Intelligent Condition Monitoring for Centrifugal Pumps

Digital Twin Starter Kit Enables Predictive Servicing and Energy-Optimized Operation

At a Glance

- Continuous real-time monitoring of flow, pressure, temperature, and vibrations
- Early detection of cavitation, erosion, and wear
- AI-supported data analysis via cloud platform (AWS or Azure)
- Quick commissioning due to automated configuration
- Directly integrated predictive maintenance function
- Higher plant availability with reduced energy and maintenance costs



The Application

Centrifugal pumps are among the most commonly used units in mechanical and plant engineering. They convey liquids using a rotating impeller that utilizes centrifugal force to continuously transport media and build up pressure. Due to their robust design, high efficiency, and suitability for large flow rates, they are used in numerous industries—from water supply and the chemical industry to food and beverage production.

However, centrifugal pumps are exposed to a variety of stresses during continuous operation. Fluctuating operating conditions, changing media, or unfavorable process parameters can lead to cavitation, erosion, or increased material wear. Unplanned downtime causes high costs and impairs plant availability.

The Goal

To ensure reliable and economical operation, the relevant operating parameters must be continuously monitored and intelligently evaluated. The aim is to permanently record flow, pressure, temperature, and vibration behavior, as well as to detect cavitation and mechanical damage at an early stage. Maintenance measures should be planned rather than reactive, while energy consumption should be made transparent and optimized. In this way, overall plant efficiency can be sustainably increased. What is needed is a scalable, easily integrated solution that not only collects sensor data but also converts it into usable information.

Hardware and Software Components



VIM3
12 kHz vibration sensor



ICE2/3 IO-Link master



BTC22
industrial box thin client



aws

Cloud instance
(AWS or MS Azure)



BOSCH
Digital Twin IAPM dashboard

SYNTAX

SAP

Optional: integration in
SAP through Syntax

The Solution

With the jointly developed Digital Twin Starter Kit, Bosch Business Innovations and Pepperl+Fuchs offer a universally applicable system solution that significantly increases machine availability and process efficiency. Specific components, such as 12 kHz vibration sensors from the VIM3 series, precisely measure status data directly at the centrifugal pump. The data is collected via an ICE2/3 IO-Link master and transmitted to the BTC22 industrial box thin client via MQTT.

Bosch's Digital Twin Solution, based on established cloud infrastructures such as Amazon Web Services or Microsoft Azure, analyzes the data in real time. AI and machine learning algorithms recognize patterns, identify deviations, and automatically derive appropriate measures. Optionally, the system can be connected directly to an ERP system so that maintenance processes are seamlessly integrated into existing company structures.

The Advantages

Commissioning the Digital Twin Starter Kit is quick and straightforward. After installing the sensor technology and connecting the IO-Link master, the BTC22 is connected to the network. Initialization and configuration are run automatically. After a short teach-in phase, the continuous transmission of process and device data to the cloud platform begins. The integrated dashboard provides transparent insights into operating state, energy consumption, and plant performance in real time and is accessible from anywhere in the world.

Predictive maintenance takes place right from the start. Early fault predictions enable targeted maintenance planning, prevent unplanned downtime, and reduce operating and energy costs over the long term. At the same time, the service life of the units is extended and plant availability is significantly increased.

Highlights

- High productivity and efficiency: Ready-to-use plug-and-play solution enables AI-supported analysis and optimization in real time
- Significant resource and cost savings through predictive maintenance strategy
- Precise condition monitoring for asset life extension
- Maximum transparency due to wide range of scenario simulations and early detection of anomalies
- Easy scalability and access via cloud platform guarantee maximum flexibility
- Direct integration into ERP systems for fast, demand-oriented spare parts management



For more information, visit: **pepperl-fuchs.com/px-digital-twin**