plants, along with major airlines, to monitor and protect over 10,000 assets and over 2,000 in-flight jet engines.

How predictive analytics complements traditional monitoring tools – and what this means to your bottom line

Most companies have already invested in sensors and an expensive infrastructure – including thermography, vibration analysis, a historian and more. The problem is: these traditional monitoring tools offer too much data and too little intelligence. SmartSignal's predictive analytics makes sense of them all. It works on top of them and analyzes all existing data from all sensors across all OEMs and critical equipment in all modes of operation, and quickly and easily provides the intelligence needed to operate a more effective business model.

Supplementing the technology are engineers in SmartSignal's Availability and Performance Center (APC) who can provide a whole-product solution, or any level of flexible servicing. They can deploy the software, monitor equipment, detect impending problems, and provide customized diagnostics and prioritizations. The APC offers all the benefits of the technology, without any heavy legwork.

The right predictive-analytic solution can be deployed quickly and easily to monitor individual plants or entire fleets across multiple, diverse, remote and harsh geographies and environments. The bottom line: lower costs, increased productivity and safety, and increased profits.

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