Predicting a failure or remaining lifetime of a component is the typical target of Predictive Maintenance. Although many highly experienced maintenance technicians have developed an intuition for an individual machine and can sense the condition and its development, they shouldn´t take the role of a fortune teller. They should be experts and leaders making good decisions based on reliable information provided by Predictive Maintenance. This knowledge is very valuable for setting up a predictive maintenance solution with human senses being replicated by sensors and guessing being modeled by rules and algorithms. Choosing the right sensors is the base for a reliable predictive maintenance solution. In this article, we explain how to get the right data with the right choice of sensors.

The right sensors for Predictive Maintenance: Finding the balance between costs of measurement and sensor benefits

In today's world it is expected that a sensor is not a cost driver in maintenance. Every smartphone is equipped with GPS, one to three photo lenses and sensors for fingerprint, acceleration, rotation, barometer, brightness, and a microphone. And the best: you can get it for 200 € or less. Many times, we have been asked by customers why not utilizing a smart phone in our predictive maintenance solution to benefit from the endless features and low costs. A great idea! However, it is impossible to match the industrial requirements with those of a commercial smartphone as dust, dirt, high temperatures and humidity are challenging people and machines in the heavy industry. Thus, the use of robust, industrial sensors is necessary, and this comes at a higher cost.

Consequently, you need to decide for the essential measurements you require for your prediction. Being in a trial and test phase you can install as many sensors as you have brainstormed for. At the stage of a standard implementation, however, you need to reduce the number of sensors to the absolute necessary. Finding sensors is nowadays not a big deal: You will find sensors or measurement systems for nearly every task. It is all about finding the right sensors which meet your specific requirements. Especially if the return on investment (ROI) or net present value (NPV) of your solution doesn't fit your company's expectations, the technology remains nice to have or a dream.

Define the target you want to reach with Predictive Maintenance

It is highly recommended to consider your target you want to reach with Predictive Maintenance: If vibration on your motor, pump or gearbox is a minor or no problem at all, don't go for an installation of sensors or Predictive Maintenance. The installation of a sensor is easy, but the added value will be zero if it is not solving the defined problem or helping you to reach your goal. If you have no target to reach, Predictive Maintenance won´t help you any further.

So, the very first task is to define the target you want to reach with Predictive Maintenance. Ask yourself which pain you want to release, or which gain you want to achieve. To do so, you may use the classical FMEA methodology (Failure Mode and Effect Analysis) or you may analyze the breakdown and maintenance history of the machine in question. You may as well interview your maintenance technicians to understand which of their senses they use to monitor the machine – what is the base of their intuition?

Review the feasibility of known measurement and sensors

In a second step you must review the feasibility of known measurement and sensors, such as the following:

- Vibration via piezo or MEMS accelerometer
- Sound pressure via microphone
- Motor current via transformer
- Temperature via RTD, thermocouple or infrared thermography
- And many more

If none of them fits your requirements, you may be forced to go for an individual development. The involvement of a specialist company is strongly recommended as regulations and required certificates are typically overwhelming. Cooperation with universities or technical institutes could be another way to develop the required sensor. Considering the timeline of a sensor development (1-3 years) and costs, the utilization of existing sensor technologies must be the first choice.

Sensor connectivity: Wireless, wired bus or wired signal?

Having chosen the measurement and the sensor, you need to decide for the technology to connect your sensor to your data acquisition system. If you are free to choose the connection method, you have the agony of choice:

- Following the current trends on the sensor market you are invited to go for a **wireless**, battery powered sensor. With this technology, you benefit from zero cabling. However, your will be limited in terms of battery lifetime and wireless range considerations. Therefore, it is important to carefully check the battery lifetime in relation to the frequency of measurement and data transmission.
- Considering the promotion of many sensor suppliers, you may go for an **IO-Link**

Which sensor for which application?

Advantages and disadvantages of sensors must be balanced considering the field of application. Below you find some examples:

- **A new and compact machine in a dust free and 30°C environment:**
  Wireless sensors are a feasible option because distance between sensors and router is no problem and sensors are easy to reach for battery replacement. IO-Link is another option because of the ease of sensor connection and field bus connectivity to the existing control system.

- **Existing machines in dusty and hot environment, many different and legacy acquisition systems to be interconnected:**
  Sensors with 4 ... 20 mA connectivity may be selected to ensure failure free connection to any data acquisition system, independently of its age and brand.

- **Industrial plant with standard IO systems based on Profibus and Modbus:**
  If there is a local standard, you have often no choice but selecting a sensor complying to the standard. However, you may find a compromise using IO-Link with an IO-master supporting your local fieldbus standard, or the same with wireless sensors and related interfaces.

communication. This is based on SDCI (single-drop digital communication interface for small sensors and actuators) and is basically a point-to-point communication between sensor and your acquisition system. With this you will benefit from the newest technology including remote configuration and monitoring, simple device replacement and advanced diagnostic.

- Talking to your automation engineer, you may be asked to use an existing **field bus** (like Profibus DB) to get the sensor data connected to the process control system or SCADA, be it by copper or wireless. It is a well-known and proven technology being used for almost 30 years. Thus, there are many applications and products supporting this technology.
- Listening to your instrumentation technician, you will go for the **classical 4 … 20 mA signal** as this is the easiest technology to be managed. It is well known, easy to apply and can be managed by using a screwdriver and multimeter. No programming nor IT knowledge is required to get this running and it can be applied worldwide.

Advantages and disadvantages must be balanced considering the field of application, already used technologies and competence level of your staff.

Questions to find the right sensors for Predictive Maintenance

Target

What do you want to achieve with Predictive Maintenance?

Sensor & Data

Which sensors and data do you need to reach your target?

Requirements & Feasibility

Which requirements do your sensors need to fulfil? Budget? Functionalities? Environment?

Smart Sensors – the added value of its edge logic

Many suppliers have introduced sensors with on the edge logic. You will find these mainly in the field of vibration or acceleration measurements for rotating machines. Thanks to their predefined algorithm and databases on bearing, pump or motor design, the build-in knowledge gives you alarms and warnings right from the beginning without additional programming or tuning of algorithms.

Replace your crystal ball with sensors and predictive maintenance solutions

Once you have identified Predictive Maintenance as a pain killer for your operation, the right selection of sensors for the measurement and connectivity will be important to successfully reach your targets. It is crucial to consider the environmental conditions and existing technologies as well the skill level and competence of your employees in the field of maintenance, instrumentation, and automation. It is important to either improve existing skills to the required technology level or choose the technology suitable to your existing skill level. With this you can keep the field easy to maintain while you can focus on your resources for the predictive maintenance solution with its algorithms and tools.

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