Manufacturing

Customer case study

Saving money and improving sustainability through energy monitoring

Highlights

- Phoenix Contact wants to measure the energy usage on its machines
- Employees in different roles can use this data to make better decisions in their daily tasks
- Phoenix Contact installed energy-monitoring systems on three of its own machines so they could capture, analyze, and take action based on this data
- Although the system is still new, it will help Phoenix Contact improve operations, save money, and reduce energy usage

As Phoenix Contact continues to refine its own energy monitoring, employees across the entire organization will soon be able to make data-driven decisions.

Customer profile

In 2005, Phoenix Contact established a development and manufacturing company at its U.S. headquarters near Harrisburg, Pennsylvania. The D&M company brings production closer to customers in North and South America.

Figure 1: Like many manufacturers, Phoenix Contact is looking for ways to improve energy efficiency in its manufacturing process.

Phoenix Contact brings a unique perspective to Industrial Internet of Things (IIoT) applications. Not only does Phoenix Contact develop and manufacture products that make the IIoT possible, but the company actively uses these technologies to improve its own operations and sustainability initiatives.

Challenge

Like many manufacturers, Phoenix Contact is looking for ways to improve energy efficiency in its manufacturing process. A machine's energy usage can impact operations throughout the facility, from the plant technician and supervisor to facility maintenance staff and up to a C-level decision maker.

Solution: Energy monitoring

At the beginning of its energy monitoring plan, Phoenix Contact identified several machines in its U.S. production facility that consume higher amounts of energy: the wave solder machine, the VARIOFACE Professional (VIP) slice machine, and the

U006327A:02.24

PHOENIX CONTACT • P.O. BOX 4100 • HARRISBURG, PA 17111-0100
Phone: 800-888-7388 • 717-944-1300 • Technical Service: 800-322-3225 • Fax: 717-944-1625
Website: www.phoenixcontact.com

Surface-Mount Technology (SMT) machine. Collecting the energy data can be simple, but different machines require different approaches.

Basic energy meters can measure and collect system conditions like voltage, current, and power. Energy meters can measure AC power in single-phase and three-phase installations. Other sensors can capture key parameters such as pressure, temperature, and flow. While the energy meters and sensors can't perform the analytics themselves, more advanced meters can send the data directly to the cloud, so it's accessible for other uses.

Figure 2: Basic energy meters, like the Phoenix Contact EMpro, can measure and collect system conditions like voltage, current, and power.

The wave solder and VIP slice machines only require measuring power at a single point of delivery. Here, Phoenix Contact uses the EMpro energy meter. The EMpro directly measures the voltage and uses a current transformer to measure how much current is flowing through the machine. Based on these measurements, it calculates how much power is being consumed. The EMpro is then polled by an internal microarchitecture application via a REST API.

For more complex machines or full production lines, a programmable logic controller (PLC) offers a higher level of data collection. The PLC acts as the "brain" of the system. Rather than just gathering the data, the PLC can preprocess the data with scalers, multipliers, and more. It can then send the data to an internal server or external cloud service, such as Amazon Web Services (AWS) or Microsoft Azure, for further use.

The SMT machine is more complicated than the other two machines. Phoenix Contact needed to measure and merge multiple circuits at different voltage levels. A PLCnext controller and Axioline power monitoring modules collect data for this machine.

The PLCnext is an open-source, Linux-based platform for edge computing. Because of its open nature, it can work with hardware and software from many other vendors.

Analyzing the data

Collected data doesn't have much impact on its own. Monitoring and collection efforts are only valuable if someone studies that data to identify insights into operations or faults. The information must be easily available to different people across the organization so that they can take the necessary actions to meet their department's objectives.

Getting a clear picture of a machine's energy usage requires processing that data, via human or automated means. Looking at the machine's historical consumption, utilization, and throughput/yield will establish a baseline. From here, you can define performance metrics or identify anomalies.

To this end, Phoenix Contact has set up databases and an internal microarchitecture (a series of servers running on its own network). The historical database can store years of data samples. To help analyze the data, Phoenix Contact uses its own Emalytics software, an open-source building automation software based on the Niagara Framework. The software helps create a "digital twin," or a digital representation of what's happening on-premises. A graphical interface makes it easier for the human brain to process the data.

Within Emalytics, the team can create different user profiles to enable different levels of access. People in different roles can look at the visualizations most relevant to their jobs. They can calculate important information like power, electrical characteristics, power factor, and reactance values.

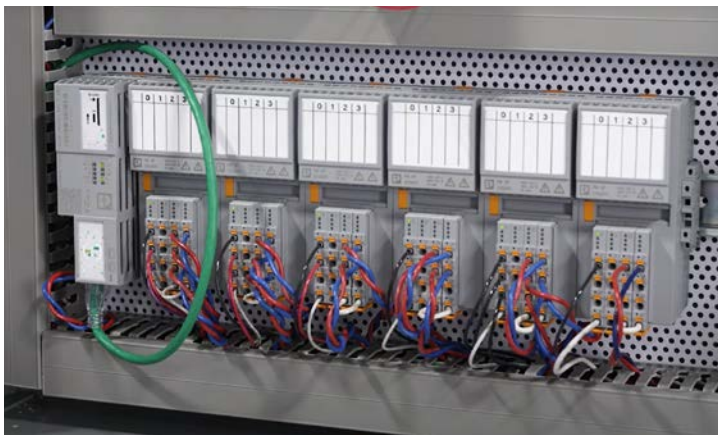

Figure 3: More complex machines will require a PLC to collect and process data. Rather than just gathering the data, the PLC can preprocess the data with scalers, multipliers, and more. An open control system like PLCnext Technology can then send the data to an internal server or external cloud service, such as Amazon Web Services (AWS) or Microsoft Azure, for further use.

PHOENIX CONTACT • P.O. BOX 4100 • HARRISBURG, PA 17111-0100
Phone: 800-888-7388 • 717-944-1300 • Technical Service: 800-322-3225 • Fax: 717-944-1625
Website: www.phoenixcontact.com

Figure 4: The energy monitoring data can be made available to anyone who can use the data, from machine operators on the floor to C-level executives. Emalytics software gives employees the visualizations relevant to their jobs.

In the near future, an automated software program utilizing machine learning (ML), neural networks, or other artificial intelligence (AI), will pour over and analyze the data. The machine will have access to years' worth of data, helping to train it in the proper data sets. From there, it could analyze the data, notify key people about anomalies, and determine the next logical step to improve functionality and cost-benefit ratios.

While Phoenix Contact prepares for the implementation of ML or AI, it uses an MQTT broker for important notifications. Any software on the network can subscribe to the energy monitoring system. An internal application can pull data from the machines to notify team members about anomalies so that they can take action.

Results: Taking action

Now that Phoenix Contact has collected and analyzed the data, team members can use that data to make decisions that impact their daily workload or the company's bottom line.

For example, when looking at the data points for a machine, one of Phoenix Contact's manufacturing supervisors noticed that the energy monitoring clearly shows when a new shift starts. The power consumption shoots up and stays consistent throughout the shift.

The team discovered the baseline power usage, or standby current power, was high. Even when the machine is not producing anything, it consumes about 5 kilowatts of power. The team evaluated whether it was more energy- and cost-efficient to put the machine into sleep mode or to shut the machine down entirely between shifts.

While this is just a single example of how the data has been used so far, there are other potential use cases.

A technician who suspects a power surge is damaging a machine could use the data to analyze historic voltage values and compare them to current data to pinpoint the root cause. They can then take the actions necessary to repair the machine and implement a predictive maintenance plan that reduces future downtime.

A building automation engineer would not be interested in the fine details of any particular machine, but could use the data as part of an overall campus energy management program. Phoenix Contact generates a significant part of the energy to meet its own electrical needs through an internal solar power system and a combined cooling, heating, and power (CCHP) system. The facility manager could partner with the production team to determine the best times to run specific machines based on green energy usage. This could reduce the company's electric bills. In the future, the facilities department could even use this data to bill different departments for their individual energy usage.

A C-level plant director could compare the energy usage data of an existing machine to the projected energy usage of a new machine. This information can clarify whether the new machine will save enough money on energy costs to justify its purchase.

Such data could get even more granular in the future, perhaps to the product pricing level. For example, an analyst could factor in the number of kilowatt hours of energy that goes into creating a single terminal block when determining the price.

Walking the talk

While Phoenix Contact USA is still in the early stages of its energy monitoring journey, the company has already implemented a digital

Figure 5: The American team is working closely with the German team to implement the best practices already learned.

PHOENIX CONTACT • P.O. BOX 4100 • HARRISBURG, PA 17111-0100
Phone: 800-888-7388 • 717-944-1300 • Technical Service: 800-322-3225 • Fax: 717-944-1625
Website: www.phoenixcontact.com

factory in Bad Pyrmont, Germany. The American team is working closely with the German team to implement the best practices already learned.

As Phoenix Contact continues to refine its own energy monitoring, employees across the entire organization will soon be able to make data-driven decisions. These decisions could have a significant impact on the bottom line, by helping to reduce downtime, plan predictive maintenance, improve resource utilization, and even determine product pricing.

But just as important as the financial impact, energy monitoring will also help Phoenix Contact reach its goal of becoming a carbon-neutral company by 2030. With a clear understanding of energy usage, Phoenix Contact can reduce overall energy consumption, allocate resources for cleaner energy usage, reduce emissions, and allow the company to become a better steward of the environment.

PHOENIX CONTACT • P.O. BOX 4100 • HARRISBURG, PA 17111-0100
Phone: 800-888-7388 • 717-944-1300 • Technical Service: 800-322-3225 • Fax: 717-944-1625
Website: www.phoenixcontact.com