Siemens-Gerätewerk in Erlangen **Digitalization in the factory infrastructure**

Monitoring the factory infrastructure to boost productivity and achieve decarbonization goals

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Gerätewerk Erlangen electronics manufacturing plant (GWE) was founded back in 1971 and in addition to SINUMERIK CNC controls and SIMOTION motion control systems, it also produces SINAMICS converters. The electronics plant needs to handle over 1000 possible product variants, and yet be able to flexibly and quickly respond to volatile market demands around the globe. Significant order entry fluctuations are no longer uncommon, leading to challenges during factory and production planning.

However, in many cases the factory infrastructure has been somehow neglected, even though it is indispensable for the production processes. At GWE, various pump, fan and compressor systems ensure the right ambient conditions within the different production areas. Failure of infrastructure systems would result in scrap as well as downtimes, and thus in, high costs. GWE is now implementing digitalization solutions to avoid those costs.

Fig. Clean room plenum

Customer
Siemens AG

Location
Gerätewerk Erlangen (GWE)

Time frame
Installation and commissioning of 26 sensor modules in two days

Scope of supply
Complete, holistic solution for condition monitoring of low-voltage motors, including
- MindSphere as comprehensive cloud-based IIoT-as-a-service platform
- 26 SIMOTICS CONNECT 400 sensor and connectivity modules
- SIDRIVE IQ Fleet motor analysis app incl. the corresponding subscriptions
- Corresponding Predictive Service Assistance service app as part of the Predictive Service Portfolio

The challenge

Achieving carbon neutrality and remaining technology leader through innovation will represent significant challenges in the decades to come. This has a considerable impact on production facilities, their various machines as well as buildings.

"The infrastructure is the basis for production. Without the right infrastructure, nothing can be produced," was Markus Geyer's summary of the issue. He is one of the lead engineers heading the "Digitalization Infrastructure@GWE" project – which has four main objectives:

1. Reducing maintenance costs:

Currently, the systems are routinely maintained at fixed intervals – maintenance work is carried out by Siemens as well as by external service partners. By precisely evaluating system data, maintenance based on the actual machine condition can be harmonized between all parties involved. Maintenance costs can be significantly reduced by utilizing this condition-based strategy.

2. Increasing plant and system availability:

Potential failures can be avoided by identifying anomalies or irregularities in the captured data at an early stage. This is important because "we are striving for a 100% plant availability," Markus Wölfel emphasized, who manages the GWE process infrastructure and who is also one of the project leads.

3. Minimizing manual interventions:

Currently, maintenance staff needs to routinely inspect the various machines to obtain an overview of the condition of the systems. "The objective is to provide these values digitally without our personnel having to physically go to each individual machine," Markus Geyer outlined.

4. Energy-saving and decarbonization:

Siemens has committed to making its operative business CO_2 neutral by 2030. To achieve this goal, all Siemens production facilities and buildings worldwide are to have a net CO_2-free footprint by 2030. To achieve this ambitious goal, the infrastructure in all factories must become more energy efficient. Through full operational transparency based on captured data, GWE wants to identify optimization potentials and realize them step-by-step until 2030.

GWE's production infrastructure covers many different systems and machines. And especially the clean rooms do have high requirements on the infrastructure. The infrastructure includes high pressure pumps, pumps to recover thermal energy as well as air supply and extraction systems. These are complemented by additional applications, such as vacuum compressors and process air discharge systems.

Fig. Process air extraction system for GWE production areas

The solution

"It was important for us to find a scalable solution, which we can use as a base to address the four pillars that we have identified." Detailing the requirements for the project, Markus Geyer added, "Having said that, the solution should also be able to be easily and quickly transferred to other locations." Markus Geyer is responsible for the roll-out to other Siemens plants within the scope of "Lean Digital Factory".

With SIMOTICS CONNECT 400, the project team has found a plug & play sensor that encompasses all of these requirements – and what is particularly important – can also be deployed in brownfield environments, i.e. existing plants and systems. The total of 26 applications were able to be connected and linked to MindSphere in just a couple of hours. Talking about the commissioning, Markus Wölfel continued – "The fact that these sensors can be quickly and simply installed without any changes to the system and during operation represents a huge advantage." Essentially, the installation involves attaching the sensors using a two-component adhesive and commissioning them with a smartphone.

WLAN-based data transfer was also an attractive feature and represented a huge advantage since no expensive cable-based network infrastructure needed to be installed at GWE factory. The standardized maximum length

of network cables is 100 m. Therefore, the costs involved to set up a respective network can quickly reach a low five-digit euro amount. However, GWE was able to use the existing WLAN infrastructure and therefore could optimize its costs. Wherever the existing WLAN network was not sufficiently available, it was able to be expanded, quickly and cost-efficiently. Even the sensors operated in shielded metal housings were able to be simply commissioned.

Raw data from the field (vibration levels, magnetic fields, temperatures) is processed, analyzed and visualized in MindSphere using the complementary SIDRIVE IQ Fleet app. SIDRIVE IQ Fleet provides a comprehensive overview of the connected motors, including electrical parameters such as power, torque and energy consumption. Calculations and analyses are performed based on a motor-specific digital twin. The twin includes for example the electrical equivalent circuit diagram, and therefore is increasing the precision of the analytics, and the overall data quality.

"From just three measured values, many parameters are calculated, which the app displays with a high degree of quality. The sensors are registered in the cloud and all the analytics is performed completely automatically without the need of any manual intervention. This simplifies our work to a huge extent," Annika Gügel explained, who is supporting the project as expert for connecting production machines to MindSphere.

SIDRIVE IQ Fleet makes condition monitoring simple. For example, the cloud-based app triggers notifications when it identifies any anomalies. SIDRIVE IQ Fleet uses artificial intelligence (AI) to support users by automatically recommending the right level of threshold values. Based on the "fingerprinting" function, good states can be defined, which the app automatically compares with the current operating data to identify anomalies and potential problems in advance.

Fig.
SIMOTICS CONNECT 400 mounted onto a Siemens SIMOTICS General Purpose motor

First successes

"Within just a few weeks, we were able to clearly see the first successes," Markus Geyer explained.

The measured motor values of a process air extraction system showed anomalies in the vibration data. "The motor was relatively stable for several weeks, but on May 22, vibration levels literally doubled overnight," Markus Wölfel explained. "Without the monitoring system, this increased vibration just wouldn't have been noticed at this early stage." When the system issued the alarm, the service department was able to take prompt action and the bearing that had run dry was replaced. This prevented expensive bearing damage that could have caused the extraction system to fail – and as thus, cause production downtime.

For the thermal energy recovery system, the team was able to identify that the utilization of a redundant pump system was not evenly distributed. One of the two pumps operated for twice as long as the other. The uneven distribution was only identified and resolved by having the operational transparency based on SIDRIVE IQ Fleet motor data. Detecting the unequal distribution resulted in prolonging the calculated product lifetime by 33%.

The first successes indicated a return on investment (RoI) of less than one year. The recurring costs for the cloud-based solutions can be compensated by cost savings from reduced local inspections, optimized maintenance as well as avoiding failures and the associated cost. Furthermore, GWE was able to eliminate costly energy measuring devices as SIDRIVE IQ Fleet inherently provides transparency on the energy consumption of the infrastructure systems.

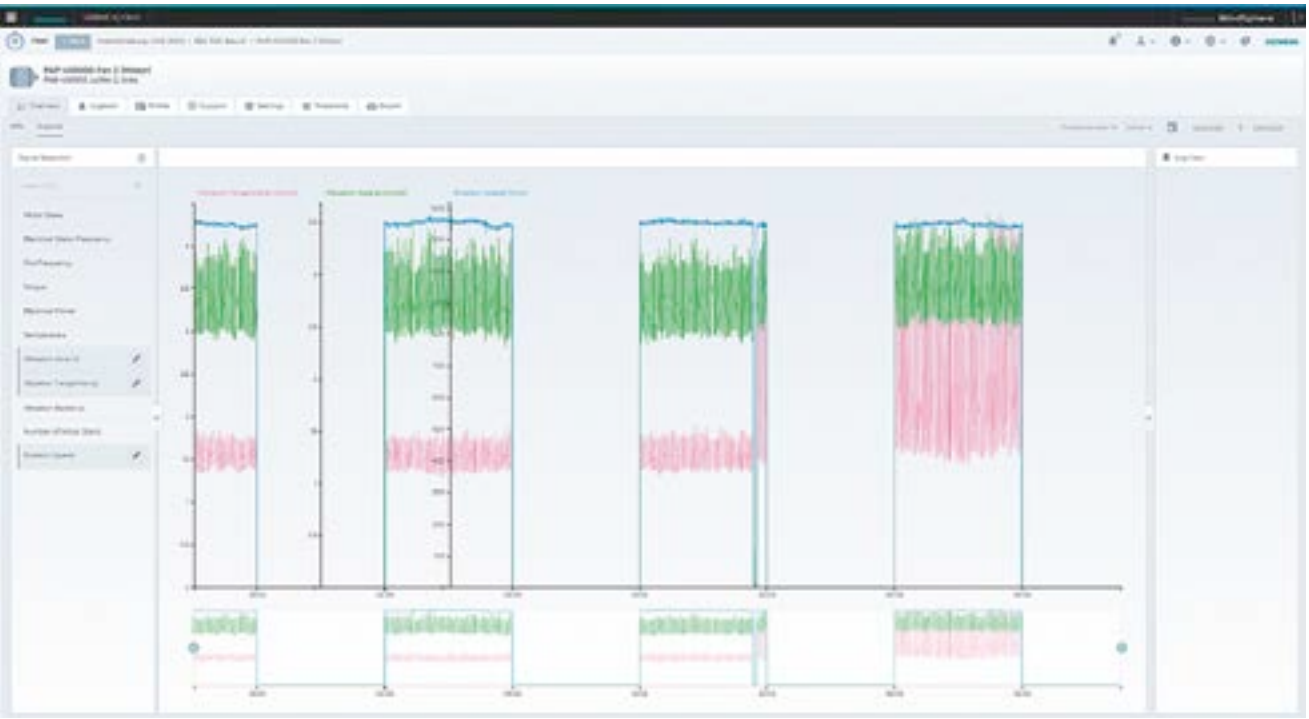

Fig. SIDRIVE IQ Fleet automatically identified the significant increase in vibration levels and notified the service team via mail

Linking with additional MindSphere apps

The electronics plant in Erlangen uses other apps in addition to SIDRIVE IQ Fleet. In EasyDash, the various assets in MindSphere can be displayed in a comprehensive and cross-factory dashboard, which in addition to the motor data from SIDRIVE IQ Fleet, also displays data from other machines and correlates all available data.

The Predictive Service Assistance app also uses data from SIDRIVE IQ Fleet to process service and maintenance-relevant information and data in a user-friendly way. In addition to a maintenance dashboard, the app also provides maintenance schedules and ensures full transparency about spare parts and other services, for example. Also here, AI-based algorithms provide valuable support to optimize maintenance planning therefore avoiding potential downtimes.

The result

These early success stories clearly show that the system functions and the four pillars the Gerätewerk in Erlangen wishes to address can be implemented in practice. The project team is very confident that their objectives can be reached. By optimizing factory maintenance and reducing manual interventions, productivity will be increased. And, based on the operational transparency obtained, the factory infrastructure can certainly play its role in ensuring that Siemens achieves carbon neutrality by 2030.

"We have a three-stage plan," Markus Geyer explained. To start, all the systems at GWE that are still not connected will be connected to MindSphere. This especially involves the factory buildings, which are not supported and maintained by the factory itself, but by Siemens Real Estate.
The second step involves rolling out the solution to other factories in Europe and China, where the infrastructure will also be digitalized to boost factory productivity and achieve carbon neutrality objectives.
In a third step, external maintenance companies involved in some of the maintenance activities will also be incorporated. There is also enormous potential for external service partners when it comes to digitalization, as remote support allows them to avoid unnecessary travelling, and therefore reduce their costs. "We are already including digitalization in tenders for future service contracts," Markus Wölfel explained, "as the value add for our partners and us is enormous and has by far not yet been fully leveraged."

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