

# What is Predictive Maintenance?

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Predictive maintenance (PdM) is continuous or periodic monitoring and evaluation of the condition of industrial equipment while it is in use. In Industry 4.0/5.0, predictive maintenance is mainly used on industrial machinery in factories and sometimes on job sites of construction and mining operations.

## How does predictive maintenance work?

Predictive maintenance evaluates the condition of industrial equipment by performing periodic or continuous (online) equipment condition monitoring. Data is received from an array of smart sensors connected to the equipment and to a centralized or decentralized network of hardware and software. The predictive maintenance system is designed to parse out data patterns from interconnected sensor data and predict when maintenance should be scheduled. It is generally performed while equipment is operating normally to minimize disruption of everyday operations in a factory, assembly line, or other industrial settings.

## What are the benefits of predictive maintenance?

Predictive maintenance (PdM) helps manufacturers reduce maintenance costs, extend the life of legacy equipment, and minimize costly downtime. By leveraging machine learning and big data analytics, facilities can make more accurate predictions and lower overall operating expenses.

Common PdM tools include oil analysis, motor circuit analysis, infrared imaging, ultrasonic testing, and laser shaft alignment. These insights enable proactive actions such as inspections, part replacements, oil changes, cleaning, lubrication, and partial overhauls to keep equipment running efficiently.

## What is the difference between predictive maintenance, preventative maintenance, and corrective maintenance?



**Predictive maintenance** is performed on machines and other equipment that are running normally during the course of production.



**Preventive maintenance** tasks are completed when the machines and equipment are shut down and not in operation.



**Corrective maintenance** is performed after the fact, when a defect or problem is detected in machines and other equipment and corrected by maintenance technicians.

## How is predictive maintenance used in Industry 4.0/5.0?

By analyzing real-time equipment and production data, Industry 4.0/5.0 predictive maintenance reduces downtime and prevents asset failures with greater accuracy. Earlier approaches relied on fixed maintenance schedules without sensor-driven, real-time insights.

Adoption of Industry 4.0/5.0 practices varies across manufacturers. Some still follow OEM maintenance intervals, others use basic statistical models, and even advanced sectors such as aerospace and energy often stop at condition monitoring without fully applying AI-driven predictive analytics. When implemented effectively, Industry 4.0/5.0 predictive maintenance extends equipment life, detects mechanical issues early, and generates high-value data to drive continuous manufacturing improvements.