



moneo|PatternMonitor

Detection of unwanted changes
of single critical process values.





Introduction

The ongoing digitalisation of industries poses challenges for companies in monitoring and controlling their production processes.

One of the significant difficulties is the reliable monitoring of critical process parameters such as temperature, flow and vibration. In modern production plants, enormous amounts of sensor data are continuously generated through manual monitoring, which is not only time-consuming but also highly error-prone. Early detection of anomalies and undesirable process changes is crucial, as unplanned machine downtime can lead to massive financial losses.

Recent studies show that the world's 500 largest companies lose around 1.4 billion dollars a year due to unplanned downtime, which equates to 11% of their total revenue. In heavy industries, the cost per hour of downtime is around 59 million dollars - 1.6 times higher than in 2019¹.

Added to this is the increasing shortage of specialised maintenance personnel. Companies encounter the challenge of implementing complex monitoring systems that work reliably and can also be operated by less specialised employees. The loss of expert knowledge due to staff turnover also makes it necessary to use systems that can automatically recognise and evaluate anomalies without relying on years of experience.

These complex challenges require innovative solutions that are both technologically mature and user-friendly. In addition, it can also be smoothly integrated into existing production environments.

Der moneo|PatternMonitor is an intelligent and innovative AI-based solution for monitoring stationary and continuous processes. It identifies structural changes and enables early warning in case of anomalies in individual critical process parameters such as temperature, flow, and vibration, allowing appropriate measures to be initiated in a timely manner.

¹ The true cost of downtime 2024: a comprehensive analysis, AEMT 2024
<https://www.theaemt.com/resource/the-true-cost-of-downtime-2024-a-comprehensive-analysis.html>

Your solution: moneo|PatternMonitor

The moneo|PatternMonitor represents a pioneering solution in the field of industrial process monitoring and was designed as an intelligent assistance system.

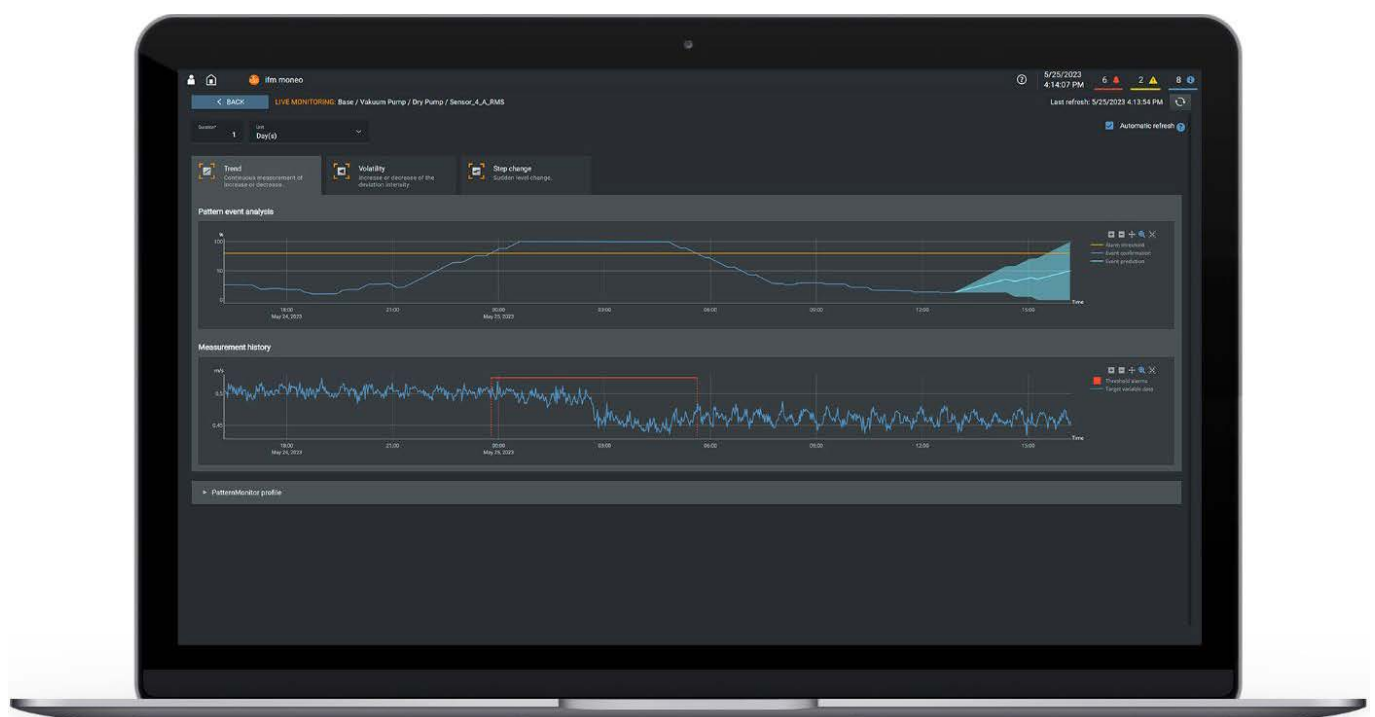
The system uses a combination of different machine learning algorithms and AI technologies that make it possible to capture and monitor the individual 'fingerprint' of a machine or process.

Particularly important is the no-code approach, which allows users without data science knowledge to implement and control complex monitoring systems. The technology is based on advanced statistical methods and continuously analyses three critical pattern types: **Trends**, **volatility** and **step change**.

Thanks to the intuitive user interface and the integrated 5-step wizard, users can get the system up and running quickly and easily without having to deal with complex programming or data analysis.

The scalability of the system enables the monitoring of a wide range of process variables - from individual machine components to complete production lines. The self-learning algorithms automatically adapt to process changes and ensure continuous 24/7 monitoring without manual interaction.

The intelligent filtering of false alarms and the automatic adaptation of monitoring parameters ensure a high level of reliability in anomaly detection. The flexible system architecture also allows integration into existing production environments. Also an easy expansion to include additional process variables into the system is possible, so that companies can gradually expand their monitoring systems.



Monitoring the pattern types

The moneo|PatternMonitor enables the automatic detection of anomalies, unwanted characteristics and critical process variables such as temperature, flow or vibration.

The software checks whether the change behaviour of a critical process variable corresponds to one of the specified patterns using statistical methods (see right).

This allows the behaviour of the process variables to be continuously monitored and abnormalities to be automatically evaluated, assessed and output. Various configuration options are available to the user.

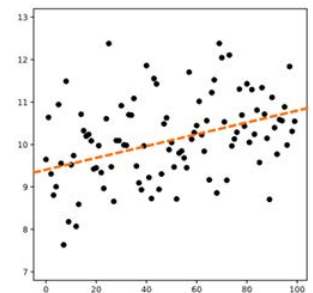
Explanation

The moneo|PatternMonitor continuously searches for patterns (anomalies) in the running process in order to recognise unexpected deviations at an early stage. It analysed the structure of the data of a critical process value statistically for the presence of a trend, a change in volatility or a change in level.



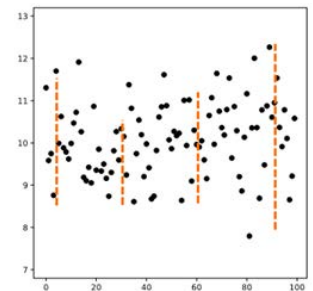
Trend

Continuous measurement of increase or decrease.



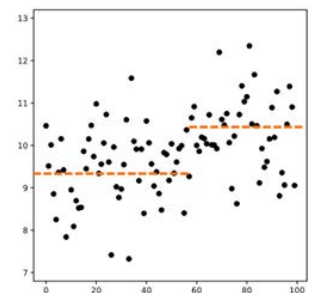
Volatility

Increase or decrease in fluctuation intensity.



Step Change

Sudden abrupt changes.





Use Case: Monitoring a vacuum pump

Vacuum pumps play an essential role in industrial applications and must always be in optimum operating condition to ensure the quality, efficiency and long-term durability of the machines. Components are often replaced either too early or too late, which leads to increased costs. Monitoring systems are used to minimise these costs.

In the following case, the monitoring system consists of:

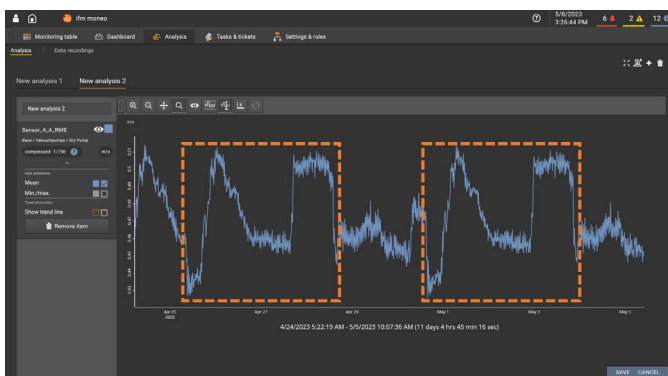
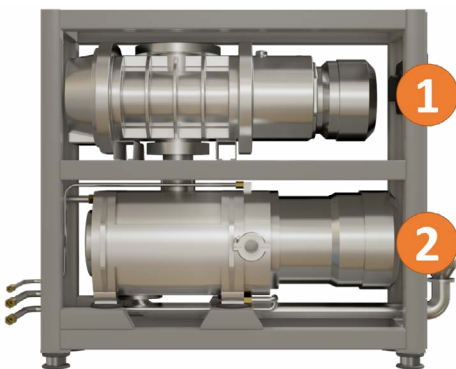
- **vibration sensors**
(each on the booster pump and the dry-running pump),
- **diagnostic electronics,**
- and the **moneo|PatternMonitor**

The vacuum pumps consist of a booster pump (1) and a dry-running pump (2). To ensure optimum production conditions, they require maintenance or component replacement every 6 to 12 weeks.

During operation, the pump runs through a stationary process in which changes in patterns (trend, volatility or step change) indicate possible damage to the system at an early stage. Such structural changes are signalled by warnings or alarms. The vibration value "a-RMS" of the dry-running pump serves as the target value.

To check the suitability of the data and ensure that a process is stationary, it should be analysed in advance.

A typical discrete course is repeated, but fluctuates within the cycles. The graph on the left illustrates this behaviour.



The 5-Step Wizard of the moneo|PatternMonitor

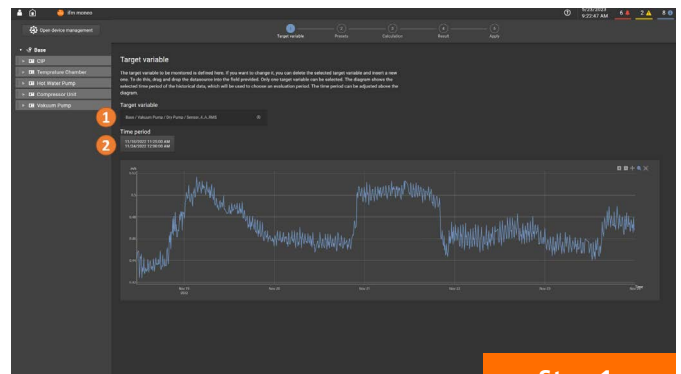
The moneo|PatternMonitor tool can be opened via the „PatternMonitor“ icon on the home screen. In the topology, select the corresponding target variable and then start the setup wizard via “Start wizard”.

Step 1: Selection of target variables and historical data

This first step involves:

- selection of the critical process variable/target variable to be monitored (1), which represents the core process
- definition of the time interval (2) for the historical data

Care must be taken to ensure that only data in the normal operating state (good or normal state) is included and that all relevant operating states (e.g. on/off/neutral) occur in the selected time period.



Step 1:

Step 2: Presetting the pattern recognition

This step offers two configuration options:

1. Basic presets (Basic Mode):

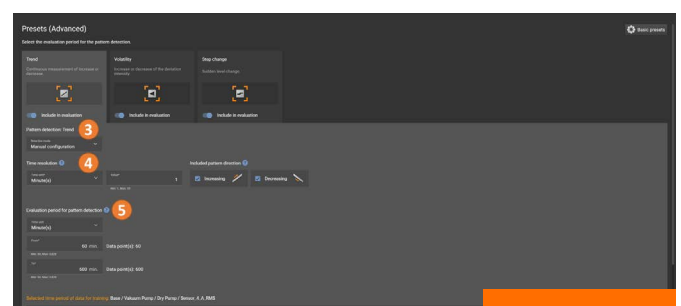
- selection of the evaluation period (1) (day, week or month)
- automatic mode, in which the AI independently determines the optimum combination of evaluation period and time resolution

2. Advanced presets (2) (Advanced Mode):

- option to activate or deactivate individual pattern types (3)
- definition of the pattern direction
- manual configuration mode, in which individual settings can be made:
 - the time resolution (4)
 - the evaluation period (5)



Step 2:

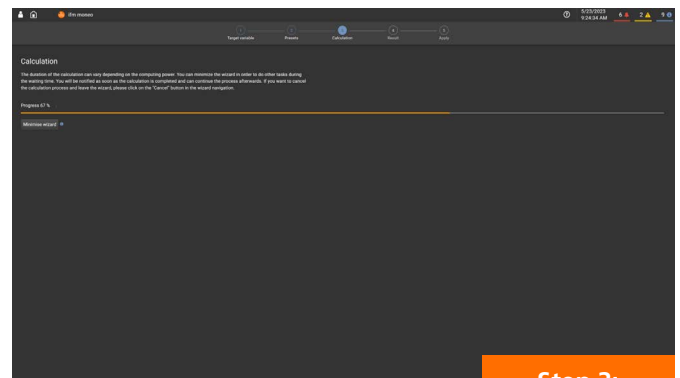


Step 2:

Step 3: Calculation and evaluation

In this phase:

- a profile is calculated based on the settings made
- the event confirmation for the evaluation periods of the individual patterns is determined
- the probability of a pattern occurring is calculated



Step 3:

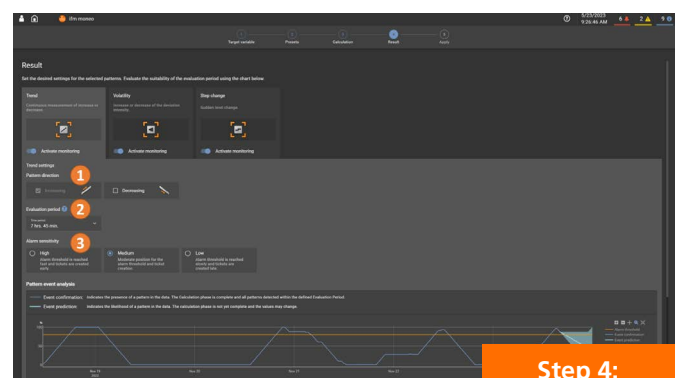
Step 4: Configuration of pattern recognition

This step includes:

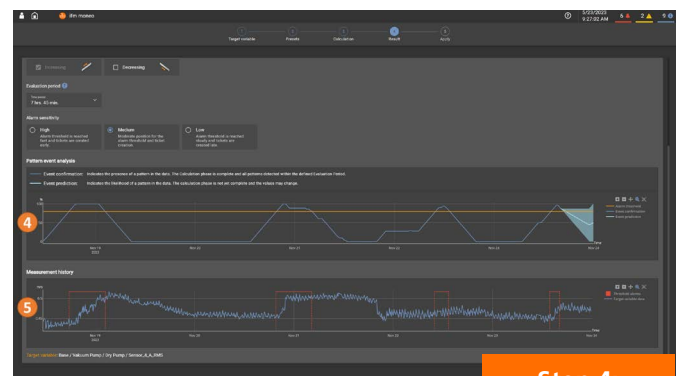
- the display and configuration of the patterns based on the calculation results
- defining the pattern direction (1) and the evaluation period (2)
- setting the alarm sensitivity (3) to three levels (high, medium, low)

Validation by:

- Event analysis: Shows the event confirmation (blue) and the alarm limit (orange) (4)
- Measurement history: Visualises target variable data (blue) and generated threshold alarms (red) (5)



Step 4:

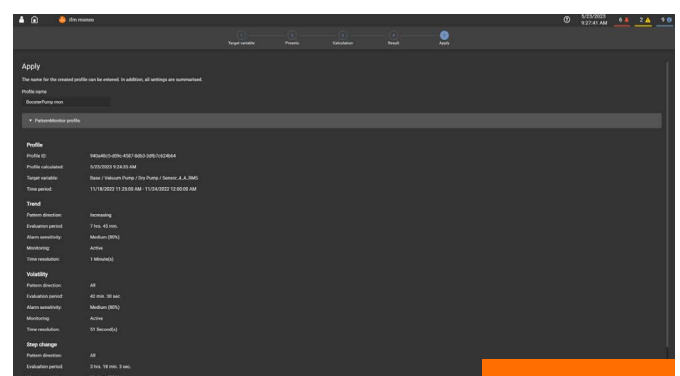


Step 4:

Step 5: Verification and activation

In the final step:

- all defined configurations are summarised
- a profile name can be assigned
- the profile is created and activated
- it is recommended to call up the live monitoring to validate the behaviour of the PatternMonitor in live operation

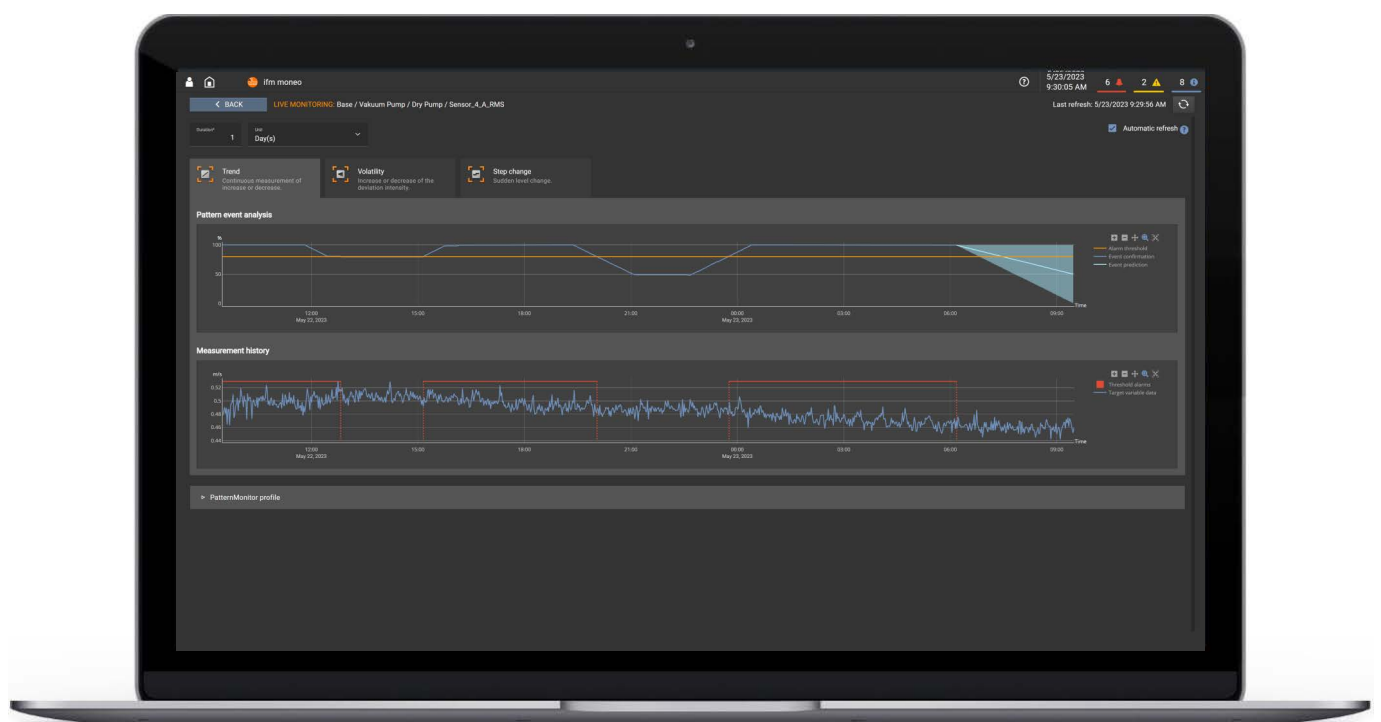
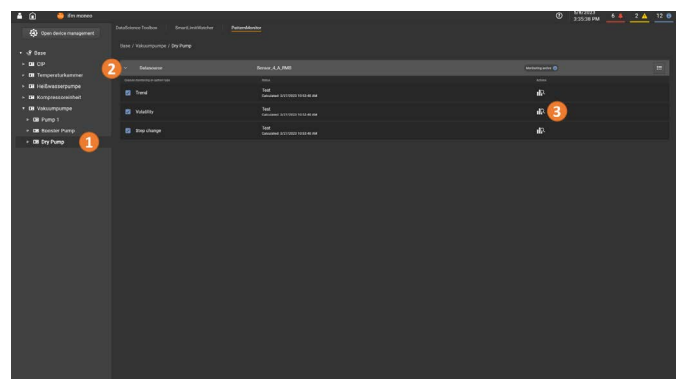


Step 5:

Live monitoring of the moneo|PatternMonitor

The moneo|PatternMonitor can be opened via the 'Pattern Monitor' icon on the start screen. The corresponding node (1) can be selected in the topology and the data source (2) can be opened. The individual patterns can be called up and monitored live via the 'Actions' column (3).

The display of the live monitoring corresponds to the view described in step 4 of the wizard.



Further tools of the moneo|Industrial AI Assistant

The moneo|Industrial AI Assistant is an integral part of the moneo|IIoT Insights software add-on and therefore also of the moneo|IIoT Core. The Industrial AI Assistant currently includes the AI software solutions moneo|SmartLimitWatcher, moneo|PatternMonitor and moneo|LifetimeEstimator, which are used for anomaly detection and in the field of predictive maintenance.

			
	moneo SmartLimitWatcher	moneo PatternMonitor	moneo LifetimeEstimator
Features			
Anomaly detection	✓	✓	X
Predictive analysis	X	X	✓
Usage of one measured value	X	✓	✓
Usage of several measured values	✓	X	X
Pattern identification	X	✓	X
Dynamic alarm and warning thresholds	✓	X	X
Prediction of the remaining useful life	X	X	✓
AI/ML technology	✓	✓	✓

