INTERACTIVE SESSION ORGANIZATIONS

Predictive Maintenance in the Oil and Gas Industry

In a number of industries, improving the productivity of existing assets by even a single percentage point can generate significant benefits. This is true of the oil and gas sector, which is deeply affected by unplanned downtime, when equipment cannot operate because of a malfunction. A single unproductive day on a platform can cost a liquefied natural gas (LNG) facility as much as $25 million, and an average mid-sized LNG facility experiences about five down days a year. That's $125 to $150 million lost. Minimizing downtime is critical, especially considering declining revenues from lower energy prices. Big data analytics can help.

Sensors in oil fields and in oil and natural gas pipelines produce a vast amount of data that can be analyzed for predictive maintenance. McKinsey & Company estimates that a typical offshore production platform can have more than 40,000 data tags. Energy companies have been using oil field sensors to monitor real-time operations status, and now they are starting to use IoT data to predict equipment failure and address issues before they become costly problems. Physical inspection of equipment in remote locations is typically an expensive process. This lack of visibility can lead to equipment failure and costly unscheduled maintenance and nonproductive time, as well as oil spills, leakages, or accidents resulting from failing equipment.

Predictive maintenance tools evaluate the condition of operational equipment and predict its maintenance requirements in order to achieve optimum performance and prevent malfunction. They use automated condition monitoring and advanced data analytics to gather vital equipment statistics such as vibration, temperature, sound, and electric current, comparing them with historical records of similar equipment to detect signs of deterioration. The insights gained from predictive maintenance programs enable decision makers to schedule maintenance activities without disrupting routine production operations and to determine which repairs are the highest priority.

British oil and gas company BP worked with General Electric (GE) in 2015 to equip 650 of its thousands of oil wells with GE sensors linked to GE's Predix cloud platform. Predix provides services for developing and running IoT applications that collect data from industrial sensors and analyze the data in the cloud, providing real-time information to schedule maintenance checks, improve machine efficiency, and reduce downtime. Each BP well was outfitted with 20 to 30 sensors to measure pressure and temperature, transmitting 500,000 data points to the Predix cloud every 15 seconds. BP hopes to use the data to predict well flows and the useful life of each well and ultimately to obtain an enterprise-wide view of its oil fields' performance.

The BP partnership with GE recently produced an application called Plant Operations Advisor (POA) that will further improve the efficiency, reliability, and safety of BP's oil and gas production operations. Plant Operations Advisor will prevent unplanned downtime by helping engineering teams respond quickly to problems as they occur in real time. BP first used Plant Operations Advisor to help manage the performance of one of its platforms in the Gulf of Mexico and will soon deploy this tool to other BP facilities around the world.

GE identified pipeline risk management as a major challenge for the oil and gas industry. There are 2 million miles of transmission pipe throughout the globe, moving liquid oil or gas from its point of extraction to refining, processing, or market. About 55 percent of transmission pipeline in the United States was installed before 1970. Pipeline spills are not frequent, but when they occur, they create serious economic and environmental damage as well as bad publicity for pipeline operators and energy companies. Pipeline operators are always anxious to know where their next rupture will be, but they typically lacked the data to measure pipeline fitness.

GE developed a pipeline-management software suite for accessing, managing, and integrating critical data for the safe management of pipelines, including a risk assessment tool to monitor aging infrastructure. GE's risk-assessment solution combines internal and external factors (such as flooding) to provide an accurate, up-to-the minute visual representation of where risk exists in a pipeline. This risk assessment tool enables pipeline operators to make real-time decisions about where field service crews should be deployed along the pipeline.

Weather has a sizable impact on risk for pipelines in areas prone to seismic activity, waterways, and

washouts. Checking weather patterns along thousands of miles of pipe for rain or flood zones, and integrating those data with other complex pipeline data sets is difficult to perform manually. But by bringing all relevant data together in one place, GE Predix gives pipeline operators easier access to information to help them address areas with the greatest potential impact.

Royal Dutch Shell PLC is using the Microsoft Azure cloud platform and the C3 IoT platform-as-a-service (PaaS) application development platform to monitor and predict where and when maintenance is needed for compressors, valves, and other equipment. Predictive maintenance applications built with these tools are moving into production. One handles equipment performing coal seam gas (gas collected from unmined coal seams) production in Australia, while another helps detect anomalies in downstream valves. Shell is now trying to deploy predictive maintenance technology at tens and even hundreds of thousands of sites and over one million pieces of individual equipment.

Sources: www.ge.com, accessed April 20, 2020; "BP and GE Announce New Offshore Digital Technology with Plans to Deploy Globally," www.powergenadvancement.com, accessed April 12, 2020; "Predictive Maintenance Gains Greater Significance in Oil and Gas Industry," *Oil & Gas Engineering*, May 24, 2019; Caroline Donnelly, "AI and Machine Learning Help to Power Shell's Multi-Decade Digital Transition," *Computer Weekly Nordic*, November 2018–January 2019; Steven Norton, "Shell Announces Plans to Deploy Applications at Scale," *CIO Journal*, September 20, 2019; and Laura Winig, "GE's Big Bet on Data and Analytics," *MIT Sloan Management Review*, February 2016.

CASE STUDY QUESTIONS

1. Why is predictive maintenance so important in the oil and gas industry? What problems does it solve?
2. What is the role of the Internet of Things (IoT) and Big Data analytics in predictive maintenance?
3. How did BP and Royal Dutch Shell's predictive maintenance applications change business operations and decision making?
4. Give an example of how predictive maintenance systems could be used in another industry.

Another example of operational intelligence is the use of data generated by sensors on trains and equipment by SNCF, which operates France's rail services, including France's high-speed rail network. The railway network consists of about 32,000 km (20,000 miles) of route and about 14,000 trains run daily. The sensors monitor data about train speed, engine and train car functioning, and track conditions. SNCF is able to analyze these data to reduce failures and improve the reliability of trains, signals and tracks. Engineers can connect to running trains in real time, enabling the company to figure out if a component is likely to fail, which could lead to a train being taken out of service (Zarembski, 2018; Venna, 2017).

Location Analytics and Geographic Information Systems

Decisions are also based on location data. BI analytics include **location analytics**, the ability to gain business insight from the location (geographic) component of data, including location data from mobile phones, output from sensors or scanning devices, and data from maps. For example, location analytics might help a marketer determine which people to target with mobile ads about nearby restaurants and stores or quantify the impact of mobile ads on in-store visits. Location analytics would help a utility company view and measure outages and their associated costs as related to customer location to help prioritize marketing, system upgrades, and customer service efforts.