WHITEPAPER

Condition monitoring as basis
for planned maintenance

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ENGINEERING TECHNOLOGY

CONDITION MONITORING
as basis for planned maintenance

Industrialisation started with the steam engine, and over the decades we have now entered the fourth round of industrialisation. Machines are intelligent and cross-linked to each other. Information is collected in real time and processed and evaluated via artificial intelligence (AI).

A central task of Industry 4.0 is to further increase machine availability and output quantities based on digitisation solutions. Collecting, saving and evaluating various machine and system data as well as creating a digital twin are the prerequisites for comprehensive maintenance concepts. Data is the resource of the future. An optimised, condition-based maintenance strategy requires permanent monitoring, also known as condition monitoring. The intelligent and communicative protection and power distribution solution of the REX system (fig. 1) helps collect data in a targeted way for the DC 24 V range - the heart of each automation solution.
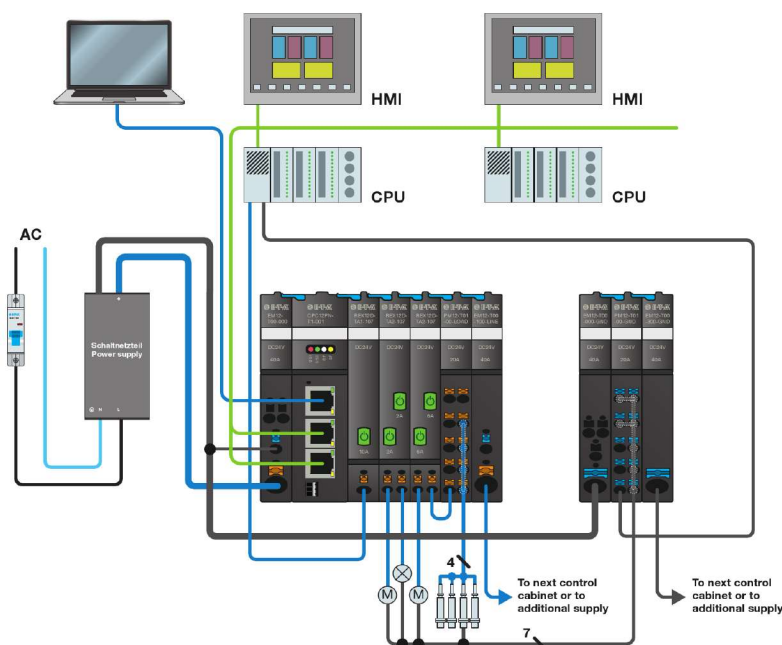

Fig. 1: The intelligent and communicative protection and power distribution solution of the REX system helps collect data in a targeted way for the DC 24 V range – the heart of each automation solution.

What maintenance approaches do we know today?

In general, we differentiate two main maintenance approaches. In addition to conventional maintenance in the event of a failure, machine operators are increasingly using planned maintenance approaches. At first glance, reacting only in the event of a failure seems easier and is also supposedly the more cost-saving method. But if you look more closely, unexpected downtimes may quickly lead to very high costs. Comparably longer downtimes due to more difficult troubleshooting and the current bottleneck for spare parts in the procurement market have a massive influence on the choice of the maintenance strategy.

We differentiate three main approaches of planned maintenance, which is the prerequisite for increased machine availability (fig. 2).
Preventive Maintenance is the easiest solution mainly based on empirical values and specified maintenance intervals.
Condition-Based Maintenance primarily works with current measuring data. The machine condition is permanently determined and monitored. Condition monitoring systems provide all essentially needed target and actual values. In case of a deviation, a message is issued.
Predictive Maintenance combines both previously mentioned maintenance approaches and calculates a forecast from a multitude of different data and empirical values using AI. The supreme discipline of the system is the forecast on which components fail and when. The result is used to precisely plan maintenance tasks and derive a specific maintenance strategy.
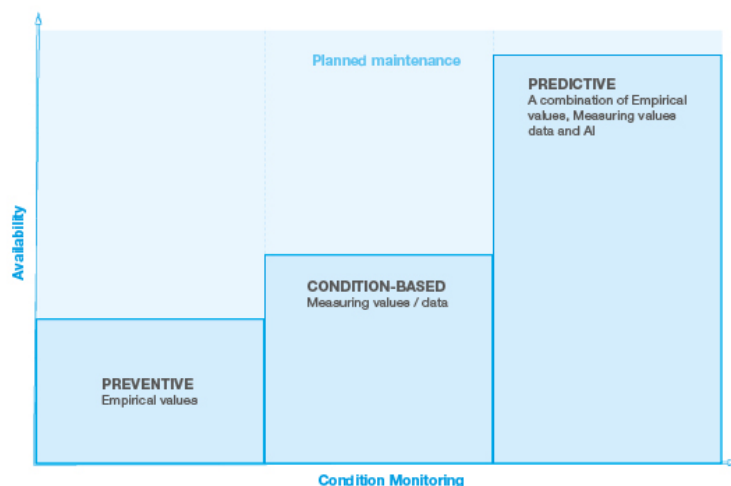

Fig. 2: Planned maintenance is the prerequisite for increased machine availability.
Condition monitoring systems provide measuring values and data.

Artificial intelligence, the Industry 4.0 flagship

Artificial intelligence (AI) means all applications where machines or computers perform human-like intelligence tasks, also including machine learning. It is not supposed to replace human personnel with machines, but to simplify the daily tasks in a meaningful and supportive way by providing such technology.

Important!

There is not only "one" AI, but strong and weak AI. Strong AI should be similar to human intelligence or even surpass it, which is still a dream of the future.
A weak or methodical AI processes a specific problem, why it is mainly used for process automation, for image and voice recognition and processing.

Condition Monitoring and its benefits

In the industrial area, machine maintenance is often done preventively in order to keep downtimes to a minimum. Machine components subject to wear and tear are replaced in determined intervals to prevent failures. This strategy does not efficiently use the component's typical life, which makes it quite costly.

Therefore, more and more machine operators prefer using planned maintenance concepts to decrease maintenance costs by using special Condition Monitoring systems. These systems permanently monitor the machine condition and provide the necessary data for a planned maintenance by detecting the actual degree of wear and tear. This helps plan maintenance actions for the end of the typical life and decrease maintenance costs.

Using intelligent Condition Monitoring solutions offers some benefits. Improved process stability leads to increased machine availability and to an increased output quantity. Early detected deviations or determined wear in applications are prerequisites for a sustainable optimisation of all maintenance actions.

Digital protection with Condition Monitoring

For a digital connection to the superordinate control unit, machine operators rely on fieldbus capable solutions. Instead of the Ethernet-based PROFINET, EtherCAT, Ethernet-IP and Modbus-TCP fieldbus connections, fieldbus-independent IO link point-to-point communication is increasingly found in control cabinets.

The REX system provides the basis for a planned maintenance. The DC 24 V Condition Monitoring solution combines selective overcurrent protection, compact power distribution of load circuits and transmission of measuring data via ControlPlex® controller (fig. 3).

Fig. 3: The ControlPlex® controllers transmit measuring data to the superordinate control unit.

The controllers are capable of all conventional communication protocols and transmit various diagnostic information for the DC 24 V range to the superordinate control level. This includes information on input voltage, load current, load voltage and threshold values as well as various setting options, such as workload warning thresholds in percent.

The measuring values and the continuous transparency are prerequisites for Condition-Based Maintenance (fig. 4). The measuring values gained during system start-up are the basis for the target and early-warning threshold values. The currently determined actual values are compared to the basic measuring values and in case of a deviation, an error message is displayed. These measured values in an intelligent algorithm - the AI - combined with the machine operator's experience and with various raw data generated in the machine, provides the basis for Predictive Maintenance.

Fig. 4: The measuring values and the continuous transparency are prerequisites for Condition-Based- and Predictive Maintenance