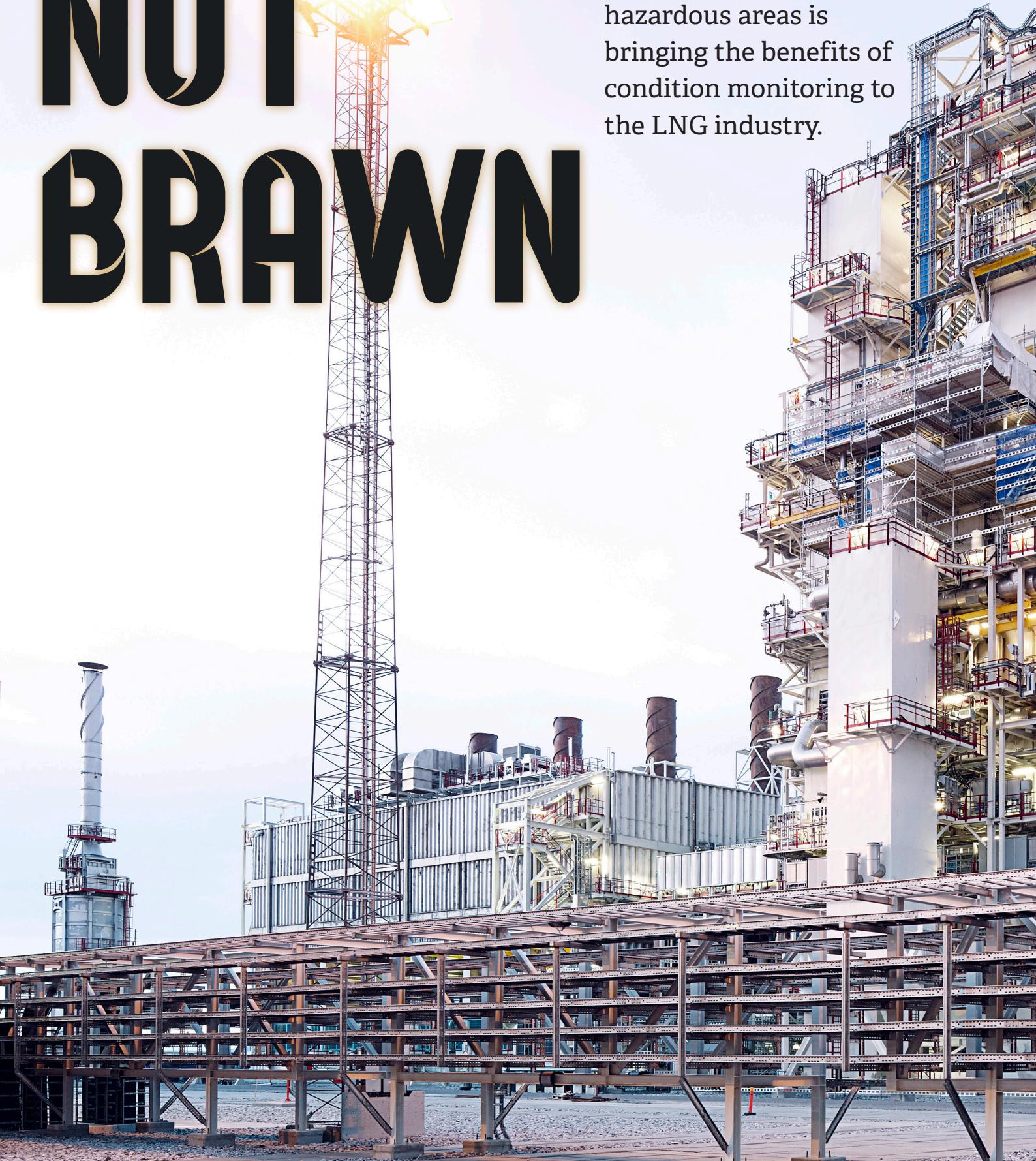


BRAINS NOT BRAWN

Teijo Karna,
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explains how a new
generation of wireless
smart sensors for
hazardous areas is
bringing the benefits of
condition monitoring to
the LNG industry.





As in any sector of the petrochemical industry, ensuring the reliable operation of rotating machinery in the LNG industry is not a trivial task. Pumps, in particular, play an indispensable role in compressing gas to convert it into a liquid for efficient transportation and storage. In addition to pumps, air cooled heat exchangers play a very important role. An average LNG train has 150 - 200 air cooled heat exchangers typically ranging from 22 - 45 kW. They are often difficult to access so remote monitoring is ideal in this application.

Monitoring the condition and performance of pump applications in these extreme operating conditions, often in hazardous areas, is a costly and time-consuming activity. Generally based on a preventive maintenance philosophy, condition monitoring requires maintenance teams to manually gather data, analyse it, and generate status reports. This

Figure 1. Smart sensors for condition monitoring can be applied to a wide range of motors used across an LNG plant.

data is critical to preventing unplanned downtime and production losses, as it offers an insight into the health of equipment.

Thanks to recent developments, the safety risks associated with data gathering in hazardous areas have now been greatly reduced with a new generation of wireless smart sensors. These sensors enable operators to remotely monitor the health and performance of assets such as motors and pumps, to help predict incipient failure.

Where can smart sensors be used in the LNG environment?

Smart sensors can be applied to a wide range of motors used across an LNG plant, such as to pump process water and chemicals and to drive compressors. They can also be used on motors, mounted bearings, and gearing operating fans in air cooled heat exchangers and cooling towers.

The profitability of an LNG production plant is directly affected by the applied maintenance strategy and its impact on plant reliability. Redundancy, for instance, is a common approach to improving the reliability and availability of critical components, but it can sometimes have the opposite effect. When a plant follows a redundancy approach, the maintenance team can change a motor when it fails, but without knowing why it has failed. This means there is the possibility that the other redundant motors will fail for the same reason. Motor replacement can be a lengthy task that



Figure 2. Wireless, battery-powered sensors pick up data on vibration, temperature, and other key parameters that can be used to gain meaningful information on the condition and performance of assets, such as motors or pumps.

can take hours when working in a hazardous area. If a number of motors fail within a relatively short period, then even with redundancy there is a risk of an unplanned plant shutdown and loss of production.

While many LNG plants manually monitor motors once a month or once every quarter, the benefit of using smart sensor technology is that it collects and transmits a high volume of data wirelessly on a frequent and regular basis. This delivers real-time, actionable data that provides the foundation for adopting a condition-based maintenance philosophy, rather than replacing equipment according to its calendar life.

Obtaining the earliest possible warning of a potential issue with a motor ensures that the correct action is taken before it results in failure. The motor might require immediate replacement, or the decision could be taken to reduce the load while continuing to monitor its health through to the next scheduled service shutdown. Equally, knowing the health of a motor might indicate that it is operating well below its full capability, and therefore its maintenance intervals can be extended with no impact on reliability.

The added benefit of smart sensors is that equipment installed in difficult or dangerous-to-access locations can be monitored safely and remotely. That helps keep operators from being exposed to hazardous conditions.

The need for a new smart sensor for hazardous areas

While the benefits of smart sensors have become well established across many industrial applications, their use in the LNG industry has been limited by the lack of cost-efficient and easy to deploy solutions suitable for installation in hazardous areas. This is because any electrical device situated in potentially flammable or explosive surroundings requires compliance with stringent industry standards. ABB's new generation of smart sensors are ATEX and IECEx certified for hazardous areas, with NEC and other certificates to follow shortly.

These wireless, battery-powered sensors pick up data on vibration, temperature, and other key parameters that can be used to gain meaningful information on the condition and performance of assets, such as motors or pumps. The smart sensors offer more monitoring capabilities, a broader communication range, and exceptional battery life, which can be up to three times longer than most competing designs.

The sensors provide reliable line of sight communications over a distance of a few hundred meters, owing to a new antenna design that extends the transmission range by a factor of three to four. The smart sensors communicate with smartphones, tablets, PCs, and plant gateways using low-energy Bluetooth or WirelessHART protocols. The data collected is sent to the cloud where it is analysed by advanced algorithms based on ABB's broad motor expertise gained over several decades.

The sealed-for-life sensors, which carry an IP66/67 rating, can be mounted directly onto equipment with a simple mounting bracket in a matter of minutes. The wireless design is particularly cost effective as it eliminates the cost and complexity of the wiring.



Figure 3. New smart sensors with ATEX and IECEx certifications help keep operators from being exposed to hazardous conditions.



Figure 4. LNG plants may manually monitor assets every month or quarter, while smart sensor technology delivers real-time, actionable data for a planned condition-based maintenance strategy.

Monitoring motor bearings

Having a scheduled maintenance plan does not always guarantee that maintenance takes place appropriately. For example, when motors with hot-running bearings are operating in hazardous areas it may make it difficult for maintenance personnel to lubricate them at scheduled intervals. Instead, this might only take place every second turn, making it challenging to ensure that individual bearings are maintained in the best condition to ensure long life and reliability.

There can also be the possibility that a bearing gets over-greased to make up for skipping lubrication on the previous inspection. This can be just as damaging as under lubrication, since excess grease often results in increased friction and pressure, which raises the temperature inside the bearing. The increased running temperature could actually decrease the effectiveness of the lubricant and result in premature failure.

A crucial upgrade offered by the smart sensors for hazardous areas is that they have greater sensitivity to small changes in the condition of the equipment, including advanced warning of bearing damage. This is due to the incorporation of a 10 kHz accelerometer that can detect

bearing damage at a very early stage with a high level of confidence.

The smart sensor platform allows plant maintenance personnel to get an indication of the bearing's health more efficiently than would be possible through manual data collection. This, in turn, helps to schedule necessary maintenance, improve reliability and safety, and extend the life of equipment, while reducing costly unplanned downtime. This information also helps to predict potential failure sometimes months ahead, enabling remedial action to be taken before breakdown occurs.

A first step in the digital journey

Different LNG processing sites will all have their own specific requirements and challenges. One size certainly does not fit all when it comes to finding a digital solution. Intensifying these challenges is the fact that some plants can be ageing, with only isolated pockets of automation limited to programmable logic controllers (PLCs) and supervisory control and data acquisition (SCADA) systems.

Another challenge is that solutions from different vendors often use different communication protocols, making it hard to bring them together to provide a seamless overview of how the plant is performing. Cost is of course a major factor. Not just the cost of the digital technology but also the cost of implementing it and training staff in using it effectively. Therefore, any digital solution must be easy to deploy and use and show clear benefits under the tight scrutiny given to prospective large CAPEX projects.

One effective solution is to adopt an incremental approach, working with existing automation systems and seeking to reduce the number of isolated islands of control. Ideally, all pockets of automation would be brought together under a single over-arching system. The adoption of open communication protocols will also avoid being locked into proprietary standards that might limit future expansion and upgrading options.

Adopting wireless smart sensor technology is a good first step in this digital journey. The availability of cloud computing, data analytics, and mobile data transmission, has paved the way for the arrival of low-cost, IoT-based wireless sensors that are now suitable for deployment in hazardous areas. With no hard wiring requirements, they allow for permanent monitoring at a fraction of the cost of traditional condition monitoring systems. They are simple to install, and motors can still be running while fitting the sensors. The sensors can even identify energy-saving opportunities that can optimise energy consumption and lower costs significantly.

The digital journey begins with smart sensors

In continuous process plants, such as LNG facilities, a single failure or plant trip can result in substantial production losses. Therefore, any solution that has the potential to improve productivity and safety could make an important contribution to the financial performance of a plant.

Digital technologies that enable enhanced capabilities, such as remote condition monitoring and preventative maintenance, can go a long way to eliminating the risk of unplanned shutdowns. Low-cost, wireless smart sensor technology is the perfect starting point. **LNG**