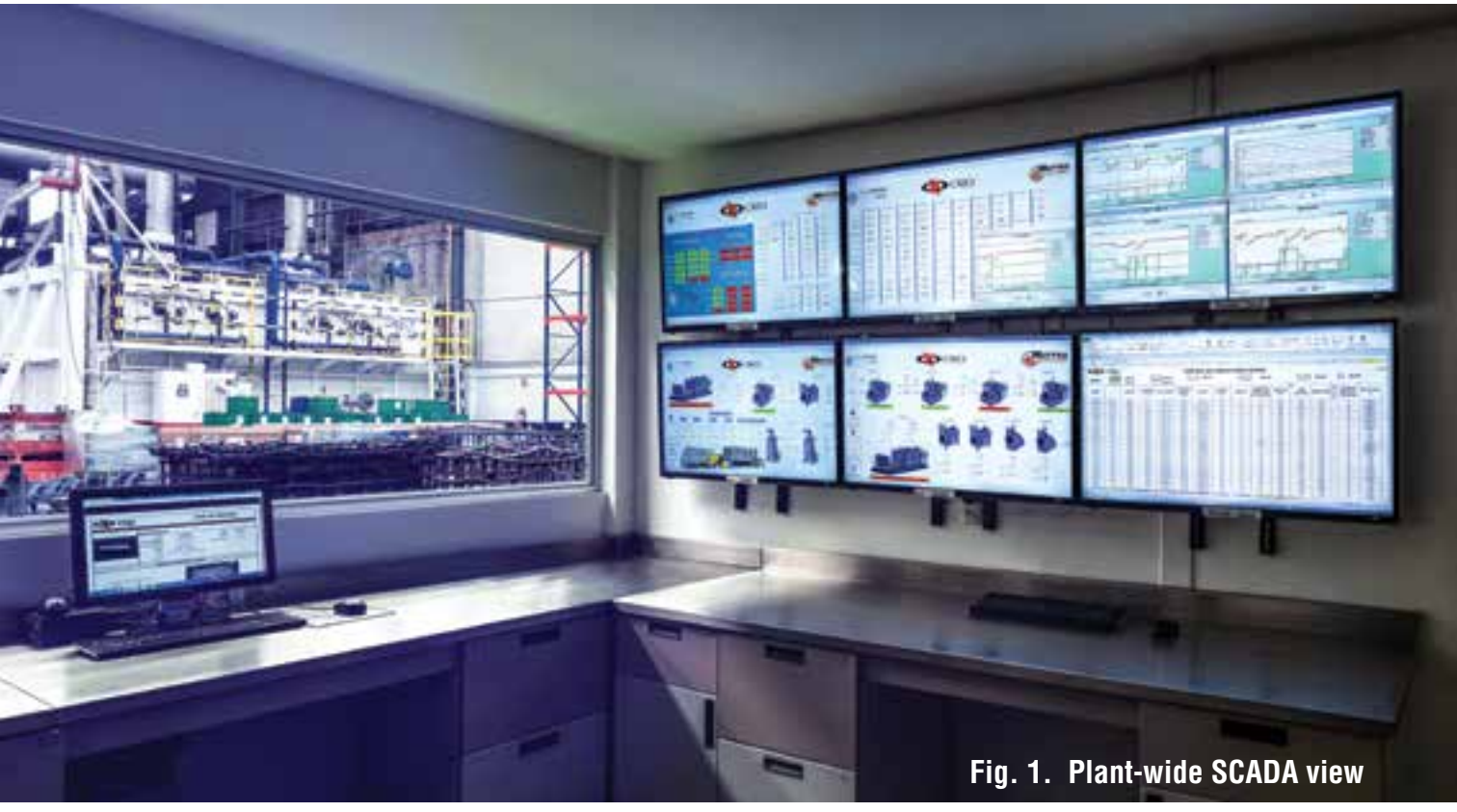

Fig. 1. Plant-wide SCADA view

Industrial Automation: Manufacturing, Heat Treating and Data Analytics

» Jim Oakes – Super Systems Inc.; Cincinnati, Ohio

It is an interesting time to say the least. Worldwide impact on manufacturing will be measured in years from the COVID-19 pandemic.

Companies are trying to establish the new normal for working environments – whether that involves work-from-home employees, creating safe work spaces on the shop floor or business interactions through voice and video conferencing. We have been hearing much about the broken supply chain as the pandemic impacted different regions of the world at different times and at varying degrees.

With this heightened awareness of supply-chain disruption, remote workforce and fewer workers on the shop floor, will the move to industrial automation and data analytics happen at a quicker pace? You could easily say the shift in manufacturing to automation and data analytics has been happening for years because of the competitive labor markets in the U.S. due to low levels of unemployment.

What does that mean for heat treat? How is the Industrial Internet of Things (IIoT) and Manufacturing 4.0 positively influencing our industry? This is a small slice in the projected $300 billion market of industrial

automation, but it will no doubt impact the heat-treating industry.

Data

Sensor and control technology provide amazing insight into equipment health, operational efficiencies, costs and quality. The aftermath of the coronavirus will have manufacturers and heat treaters looking at data analytics to address all areas of their processes.

Most companies today have equipment that provides some level of process repeatability and proof of process through data acquisition and automated controls. This can be found in electronic data recording, recipe control and automated equipment (Fig. 2). Most heat treaters today have electronic information at their fingertips for validation of the thermal treatment performed on the parts they are running. Many recognize the value in that data – not only as a step to ensure the process and meet a quality objective but also as a chance to gain operational benefits. These opportunities come in many different areas, but most companies are taking advantage of managing workflow, maximizing resources and preventive maintenance.

A common problem with data is having it in too many locations without a centralized view. This could be at the equipment level, department level or a result of different computer systems. The goal should be creating a synchronized operation with a holistic view as opposed to these data "silos." Shared information creates more widely relevant and readily available information as opposed to relying on a single source of information addressing a small piece of the puzzle.

Spreadsheets are a perfect example of silos

Fig. 2. Integrated controls with SCADA provide quick access to information and unique data-capture capabilities.

of data. In many cases a spreadsheet requires data entry, where someone transcribes summarized data for information that is important to that person or their supervisor. The downside is lack of visibility and usefulness to others for proper decision-making.

If you are using a spreadsheet today, challenge yourself or those using the spreadsheet to have the systems in place (SCADA – supervisory control and data acquisition, MES – management execution system, ERP – enterprise resource management) to automatically provide the data in a meaningful format derived from collected data. You immediately ensure a "one version of the truth" for data, reduced labor for data entry and a holistic view across the organization. Using a SCADA system, you can look at statistical data for control analysis for QA, equipment downtime, pyrometry activities by equipment and time between loads. With this type of analysis, evaluation for future equipment, labor and spare parts can be derived, leading to better analysis for that operation.

With the SCADA systems as the foundation of plant-wide data (Fig. 1), more and more

people are either finding or being forced to do more with the information available to them. The same tools can provide a heartbeat of the operation and the health of equipment. There is tremendous value in collected information that the day-to-day user may not look at. Technology becomes a major driver of this because the cost of capturing data is insignificant along with the number of sensors available that allow for SCADA systems to capture, display and store information.

With digital transformation well underway on the shop floor, there now is a greater emphasis on integration between the shop floor and the back office. With communication protocol standards and interface "hooks" between separate systems, data is easily shared when and where it makes sense. Application program interfaces (APIs) are commonplace with software today to allow systems to provide accessibility across multiple operational and technological levels.

Mobile applications and ERP systems will use APIs to gather, share and update information across platforms (Fig. 3). This sharing of information eliminates silos of information. We have seen customers use data at the SCADA level to provide operational and customer order information to MES systems, leading to increased operational visibility for reporting and enhanced customer service with job-status and delivery notifications.

At the ground level, shop-floor data is gathered by discrete sensors, accumulated by multiple pieces of equipment and then centrally stored for real-time and historical review. There are thousands of data points being logged and, in many cases, millions of points over the course of a day. The amount

Fig. 3. Mobile applications provide quick access to information and unique data-capture capabilities with smart mobile devices.

of data that is actually being used is a small subset, but there is tremendous value to all areas of the business if the right information can be segregated out and mined properly for the right individual.

"From a very high level, data analytics is about productivity when we boil it down. Data analytics has the ability to expose flaws and inefficiencies in everything from actual thermal processing to plant operations if the data is visualized the correct way," said Clifford Bateman, lead technical developer at Super Systems. "The first frontier in thermal processing that I see data analytics being implemented has been in preventive asset maintenance and calibrations."

Opportunities for preventive

maintenance are abundant when it comes to instrumentation and sensors. Controllers are smarter today, doing the mining for individuals and making suggestions on what might be happening. That can come in the form of historical trends moving away from a baseline, sudden deviations from statistical norms, and counters and timers of activities, to name a few. The key is providing the right subset of data to the right individual to make a decision that ensures uptime of equipment and maximizes performance and quality.

Sensors

Many thermal applications ensure – through periodic maintenance – that gas-fired burners are operating in a range that maximizes burner efficiencies, which reduces and eliminates dangerous emissions. Using sensor and monitoring systems provides real-time data with alarming to ensure burners are at peak performance. This leads to a reduction in recovery time (more loads), increase in fuel efficiency, consistent temperature uniformity and longer equipment life.

Many sensors are used to monitor the health of the equipment today. Much of the existing equipment can be fitted with sensors that provide insight to operational health. Using PLCs or microprocessors acting as data concentrators, data can be interrogated and provide immediate feedback for action. Ideal configurations allow for warning in advance of failures. Equipment temperature, vibration, logic counters and frequency monitors are just a few of the sensors utilized for the predictive planning used by controls and SCADA systems with the goal of eliminating unplanned downtime on critical equipment.

"Most equipment that does not have modern instrumentation and sensors can be updated with the latest technology to take advantage of software and control applications," said Chris Davidson, senior project engineer at Super Systems. "In the near future, I see and have seen most big corporations and smaller leading-edge companies investing in sensor technology in a variety of applications, such as pressure, force, vibration, level, power, etc. combined with software and artificial intelligence to start creating better tools to not only increase and monitor efficiencies but determine deficiencies in the equipment or operations."

Artificial Intelligence

How does artificial intelligence (AI) make its way to the heat-treating industrial automation market? There will be many views on the existence and progression to AI in our market. Regardless of the level of sophistication, data and computing are the foundation for making this happen, and both are in place on the factory floor.

"In regard to our industry of thermal-processing and heat-treating solutions, AI gives us the ability to make previous aspects of plant operations smarter," Bateman said. "From maintenance to processes and everything in between, including plant operations and management, AI has the potential to not only expose flaws and inefficiencies but also provide and implement solutions tailored for the individual company. We are constantly using field experience where individuals make actionable decisions and build that into our software and controls."

This article previously discussed deviations from baselines and alarming or warning of

Sensors for Predictive Planning

Ammeters and current transducers

Temperature sensors

Flow and pressure monitoring

Ammeters and current transducers can be used to track electrical consumption on equipment or specific components. With the correct software and user input, reports and historical trending can be exported to analyze operational costs, process costs and even compare between shifts or equipment on efficiencies/deficiencies during production. Additionally, separate reports and alarming can be created to highlight potential issues, allowing for planned downtime before a major issue occurs.

Temperature sensors provide great information for preventive maintenance. They can be used to track performance on heat exchangers and coolers (indicating potential clogs or the need to be cleaned); monitor excess temperature generated by motors and pumps that may indicate failing bearings or seals; or indicate potential temperature losses through walls, doors or sealing surfaces.

Flow and pressure monitoring are invaluable in monitoring system health. Supply pressure monitoring can provide feedback on potential supply issues (pumping system, tank pressure) or piping integrity (leaks or clogs). Component or equipment outlet-pressure monitoring can provide feedback on the system itself (clogs, leaks and other system losses). Flow monitoring will provide the greatest feedback to ensure that the proper amount of gas or liquid is being passed through the system, helping to ensure proper heat-treating or equipment performance. Any unexpected or downward-trending indication in flow will almost certainly show that there is a supply or equipment issue, which can quickly be differentiated with the use of inlet-pressure monitoring.

Chris Davidson, senior project engineer at Super Systems Inc.

this occurrence. The simplest view of AI in heat treating is letting the instrumentation perform some of the tasks that we rely on individuals to do based on data the system gathers over time. An argument can be made that there is some level of AI built into the automated controls and equipment based on microprocessor decision-making from current and historical sensor technology. You also see decisions or learning based on historical data or simulation for future processes that are in play in heat treating today.

Conclusion

The industrial automation market undoubtedly will continue to grow, and the heat-treating industry will reap the advantages, which include lower operating costs and wastage, reduction in human error, efficient manufacturing, synchronization of procedures and quality production. The advancements of sensor technology and computing power provide the foundation for better and automated decision-making, and the heat-treat community has this in place today.

For more information: Contact Jim Oakes, president, Super Systems Inc., 7205 Edington Dr., Cincinnati, OH 45249; 513-772-0060; fax: 513-772-9466; e-mail: joakes@supersystems.com; web: www.supersystems.com.