

# „We give the user a valuable time advantage“

*Every plant operator or maintenance technician knows them: the ‚problem children‘ - plant components or machines for which you prefer to do an extra monitoring round just to make sure that everything is really in the green. These are mostly mechanical components with a low level of automation. They are not classified as highly critical and are therefore not monitored extensively. And yet a failure would lead to greater expense and possibly to a longer plant downtime. With an all-around easy-to-use system and by using artificial intelligence, Siemens AG wants to turn such problem children into the new asset darlings of a plant. We found out exactly how this works in an exclusive interview in the German technical journal atp magazin with Johannes Burchardt, Lukas Marschalek, and Michael Hartl.*

## **The system is called Sitrans SCM IQ. Mr. Burchardt, can you briefly outline what this is all about?**

Burchardt: Sitrans SCM IQ stands for Smart Condition Monitoring using IIoT sensors. These sensors are attached to rotating or vibrating plant components and collect data that is subsequently sent to a cloud application via gateways. There, artificial neuronal networks analyze vibration characteristics and monitor them continuously. The system then issues event-related warnings that alert the user in good time to an impending failure of these assets.

## **On the one hand, this sounds like a solution that brings users real benefits, and on the other hand, it sounds like a lot of effort. What is the situation here?**

Burchardt: The effort is not on the customer side but was put completely into our development - under the specification of creating a robust and absolutely easy-to-use system. In close cooperation with our customers, this has been achieved.

Marschalek: Yes, on the way from prototype to small series to the finished product, we were accompanied, for example, by the Coca-Cola Hellenic Bottling Company plant in Edelstal, Austria. Here, we continuously collected feedback from the customer, and in certain aspects this was formative for the products themselves.

## **How does this application work and of what components does it consist of?**

Marschalek: We divide the application into three levels:

First, there are Sitrans MS200 multisensors, which are attached directly to plant components in the field.

Then Sitrans CC220 gateways, which collect the vibration or acceleration data in the connectivity layer and transfer it to the cloud application.

The real intelligence then finally comes from the third level, in the Sitrans SCM IQ apps in the cloud. They are operated and output via mobile or stationary devices.

## **Are there special multisensors for specific assets?**

Marschalek: No, we have developed the system so that it can be generically applied to any plant component that vibrates or rotates and that is within the range of the sensor’s specification. Here we are talking about compressors, pumps, agitators, or heat exchangers, for example. The multisensor is housed in a robust cylinder with IP 68 protection, which is screwed directly onto the plant component using a stud bolt or grub screw. Alternatively, clamping is also possible.

## **And what installation steps are necessary subsequently?**

Marschalek: The sensor is ready for use as soon as the inserted



Figure 1: The hardware consists of gateway and sensor

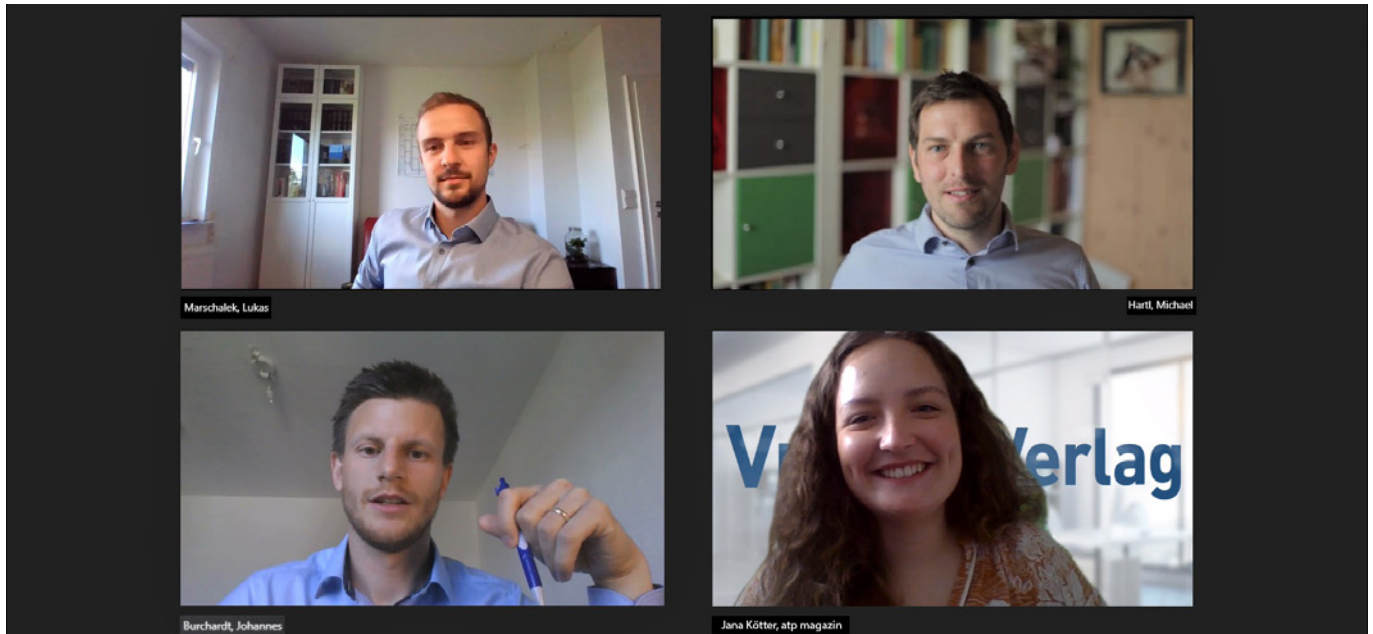


Figure 2: Mission: AI-supported condition monitoring - Lukas Marschalek (top left), Michael Hartl (top right), Johannes Burchardt (bottom left) and atp editor Jana Kötter.

industrial battery is connected. No other cables are necessary, the vibration and temperature data are transmitted via Bluetooth Low Energy (BLE) to one of our cloud gateways.

**There are no other installation regulations?**

Burchardt: No, the integrated intelligence of our system takes care of the rest. The user only needs to know what exactly he wants to monitor, because the task determines the installation location of the sensor. It should always be installed as close as possible to the vibrating machine part that is to be monitored. If I want to prevent cavity damage in a pump, then I position the multisensor at the pump inlet. If I want to detect rotor damage in good time, I position it on the rotor housing or as close as possible to the bearing if I want to prevent bearing damage. Several sensors can also be attached to one asset, depending on how closely meshed I want my monitoring concept to be or what experience I have gained with my assets in the past.

Marschalek: If the battery is connected, the sensor initializes, is made known to the responsible Sitrans CC220 and nothing more needs to be done on the machine side.

**Then the connectivity layer takes over?**

Marschalek: Exactly! Each of our cloud gateways can receive the data transmitted via Bluetooth from multiple multisensors. Sitrans CC220 is designed for installation in the control cabinet. Depending on the conditions on site, the gateway can also be extended with a Bluetooth antenna outside the cabinet. Afterwards, the user only provides access to the Internet, and then the onboarding process with MindSphere, the leading industrial IoT-as-a-service solution from Siemens, can take over. All in all, it takes 15-30 minutes to install a sensor, pair it up and log it into the cloud - completely without any prior knowledge!

**IT security plays a central role, especially in cloud applications. How is this regulated?**

Hartl: We rely on end-to-end encryption: from the sensor to the

gateway and from there to the cloud and the apps. In addition, encryption is also provided throughout within the application, all the way to the back end. Certificate management also makes authentication and connection of the gateways to MindSphere secure. The cloud-based, open IoT operating system from Siemens itself is based on security measures in accordance with the IEC 62443 and ISO/IEC 27001 industry standards.

**What happens then when the complete installation is finished after a good 30 minutes?**

Hartl: Once the sensors are online and the cloud application is supplied with the raw data, the learning phase can begin: Over a period of about two weeks, the system independently learns the condition of an asset. We train an individual model for each sensor. This allows us to dispense with exact installation specifications, as explained earlier.

**What does the user have to do for this?**

Hartl: Nothing more than marking in the app the period of time during which data was collected by a sensor on a machine in normal operation. Our artificial neuronal network learns from the data of this time period the different load states and possible operating states, for example downtime, cleaning, format or product change. They are all assigned to 'good state' and it is not necessary for the user to document or explicitly make the operating states known to the system within the time. Once the initial teach-in has taken place, the AI model determines the so-called deviation index. This is a relative distance measure from the trained good model to the currently transmitted state. If this becomes too large, a message will be sent.

**Is the deviation index comparable to a defined limit value?**

Hartl: It is a threshold value, but not a fixed one, rather a dynamic one. That is, the user does not set any threshold values, but the system determines it on a floating basis. So again, the user doesn't have to worry about anything. This is only necessary in the case of false-positive events: If a pre-

viously unlearned condition occurs, our system also reports an anomaly. This can be, for example, a previously unknown load condition. After verification by the user, the time period is marked and made available to the system for so-called re-learning.

### And what happens when anomalies are detected that are not due to regular load or operating conditions?

Burchardt: This is when Sitrans SCM IQ notifies the user that a machine part is on its way to a bad state. The message is sent via SMS or e-mail to the maintenance specialists. They check the corresponding machine and if the cause is found, the next step comes, which contributes to the continuous improvement of our system: The app can be used to record what is actually indicated, for example signs of incipient bearing damage, seal damage, imbalance or similar. It also documents which maintenance steps were performed on the machine. If the same characteristic deviation occurs at any time, Sitrans SCM IQ reports that it is very likely to be the same incipient fault.

Marschalek: With our Smart Condition Monitoring, we give the user a valuable time advantage. We prevent unplanned plant downtimes by giving those responsible sufficient time to deal with machine anomalies. Even if experienced asset watchers, of whom, by the way, more and more are retiring, notice subtle changes - our system can detect them still earlier and, moreover, for any vibrating assets. And our system is even superior to a temperature monitor in a motor winding, because this kicks in at a fixed temperature and shuts down the motor to protect it from overheating. Then the motor is saved, and the process is still interrupted. We are moving away from this ad-hoc fault detection to the optimization of planned maintenance measures, and this means significantly improved plant performance.

### These are convincing advantages. Where will the system go in the future?

Marschalek: On the sensor side, we are already working on determining other measured variables in addition to vibration and temperature. And with the current edge solutions from Siemens, it will be possible to set up even more individual hybrid architectures in the future.

Hartl: As far as the app is concerned, there are still many possibilities open to us. For example, it is obvious that we will add further machine data that is available in MindSphere to our AI models.

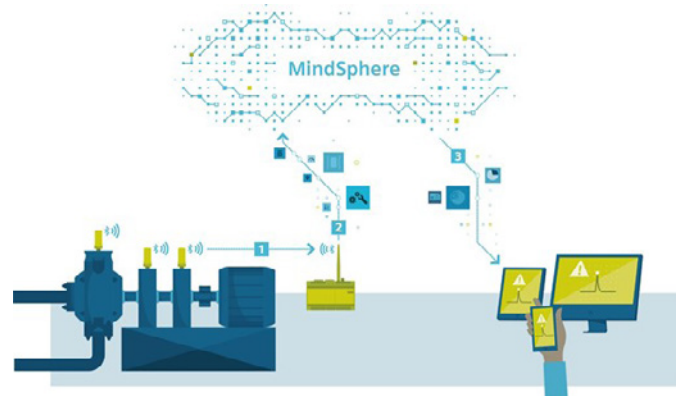


Figure 3: Possible setup with cloud services

### AI, cloud, app: How much prior knowledge is required? For whom is the solution suitable??

Burchardt: Sitrans SCM IQ is designed as a solution for plant-wide, even cross-site asset monitoring system. Customers who already take advantage of MindSphere can add it as another module to their existing digitization solution. But the system is also ideal for newcomers: existing processes are not affected in any way, and the cabling and installation effort is almost zero. The entry price for the system is so low that in many cases the return on investment occurs after just three months. With the base package, interested parties get five sensors, a gateway and the MindSphere services they need. With the investment of one hour of time - generously calculated - one large machine or several small ones can be configured for monitoring. Just these typical problem children-machines that have not actually been systematically integrated into monitoring up to now. The system can then be expanded as required - it is freely scalable. In every expansion stage, it can contribute to the performance of a plant by avoiding unplanned downtimes.



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