Coping with big data in PV manufacturing

The continuous expansion of PV production lines in Asia is generating an ever-increasing volume of data, which in turn requires processing. This presents manufacturers with significant challenges in evaluating and optimizing the efficiency of their lines. Here, halm elektronik gmbh looks at how real-time control and monitoring software can result in enhanced decision-making.

The massive growth of cell and module production in Asia and expansion of PV production lines make it more and more difficult to keep track of the measurement data, essential for quality and process control. In addition, recent expansions have been much larger than usual, and the scale of individual cell manufacturers' projects has also ballooned.

In response to this challenge, halm elektronik gmbh, a German PV measuring technology manufacturer based in Frankfurt am Main, conducted in-depth interviews with selected customers to find out how they were dealing with this tsunami of information. They were specifically interested in finding out how their customers handle their data, their evaluation methods, and the key figures they examine.

According to Michael Meixner, Managing Director at halm, the findings were eye-opening. 'We discovered that many manufacturers were extracting production data from their systems using manual or semi-automated methods and then analyzing it to gain insights into their operations. As well as being laborious and time-consuming, this approach can cause delays in identifying a defect or potential optimization, by which time several thousand defective cells may have already been produced.

We promise future-proof solutions and take whatever steps are necessary to fulfill this claim

halm also learned that each of its clients assigns different priorities to key performance indicators, the data used to measure quality and process control.

Meixner says: 'This presented a challenge for us in creating a potential solution, as it was necessary to cope with these widespread variations: we needed to be flexible and powerful enough to meet different expectations without becoming too complicated to use.'

halm's commitment to providing retrofit solutions that are compatible with all its equipment posed a further challenge. 'Our customers trust us to not only provide them with state-of-the-art innovations but also to ensure they are compatible with their existing hardware, regardless of purchase date. We promise future-proof solutions and take whatever steps are necessary to fulfill this claim, no matter how the industry evolves.'

All-in-one solution

Following extensive development work, halm successfully engineered a software solution that automates the collection and analysis of data generated by its measuring instruments and stores it all in one place, enabling

Figure 1: The top diagram shows the assigned EL quality classes of 16 lines. The lower diagram shows in detail which defects occurred in all B-quality cells

manufacturers to improve their quality and process control.

Their solution: cetis-PVCockpit software (PVCockpit), was released in mid-2021 and so named because it gives operators an all-round overview of production line performance and quality. PVCockpit is an optional, plant-wide tool that enables production data to be collected, monitored and analyzed on a dedicated server. It displays data in real time, allowing operators to compare the performance of multiple lines side-by-side or in overlays to assess production systems and uncover trends. This results in fewer errors, faster processing, greater yields, and consistently high production outcomes.

The software addresses several shortcomings in the area of quality control. For electroluminescence (EL) images. For example, manufacturers are interested in the percentage of grade 'A'EL images, 'B' EL images, etc. and the specific defects that are appearing.

Process control varies from manufacturer to manufacturer and often even for each production line. Some organizations also have different staff positions, such as line engineer, shop floor supervisor, and operations manager, all of whom have different data and insight requirements that PVCockpit can cater to with multiple views.

In the words of Michael Meixner, 'Our goal was to provide a tailored solution for each user, allowing them, for example, to monitor their specific area of production on a tablet or handheld PC as they walk through the plant.'

System requirements

In line with halm's policy of providing retroactive upgrade options, PVCockpit is sold as an add-on package to the company's systems. The typical bundle includes a dedicated high-performance server with sufficient storage capacity to handle multiple inline systems. Installation and setup, which require minimal space in the customer's IT room, are typically included in this package.

All halm measuring systems feature their own PC for processing the data and providing the user interface. This makes it easy to subsequently network them with the PVCockpit server and centralize the data from each cell line. Since large amounts of data are transferred, including high-resolution EL images, good network performance and, ideally, dedicated network connections are required.

Encouraging results

Interest in the solution is high, and with the growing size of production lines and expansions in the industry, most manufacturers recognize they will need to understand and make use of big data more and more in the future.

Figure 2: Compilation of different measurements for several lines

Our customers have a direct influence on PVCockpit's functionality

Monitoring or optimizing lines without a precise overview of your data is virtually impossible. PVCockpit offers producers without automated data handling a simple solution to this problem. And feedback on the system from halm's customers to date suggests they are on the right track. Michael Meixner comments: 'The solution is already in action at a number of major market players. So far, we have installed the software mainly at clients where experience has shown that we can work together at a high level. We are in close contact with these customers to understand how they use it and identify further future optimizations. They share their feedback with us and suggest new features they would like to see. In this way, our customers have a direct influence on PVCockpit's functionality and future development. So for us, it's anything but a 'sell and forget' process.'

Security through on-site data storage

Any reservations on the part of manufacturers concerning data security were swiftly dispelled. Since PVCockpit is developed by the same supplier as the hardware and is operated via a web-based front end on the customer's intranet, a high level of security is an integral part of the system.

halm system users can upgrade to PVCockpit by updating their software and connecting to the supplied server. This provides not only a seamless migration solution but also a simple and efficient way to achieve automated data handling. And because the system layout uses no cloud technology, cell measurement data never leaves the factory premises - nothing is stored externally, so the data is completely in the hands of the cell maker.

www.halm.de