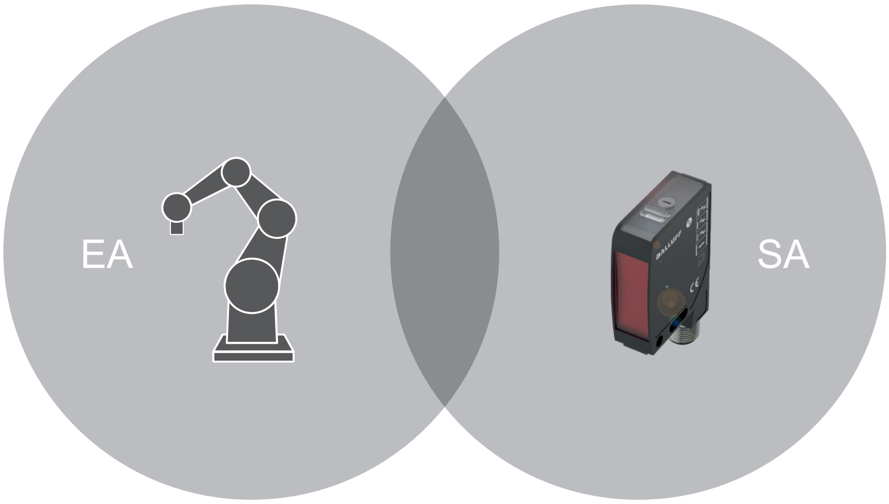
Continuous Condition Monitoring

CONDITION MONITORING



Condition Monitoring

The term Condition Monitoring (CM) is used variously depending on the source. Whereas automation component manufacturers mean function monitoring of sensors, systems builders and software creators are referring to monitoring of the surroundings.

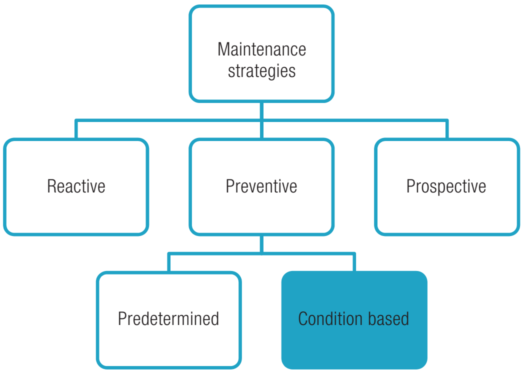
At first glance these points of view do not seem to be compatible. But upon closer consideration taking functionalities into account, it becomes clear that both definitions have parallel validity.

CM is the continuous monitoring of the condition of a machine or component.
Seen this way CM forms a parenthesis around individual and area monitoring and machine and component monitoring.

Continuity
CM does not necessarily require real time monitoring or transmission. Depending on the variables to be monitored, there is a corresponding cycle for each application in which the data are gathered and transmitted. Both cycles may be different, such as when continuous (real time) monitoring of a vibration is needed in order to detect anomalies but the values have to be pre-processed and transmitted only at certain intervals.

Another example is slowly changing variables, such as temperature. Here the transmission cycle can be several seconds or even minutes.

Maintenance Strategies



Maintenance strategies

In reactive maintenance, faults or failures are eliminated when they occur. This approach is usually associated with high costs, both in terms of personnel and machine stoppages. It is therefore suitable only for absolutely non-critical cases, such as a burned out light bulb.

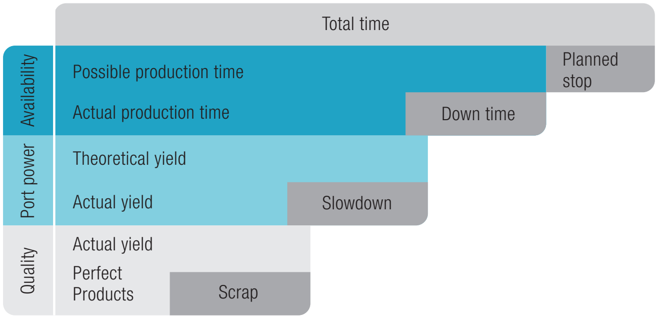
Prospective maintenance, or predictive maintenance, predicts when a maintenance action will be needed. It requires unique modeling, continuous monitoring of the entire application, and self-learning analysis techniques.

Today's most often practiced approach is predetermined maintenance. Here components and systems are maintained at prescribed intervals before a failure occurs. Possible drawbacks to this strategy: high replacement part costs due to incompletely used component life expectancies or machine stoppages for incorrectly performed maintenance.

With condition based maintenance, sensors monitor the system and its components to provide a view of the current condition and need for maintenance.

Since a sensor system for condition monitoring represents additional components and thereby costs, a combination of predetermined and condition based maintenance is often applied.

Overall Equipment Effectiveness



Overall Equipment Effectiveness

The Overall Equipment Effectiveness is a function of availability in percent, performance in percent and quality in percent.

According to Nakajima (1980) there are primarily six types of loss:

Failure time:
1. Equipment failure
2. Setup and adjustments

Slow cycles:
3. Idling and minor stops
4. Reduced speed

Scrap:
5. Startup difficulties
6. Quality defects

Failure time due to faults has a great effect on maintenance. Depending on the application, stops for unplanned maintenance and resulting scrap production in the startup time cause enormous losses since the system potential cannot be utilized.

This potential is exactly what condition monitoring seeks to exploit.

Self Awareness, SA

Self Awareness (SA) means that a product monitors itself and its condition – including the surroundings, i.e. the overlap shown in the illustration on page 1.

Life condition detection
Simplest example: a traditional, PNP normally open inductive 3-wire sensor. Without an existing target it would not be possible to say whether the sensor is functioning or is defective. For the BES04FK inductive sensor. However, IO-Link makes it possible to determine this precisely.
In a system with multiple inductive sensors this makes the following scenarios conceivable:

1. Sensor defective
Although a sensor is no longer communicating and is reported as defective, the system can keep producing. A replacement can be planned at the next opportunity.

2. Failure of multiple sensors at a splitter node
Multiple sensors fail at the same time at a splitter node. Causes could include a cable break at the splitter node or a defective splitter node.

3. Failure of multiple sensors at multiple splitter nodes
This is probably a high level cable break or even a power failure in parts of the building.

The response to each of the three situations must be different. Since the user can draw some direct conclusions about the condition of his system, he assigns action priorities accordingly.


Inductive switching sensor BES M12

Contamination
Devices with IO-Link also have the ability to communicate additional data. It is possible, for example, to detect a component aging such as the LED condition of an optical sensor and to display this to the user. Another example from optical switching sensors is the emissivity, i.e. the portion of the light which the reflector sends back to the sensor. If a change is measured, there may be contamination in play which necessitates cleaning of the sensor.


Photoelectric sensor BOS 21M ADCAP

Temperature footprint
Most devices these days have a microcontroller installed which records device-internal parameters and thereby allows calibration. A sensor for example records the internal temperature and passes this on to the user as a reference value. One must bear in mind, of course, that the internal temperature of the device can also change when it draws current or when it is damped. Only with additional information can one make an approximate statement about the ambient temperature.


Inductive measuring sensor BAW M12

Environmental Awareness, EA

A product which has the ability to monitor changing ambient variables makes Environmental Awareness (EA) possible.

If you want to determine changes in the temperature of a system or in the vibration of the motor, you need additional components that offer this monitoring function. A device with a defined primary function such as detection of a target or collecting various data sources is not sufficient here. Rather, gathering of the ambient variable which needs to be monitored should be the primary function of the device.

Put another way: the main task of a thermometer is to record the ambient temperature, and a pressure sensor is used primarily for recording pressure in an application.


Pressure sensor BSP

Virtual sensors
Many variables and conditions can be measured either with an additional component or be derived with the help of the already existing sensor. Connecting multiple measurement values into one gives you a virtual sensor.

Example: The inductive sensors mentioned in the "Life condition detection" section behave like a virtual wire break sensor, and the optical sensors mentioned in the "Contamination" section like a virtual contamination sensor.

Examples for Condition Monitoring

Heartbeat®

In industrial power supplies like the BAE00TH, Balluff has integrated condition monitoring which reports load level, stress level and lifetime to the user directly via LEDs.

The functional safety of power supplies rises and falls with the capacitors. Their critical variable is temperature so microcontrollers monitor the temperature on capacitors and other components. Together with the load and a model stored in the power supply, the result is a useful life estimate.

MOLD ID

Mold ID is used for automatic documentation of tool usage via RFID and reduces unplanned stoppages. A separate shot counter records all production cycles. All the data is available on a data carrier either directly on the mold or on the multi-coupling. In this way you always know the condition and the life cycle of the tool at a glance, directly on the machine.

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