HOW PLANT OPERATORS CAN USE AI TO ELIMINATE UNPLANNED DOWNTIME

GRUNDFOS iSOLUTIONS

PUMP CLOUD SERVICES

In partnership with

AUGURY

EXECUTIVE SUMMARY

This whitepaper explains how advanced monitoring solutions can predict issues in critical production equipment before they occur, helping plant operators avoid unplanned downtime through an efficient and customised, data-based predictive maintenance strategy. Industry intelligence indicates that such solutions can increase uptime by 45%, reduce breakdowns by 75%, lower maintenance costs by 30%, and reduce energy consumption by 20%, helping plant operators optimise efficiency and reach their production goals. In addition to monetary savings and efficiency gains, plant operators can achieve safety and environmental benefits by optimising machine health.

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UNPLANNED DOWNTIME: **A COSTLY AND COMMON ISSUE**

Avoiding unplanned downtime is one of the most important tasks facing the plant operator. If critical production equipment such as cooling pumps or CIP systems suddenly stops working, production must be stopped for investigation, disassembly, repairs, refurbishment, or cleaning. In order to stay within budget, optimise operating costs, and reach production goals, unplanned downtime must be eliminated by ensuring optimum machine health.

Achieving this goal, however, can be a challenge:

No condition data: Without reliable and up-to-date condition data for each piece of critical equipment, it is difficult to accurately assess the status of that equipment, or estimate when it will be in need of repair or replacement. Plant operators are left to base predictive maintenance and service schedules on estimates, experience, and intuition. While this strategy may often work, especially for experienced plant operators, it is not well suited for unexpected situations or equipment issues that occur without warning.

Unprocessed condition data: Even when condition data is available from machine sensors and meters, the raw data must be processed and analysed in order to translate it into actionable insights. Even for seasoned experts, this can be a challenge in complex production scenarios: Many factors need to be considered when trying to deduct the most likely cause of, for example, above-normal pump vibrations, or even just establishing the normal pump vibration range and deciding how much deviation can safely be accepted.

10%

OF GLOBAL PRODUCTIVITY IS ESTIMATED TO BE LOST DUE TO MACHINE FAILURE

Source: US National Association of Manufacturers (2016)

No time for root cause analyses: When issues occur, plant operators may not have the time or the technical expertise to carry out a detailed root cause analysis, pinpoint exactly what happened, and prevent it from happening again. From lighting and HVAC to production automation, cooling systems, and access control, plant operators are responsible for many different types of equipment and have many tasks and responsibilities. As a result, they may not have the time or capacity to eliminate problems permanently but may be forced to push on after a breakdown without being able to prevent similar situations in future.

COSTLY CONSEQUENCES

The consequences of unplanned downtime at a production facility are costly and far-reaching. Examples include the following:

- excess labour and overtime costs, for example due to weekend or holiday jobs
- missed deadlines or quotas
- accidents due to hazardous equipment failures
- increased operating costs
- increased waste or scrap
- reduced productivity and production efficiency

And losses add up: In 2016, the US National Association of Manufacturers estimated that 10% of global productivity is lost due to machine failure.

CONSEQUENCES OF UNPLANNED DOWNTIME

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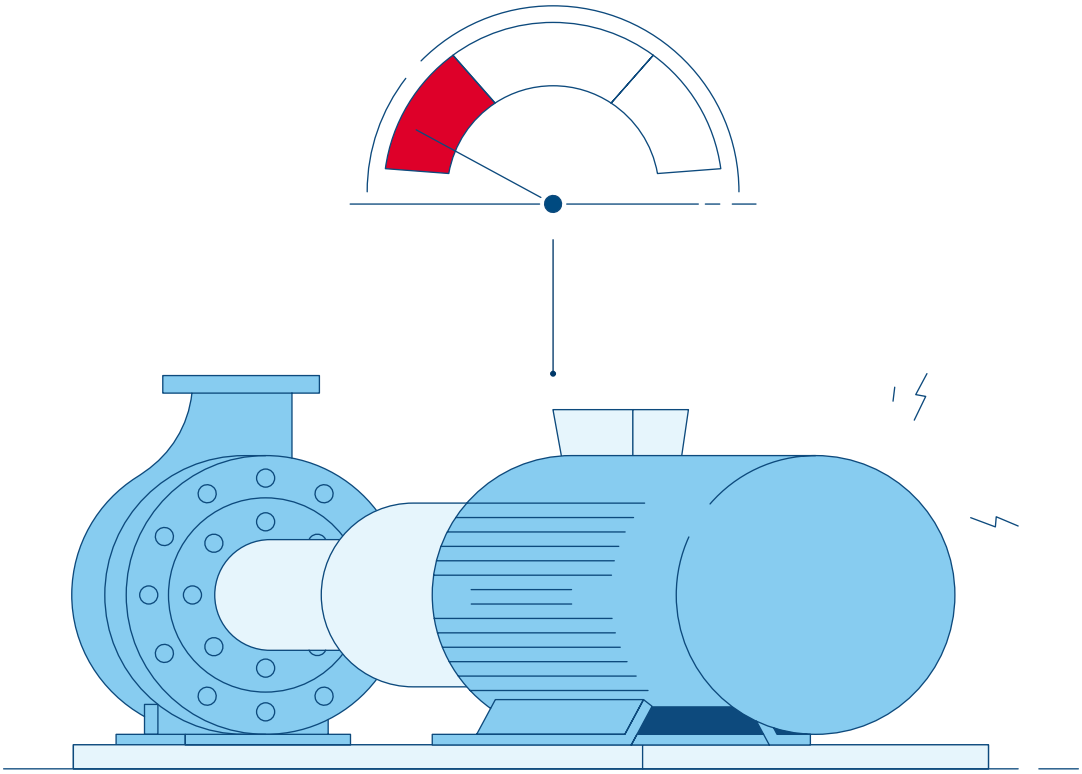
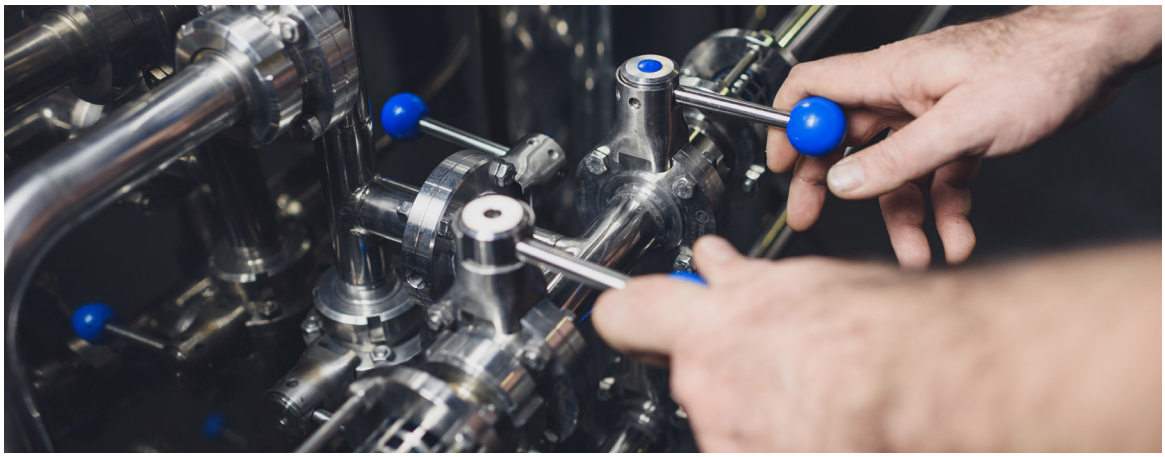


A NEW APPROACH TO PREDICTIVE MAINTENANCE

Run-to-failure and reactive repair are not an option for critical production equipment, and a predictive maintenance strategy is therefore required in order to prevent production disruptions. There are several ways of gathering the data required to develop such a strategy and ensure that critical equipment is serviced, maintained, or replaced in a timely manner.



MANUAL MEASUREMENTS OR SENSOR READINGS

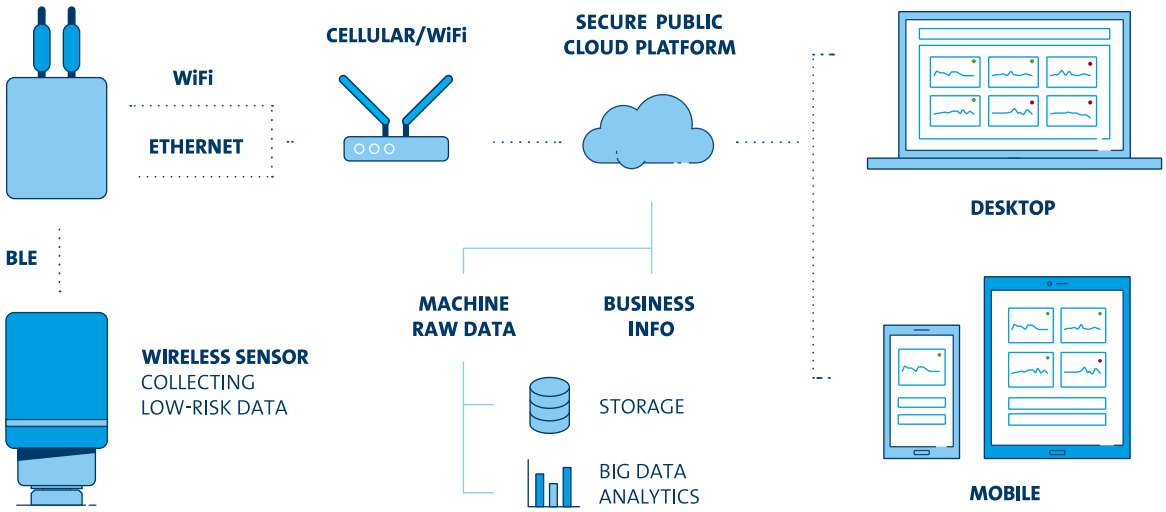
Traditionally, the two main approaches are the following:

1. Taking manual measurements as required, based on manufacturer recommendations and staff experience with onsite equipment. This is a flexible approach that can quickly be customised to current needs, and it delivers immediate results. It can be difficult to access and investigate critical equipment installed in complex or hazardous environments, and the approach requires staff with sufficient knowledge of production equipment to gather adequate and complete data. However, the approach is well suited for relatively small or non-complex installations with few pieces of critical equipment installed in non-hazardous environments.

2. Relying on data from the critical equipment. Production equipment (or the controllers used to handle that equipment) is often fitted with sensors or meters that constantly monitor operating status. Basing predictive maintenance on data from these sensors or meters has several benefits: It can provide highly accurate and detailed data, it does not require manual access to hard-to-reach or hazardous equipment, and it does not require highly experienced in-house staff. The main drawback is that abnormal sensor readings may merely trigger a warning signal with no further details of what the problem is, exactly where it is located, and what the cause may be. In other cases, the raw data may be quite detailed and require analysis and interpretation. In addition, the approach requires the equipment or controllers to be fitted with sensors or meters; if the equipment does not have such sensors, they must be installed.

PREDICTING FAILURES BEFORE THEY OCCUR

In recent years, advances in sensor technology, cloud computing, and artificial intelligence (AI) have paved the way for a third approach that allows plant operators to **predict and avoid equipment failures before they occur.** Predictive maintenance and service schedules can be based on up-to-date condition data from critical equipment, and plant operators, even non-experts, can take remedial action before minor issues develop into production disruptions.

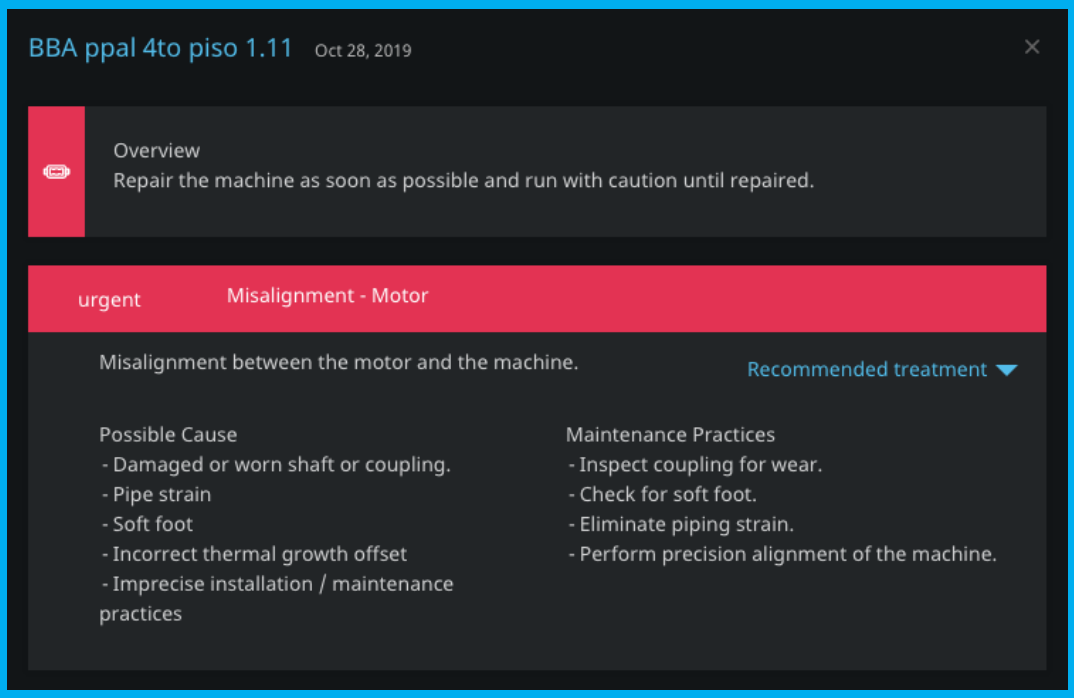


Such solutions generally include four major components:

1. **Advanced sensors** that collect data which can reliably predict breakdowns or suboptimal performance, for example RPM, vibrations, and surface temperature.
2. **A cloud computing solution** that securely stores the recorded sensor data, makes it available for analysis and reporting, and provides the processing power needed.
3. **AI algorithms** that analyse the sensor readings and convert them into actionable insights. The AI compares millions of historical asset operating hours. This vast collection of background data on vibration signatures, RPM, and surface temperatures is compared to the specific asset. If the algorithms detect deterioration or faults, an alert is automatically triggered by the solution which is then verified by a human expert.
4. **Workflows and reporting tools** ensuring that alerts can be acted upon and resolved in a rapid and efficient manner. Alerts are usually delivered over the phone or using text messages or online portals. Dashboards display machine health status at asset, plant, and portfolio level, allowing users to uncover systemic health issues and to benchmark and improve machine health across the entire asset portfolio. All findings and discussions are stored and shared for future reference.

EXAMPLE:

If a pump bearing vibrates more than usual or the bearing temperature rises, the sensors immediately record this. The sensor readings are transferred to cloud storage and then analysed by the AI to see if they are early signs of bearing failure. If the analysis shows that the plant operator needs to take action, for example because the likely cause is misalignment that will shortly cause the pump to fail, the system alerts the operator of the issue. By acting on early indications, and by providing a description of the most likely cause so that the operator immediately knows where to look, the system has greatly reduced the time needed to find and rectify issues.



Example of alert from an AI-driven solution. The plant operator is alerted in clear language with sufficient detail and accuracy to take remedial action

ONE UNIFIED PLATFORM

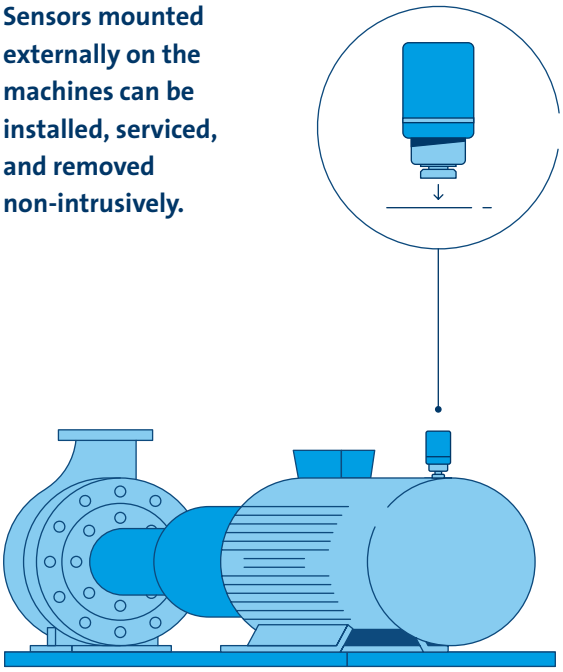
The ability to automatically gather data and translate it into insights on behalf of the plant operator is a significant improvement over both traditional predictive maintenance approaches:

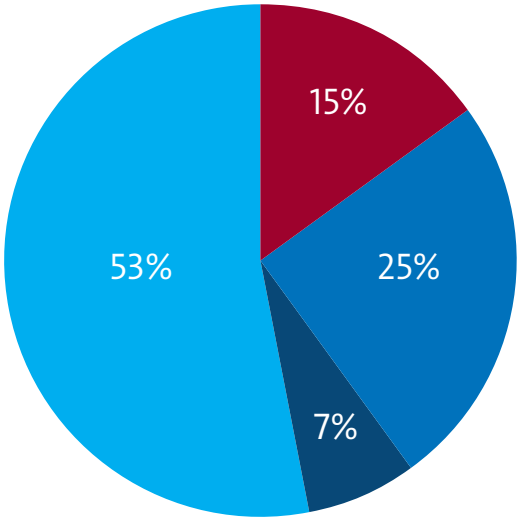
Manual readings are not required, and once the sensors have been installed, there is no need to access the critical equipment, except when sensor readings indicate that it is in need of service or repairs.

There is no need to spend time and resources analysing raw sensor data; the AI algorithms do this automatically, rapidly, and constantly. Maintenance schedules can be tailored to actual operating conditions instead of the manufacturer's generalised recommendations.

An AI-driven monitoring solution requires sensors to be mounted on all pieces of critical equipment. Some solutions are based on advanced tri-axial vibration sensors that are mounted externally on the machines and monitor all necessary parameters by recording vibrations, magnetic flux, and surface temperature. This means that such sensors can be installed, serviced, and removed non-intrusively, making it possible to install and commission the solution without lengthy production shutdowns, and without adversely affecting asset integrity or voiding the manufacturer warranty. As the advanced sensors can usually be mounted on any type of rotating mechanical equipment, the solution can provide the plant operator with a general overview of all critical equipment on one unified platform.

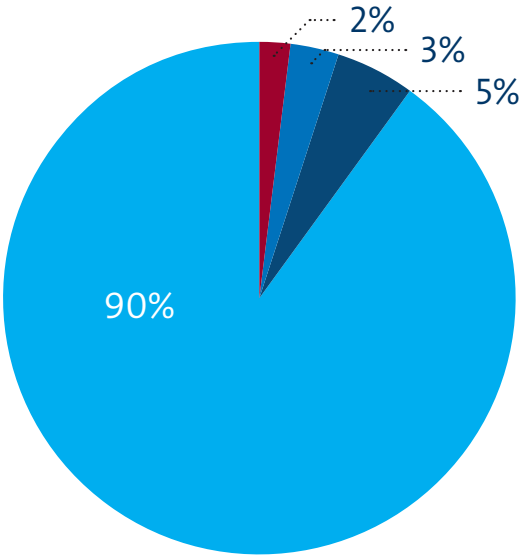
Sensors mounted externally on the machines can be installed, serviced, and removed non-intrusively.





BEFORE IMPLEMENTATION

Typical image of machine park without predictive maintenance.



AFTER IMPLEMENTATION

Result over time, when systems and processes are optimised

Acceptable Monitor Alarm Danger

Based on experience and real installation data across facilities.

DOCUMENTED SAVINGS AND QUICK ROI

The use of advanced technology means that implementing an AI-driven solution generally requires a larger investment than opting for the two traditional predictive maintenance approaches. As such, they are generally best suited for large, complex, or critical installations, or installations with hazardous equipment. However, the sensor-based insights delivered by such AI-driven solutions have proved able to reduce downtime and maintenance costs at such installations, resulting in quick ROI while ensuring uninterrupted production:

FACTOR 250

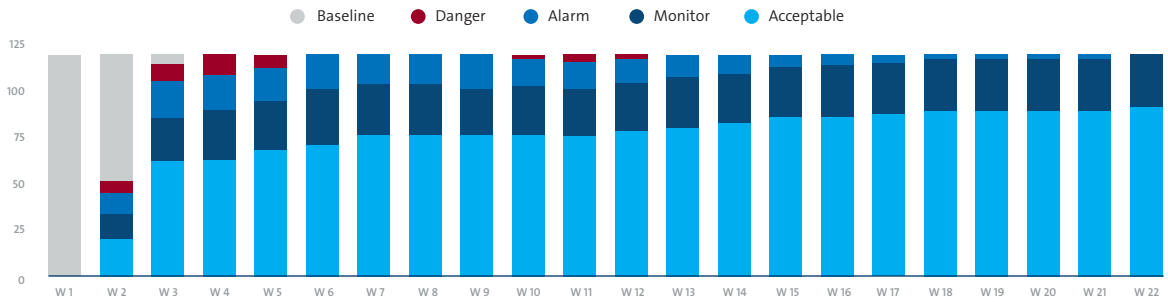
EARLY ISSUE DETECTION BY AN AI-DRIVEN SOLUTION RESULTED IN SAVINGS OUTSTRIPPING REPAIR COSTS BY A FACTOR OF 250 AT A GLOBAL LEADER IN HEALTHCARE AND BABY FORMULA PRODUCTS

USD 280,000

AT A FORTUNE 500 BEVERAGE MANUFACTURER, EARLY FAILURE PREDICTION BY AN AI-DRIVEN SOLUTION PREVENTED PRODUCTION LOSSES OF APPROX. USD 280,000

A bottle filler at a **Fortune 500 beverage manufacture**r began showing signs of rapid deterioration, bearing wear, and gear friction during a busy period shortly before Christmas. The root cause of the problem was determined to be an outboard motor bearing, and this component was subsequently replaced during a period of planned downtime at the end of the year. Had it not been prevented, the bearing failure would have resulted in the loss of over 60,000 bottles of water per hour. At an estimated 5 days of downtime, this would have cost the manufacturer approximately USD 280,000.

An AI-driven solution detected early signs of bearing wear on a fan unit in a dryer system at a **global leader in healthcare and baby formula products.** The company was subsequently able to replace the bearings, preventing estimated losses of USD 100,000 (motor replacement costs and lost production combined). By comparison, the motor repair cost the company USD 400; the savings thus outstripped the repair costs by a factor of 250.



The learning process for an AI-driven solution. Within weeks, the solution allows onsite staff to virtually eliminate alarm and danger conditions at the facility, reduces mechanical downtime, maintenance costs, and inventory costs and contributes to avoiding safety and environmental risks

30-50%

REDUCTION OF MECHANICAL DOWNTIME

10-40%

REDUCTION OF MECHANICAL COSTS

20-50%

DECREASE IN COSTS FOR INVENTORY HOLDING

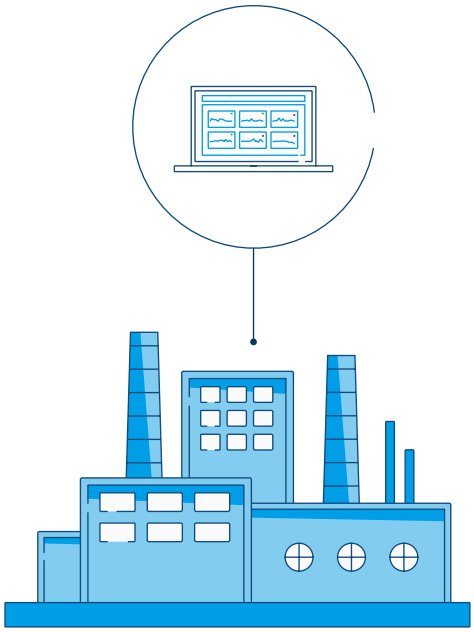
AVOIDED

SAFETY AND ENVIRONMENTAL RISKS

CONSIDERATIONS WHEN SELECTING AI-DRIVEN SOLUTIONS

While it is possible to develop, implement, and run AI-driven solutions internally, this requires high-level sensor expertise, advanced IT skills, considerable workflow experience, and in-depth knowledge of the installation and all critical equipment in it. It is therefore recommended to acquire a solution from a reliable third-party partner, for example on a subscription basis. There are two main benefits to this approach:

- Plant operators can use internal resources for other value-added tasks and free up capacity for focusing on their core business
- Subscription-based solutions necessitate no further CAPEX and do not result in more onsite equipment to manage



THE IMPORTANCE OF CHANGE MANAGEMENT

A third reason for working with an external partner is that implementing an AI-driven solution can be a challenging task. These solutions have the potential to drastically transform the organisation's maintenance strategies and daily tasks. Such transformations are often considered to be 80% people and only 20% technology; in other words, the organisation's readiness to accept and carry out the transformation is key, for example because in-house maintenance staff may be required to work in a different way or handle new tasks, such as acting on early warnings issued by the solution.

It is therefore recommended that the plant operator works actively with change management in order to prevent or overcome staff resistance and drive adoption and advocacy of the new solution. The introduction of a new solution should always be tailored to the organisation's structure and culture, and feedback from staff involved in working with the solution should always be considered carefully and taken into account in order to ensure staff engagement and commitment.

Working with an experienced partner with a proven track record of successfully implementing AI-driven solutions through onboarding and training can help the organisation towards successful adoption.

ACHIEVING UNINTERRUPTED PERFORMANCE

AI-driven solutions provide a great degree of predictability in the facility and allow plant operators to increase the mean time between failures and work-order compliance. They allow plant operators to eliminate unplanned down-time and reach their most important goals:

- staying within budget
- optimising operating costs
- reaching production goals

SIGNIFICANT AVERAGE SAVINGS

Grundfos business intelligence shows that on average, AI-driven solutions have increased uptime by 45%, resulted in 75% fewer break-downs, lowered maintenance costs by 30%, and reduced energy consumption by 20%.

AVERAGE SAVINGS WITH AI-DRIVEN SOLUTIONS

45%	MORE UPTIME
75%	FEWER BREAKDOWNS
30%	LOWER MAINTENANCE COSTS
20%	REDUCTION IN ENERGY CONSUMED

Source: Grundfos business intelligence

The savings made possible by the solutions enable plant operators to quickly recover their investment, further improving the financial performance of the facility after ROI has been achieved. In addition, they can reduce onsite inventory because they can stock fewer spare parts as a result of a more efficient predictive service and maintenance strategy.

IMPROVED SAFETY AND ENVIRONMENTAL PERFORMANCE

Optimised production equipment provides two additional benefits:

1. **Improved workplace safety:** When the risk of sudden equipment failure is lowered, and when there is no need to go near equipment unless service and maintenance are necessary, the risk of injuries to workers is significantly lowered as well. By eliminating unnecessary man-machine interactions, AI-driven solutions contribute to better occupational safety, especially in installations with hazardous equipment. In addition, the ability to remotely see the likely cause of equipment issues helps maintenance staff prepare for service and repair jobs in advance. This improves employee satisfaction and retention.
2. **Improved environmental performance:** When equipment is running as efficiently as possible, and energy consumption is therefore reduced, the facility's carbon footprint is minimised. As well-maintained equipment also tends to last longer, the organisation's green profile is further strengthened because equipment does not have to be replaced prematurely.

TALK TO OUR EXPERTS AND GET A FREE DEMO

We are ready to help you eliminate your unplanned downtime. Our experts in machine health will be happy to discuss with you the specific options for your company and help you improve uptime, reduce breakdowns and maintenance costs.

Book your meeting

GRUNDFOS Holding A/S
Poul Due Jensens Vej 7
DK-8850 Bjerringbro
Tel: +45 87 50 14 00
www.grundfos.com

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