avathon.

Case Study

IMPROVING SAFETY BY PREVENTING CRITICAL ASSET FAILURE WITH AI AT THE EDGE

PROBLEM

A large petrochemical company faced increasing costs and additional safety liability from reactive, manual inspection of refinery assets.

PROJECT

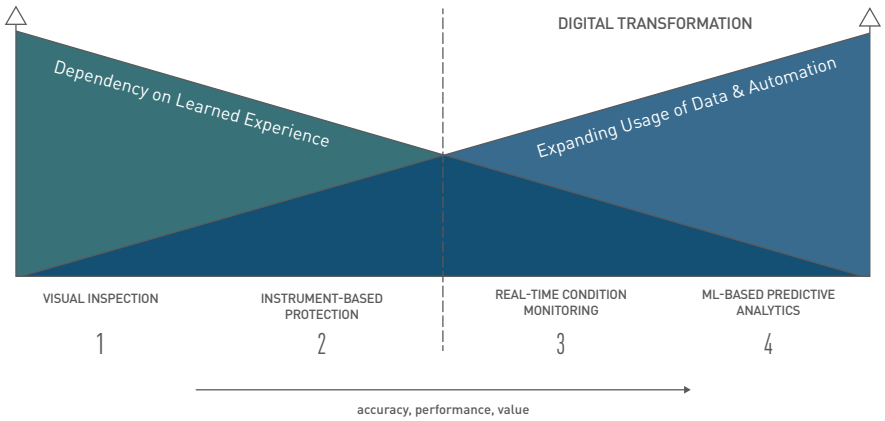
Machine learning-based predictive analytics were applied to improve refinery safety and productivity, starting with industrial pumps.

RESULTS

The new solution identifies precursors to pump failure, allowing operators to avert accidents and plan repairs ahead of time.

Refinery operations by their nature are highly involved, with many moving parts and processes interacting in unpredictable and hazardous environments. Operators' focus is to improve yield and quality of the manufactured products while also maintaining high safety standards for the onsite operators. Getting this mix right is critical for remaining competitive and growing the business. Today, refineries are turning to digitization as a means to enable remote operations and increase safety and reliability across their plants, applying sensors and advanced analytics to pumps, valves, boilers, and other assets.

FIGURE 1: Maintenance and Reliability Maturity



THE PROBLEM

A leading contract manufacturer of specialty petrochemicals that owns and operates a plant in Texas required operations and maintenance teams to monitor equipment manually and through wired sensors at a significant cost in dollars and man-hours each year to inspect on-site equipment.

With a strong, people-focused company culture, the company was looking for ways to increase worker safety, improve efficiencies, reduce costs, and take profitable action. These factors set the company on their digital journey, a project they've branded the "Refinery of the Future." This project is coordinated by the company's system integrator.

For the initial scope of the project, the company prioritized analytics for a vacuum pump on their main production process and a boiler feed water pump that serviced the entire plant, both of which were critical to operations and did not always operate at peak efficiency. Their goals in digitizing these pumps were to monitor them automatically with minimal manual inspection, and to use advanced analytics to identify the various problematic operating states that affect production and accelerate failure.

Wanting to act quickly and execute on this multi-year plan, the company turned to Deloitte to deliver an end-to-end IIoT implementation in late 2017. Over the course of the next two years, Deloitte coordinated the following partners for the project:

1. National Instruments to outfit pumps with sensors that collect operational data
2. Hewlett Packard Enterprises to enable deployment at the edge
3. OSIsoft PI to aggregate the sensor data from the NI sources
4. Avathon to predict impending pump and maintenance needs
5. A leading pump manufacturer to help develop the model and data flow architecture
6. PTC ThingWorx to create a mobile-supported interface

THE SOLUTION: AI ANALYTICS AND APPROACH

Installation of the data acquisition hardware and edge infrastructure was completed in the spring of 2018. For the first time, the company's operations team was able to monitor live pump behavior from wireless sensors and react to impending failures. Avathon could not model the asset behavior with its Industrial AI platform immediately, though, as machine learning models depend on rich, historical data. But within two months of implementation the Avathon Industrial AI platform was able to create accurate asset models.

Once enough data was collected, Avathon data scientists built a model of the pump operating behavior based on features derived from accelerometer, pressure, and temperature data. They initially began with 125 features, and with input from the company's operations and maintenance team, reduced this feature set down to the 70 most relevant to the model's performance. With a still-limited data set and no labeled failure data, the data scientists used an unsupervised approach to train the model. Unsupervised learning finds patterns in unlabeled data so that a subject matter expert can interpret and label them appropriately. In total, the data cleansing, feature engineering, model building, and deployment took just over one month to complete. Another Avathon partner, a leading pump manufacturer, was consulted for validation of the approach.

THE RESULTS

While catastrophic failures are not common, pumps can often shift into problematic operating states that greatly reduce their efficiency and lifespan. Using just a few months of training and testing data, Industrial AI platform successfully identified five different, nuanced operating states for the vacuum pump. Having visibility into the changes of state gives the company's SMEs valuable insights about problematic behavior, helping them identify precursors to failure like misalignment, cavitation, imbalance, and worn bearings.

Another benefit of the solution is the explainability of Industrial AI platform's outcomes. For each operating state identified, Industrial AI surfaced the main contributing features that were most highly correlated. This way, SMEs can better understand why and how the behavior has changed and take steps to minimize the negative impacts on flow and overall efficiency.

Lastly, by continually ingesting new asset data, Industrial AI platform's learning algorithms will fine-tune and improve the model's performance over time, adjusting to the changes in standard operation that occur due to maintenance, repairs, and lifecycle. This will keep the solution's total cost of ownership low and maintain the high performance needed for critical assets.

> *"Avathon's ability to deliver reliable, AI-based predictive analytics helps the people working with and on the equipment to not only know what is happening, but more importantly, what is going to happen, and when. This is a game changer. Not only does this improve plant safety, but it increases productivity by reducing unplanned downtime."*
>
> —Company CEO

NEXT STEPS

Having proven success with the first asset, the company is next planning to deploy data acquisition and Industrial AI's analytics on a boiler feed water pump. Avathon data scientists will use the same methodology to model the pump behavior, but expect to develop the model in less than one week by redeploying the framework developed for the vacuum pump. This deployment further validates the practicality of AI at the edge, enabling the company to conduct safe operations and make better decisions.

ABOUT AVATHON

Avathon, a leader in Industrial AI, extends the life of critical infrastructure while advancing the journey toward full autonomy. Avathon's Industrial AI platform empowers commercial and government customers with scalable, secure, and value-driven solutions that enhance efficiency and resilience across heavy industry.

To learn more about how Avathon's AI solutions can unlock the power in your data, visit https://avathon.com/industries/energy/oil-gas/.