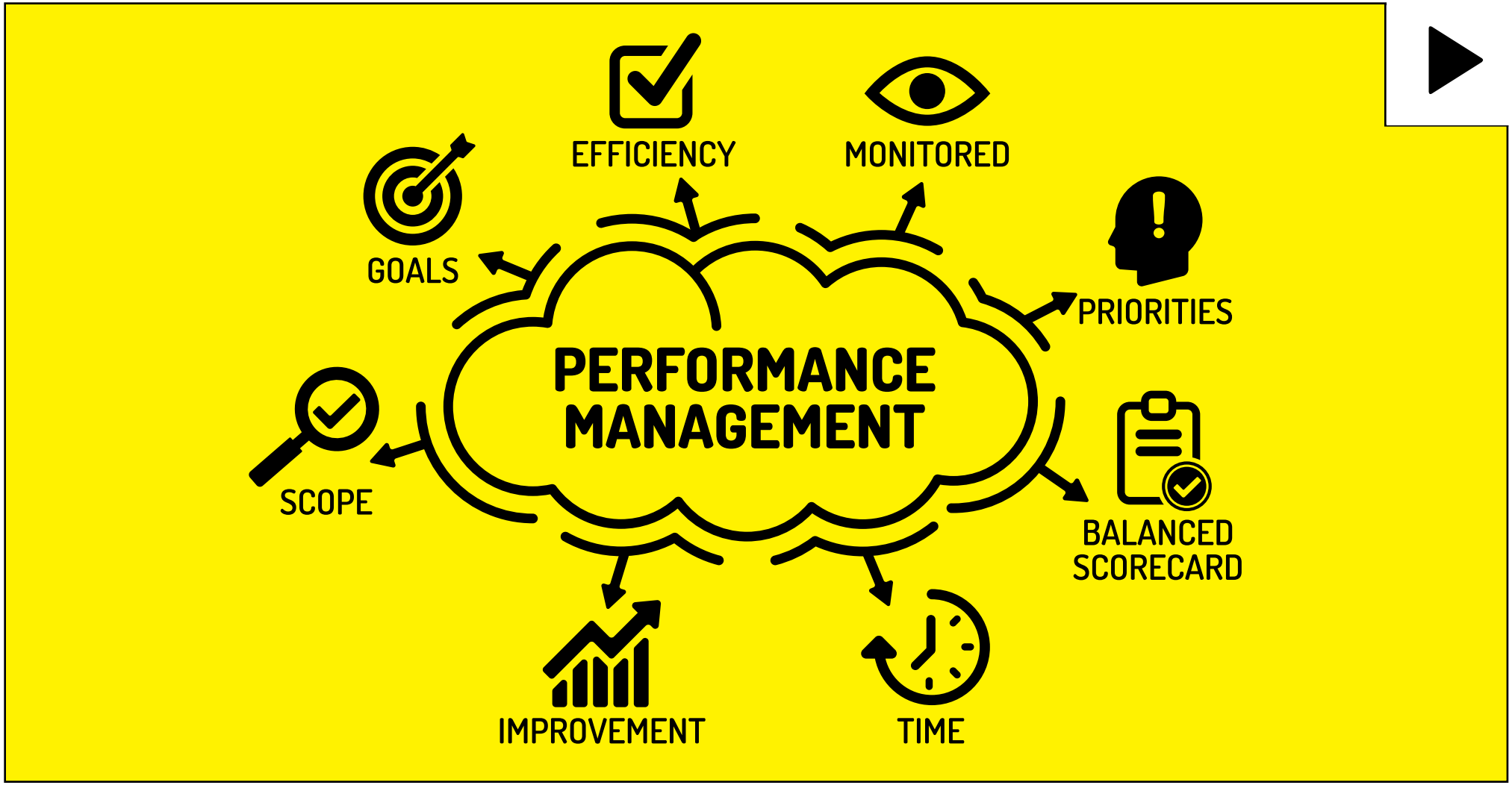

AutomationWorld® TACTICAL BRIEF

Increase Operational Efficiency

CONTENTS

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Maintenance Isn't an Expense; It's an Investment

Maintenance becomes strategic when you leverage real-time machine data to proactively manage your production assets.

By Michael Gurney, CEO, Concept Systems Inc.

Almost a third of all manufacturing facilities experience unexpected machine failure, and many report up to 800 hours of downtime each year. Fortunately, this reality is about to change. Companies that are investing in preventive maintenance strategies are reducing their risk of unplanned downtime and in turn improving their production volumes and profits.

The majority of manufacturers—past and present—rely on equipment specs to set up maintenance and replacement schedules. Companies value and understand the importance of avoiding unplanned downtime, but without machine data, scheduled maintenance is the best defense. But machine specs and maintenance guidelines don't accurately incorporate actual use on the floor. Companies are left with a reactive strategy, leaving them vulnerable to unnecessary maintenance, equipment being replaced while it still has a useful life, or unnecessary downtime due to unexpected problems.

Let's look at a cylinder. An operator would never notice any lag between the moment a signal is sent to the cylinder to start and when it actually starts. However, it is possible that the cylinder actually took 50 ms to start; knowing that piece of information could reveal a developing problem. By monitoring that data, you identify a pattern that indicates an impending failure. Once the pattern is identified, the component would be scheduled for repair and be replaced prior to failure, during a "planned maintenance event."

Condition monitoring identifies changes and events that could shorten the normal lifespan of a machine. By tracking the equipment in operation, problems can be flagged and repaired. Replacement parts can be ordered in advance and personnel are scheduled to make the repair during normal operations. Bottom line: Condition monitoring is a proactive strategy to take the "what if?" out of maintenance.

There are many monitoring tools that can be used in a predictive maintenance program, including vibration analysis, thermography, motor testing, tribology and laser shift alignment. Whether you need standalone modules or can integrate these tools with your existing automation and control systems depends on your situation. A control system integrator can assist you in assessing how to start and identify which data to track to give you the greatest return.

This newfound data has given us the ability to use statistical process control (SPC) in ways that have not been considered before. With SPC, you can monitor and potentially control devices to ensure reliability by predicting anomalies that lead to failures. SPC can be set up to monitor normal operation on any data point and detect statistical variances that identify upstream problems well before they become unscheduled downtime.

Because there is so much data available, it's important to identify what data to collect, how to analyze it and what to communicate to the shop floor. Failure to carefully consider your roadmap for your

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Maintenance Isn't an Expense; It's an Investment

data usage can lead to wasted money, frustration and poorly functioning systems. Start with your most critical assets, build a foundational system and build onto it, in small chunks, from there. In this way, you can start getting important information to plant personnel right away so action can be taken right away.

Maintenance becomes strategic when you leverage real-time machine data to proactively manage your production assets. Reducing unplanned downtime results in improving profitability. That's how you convert maintenance from an expense to an investment.

Increasing Plant-Level Awareness of the Industrial Network

Leveraging Real-Time Visualization and Monitoring Across Ethernet Endpoints

Introduction

As production facilities aim to further automate their processes by using smart manufacturing and Industrial Internet of Things (IIoT) concepts and technology on their plant floors, the number of connected devices that need to be monitored and controlled dramatically increases. This is driving a shift in the way the plant floor works at many facilities. Currently, automation and controls engineers need to integrate older propriety and serial industrial networks, which were tightly tied to automation, with new networked systems based on an IT infrastructure.

With their previous systems, there were only a few nodes to hook up, control, and monitor. This allowed automation and controls engineers and technicians to manage and troubleshoot their networks using programming software tied to the automation system. Now, Industrial Ethernet, which uses standard Ethernet protocols along with rugged connectors and extended temperature switches, is becoming the new standard for automation and process control in industrial environments.

These systems connect computers, networks, data centers, machines, and a variety of other devices. By nature, these systems are built on IT-oriented technologies, yet because of their impact on production output, they can be much more critical than a typical in-office network. While these systems use IT-based technologies, their impact on plant output requires collaboration between IT personnel and automation and control engineers to ensure the Ethernet network provides an effective control system foundation for plant operations.

With so many connected devices to manage in industrial environments, it can be challenging to identify and visualize where each device and system are connected. Therefore, detection, diagnosis, and problem resolution have become increasingly costly and more time-consuming. Many companies are falling into the cycle of letting their infrastructure break and then reactively fixing the issues, in spite of latent risks, rather than taking a proactive approach to monitor and predict maintenance needs for their facility. As a result, in the United States, almost 80% of companies have insufficient or ineffective preventive maintenance programs.1 This white paper discusses the need for manufacturing facilities to increase real-time visibility of the industrial network to determine and resolve connectivity issues while increasing time and cost savings.

Real-Time Visualization of the Plant-Floor Network

As the number of smart, connected devices implemented on the factory floor increases, so does the likelihood of a failure. This is especially true for companies that have more established manufacturing processes. Many of these plants are being retrofitted with new

equipment piecemeal as permitted by time and budget availability. While plant managers and automation and controls engineers understand the importance of maintaining up-to- date documentation of their network, this can be quite difficult. Not all components are added to the factory floor at the same time or by the same technicians. Often, efforts are made to manually track information such as the IP addresses for devices on the plant floor, or to update industrial network drawings. These types of tasks usually require a substantial amount of work, which is quite difficult in an industry that has shrunk by nearly 15% in the past decade and has dealt with many challenges around workforce availability, training, and aging.2 Thus, there are substantial knowledge gaps within companies regarding how systems are interconnected and which components rely on each other to function.

Additionally, because of the harsh nature of the plant floor, automation networks are highly susceptible to interruptions. However, for the design and deployment of industrial systems, the physical layer of the system usually gets the least attention and less than 10% of the budget; yet, nearly 80% of network issues on the plant floor originate from problems with physical layer connectivity (Figure 1).

This often results in downtime and lost production, especially since closed-loop process control often relies on an Ethernet link. Frequent breakdowns can be costly for manufacturers or potentially dangerous for factory floor workers.

Executives in the manufacturing industry anticipate that 95% of companies will take advantage of IIoT technology within three years.3 This will dramatically increase the number of connected industrial devices on the plant floor in the future, making the possibility of disruptions even more likely, and the need to rapidly detect those disruptions even more critical.

Ideally, automation and controls engineers need to assure network uptime with real-time visualization and monitoring of the entire network, in addition to network diagnostic capabilities. With awareness into all levels of devices and connectivity, operational field technicians can efficiently communicate with IT and automation

Accelerate Deployments While Reducing Risks

The Panduit Integrated Network Zone System enables network communications between the control room and manufacturing floor within an industrial facility. Integrated with an Allen-Bradley Stratix switch, the pre-engineered, tested and validated system reduces deployment time up to 75%.

Continued
Increasing Plant-Level Awareness of the Industrial Network

teams about issues, allowing individuals who are not network or machinery experts the ability to respond to issues as if they were. This approach could help manufacturers proactively improve the uptime of their Industrial Ethernet infrastructure. IntraVUETM industrial network and visualization software by Panduit® offers automation and controls engineers the ability to use this approach to address the challenges unique to these industrial environments.

Continuously Monitoring the "Edge" of the Network

With the implementation of IIoT through Industrial Ethernet, the number of connections at the very edge of the network has grown drastically and the architecture of networks has become increasingly complex. Many components on the plant floor are now interconnected, including Input/Output (I/O) devices, PLC controllers, human-machine interfaces (HMIs), drives, process instruments, and IP cameras (Figure 2).

Instead of only providing computing resources, these connected devices make machines move, sense positions, and provide safety features. These devices also have requirements and applications that are quite different than the typical Ethernet network operating in an enterprise environment. Thus, within plant networks, it is critical for IT teams and automation and controls teams to work closely together to ensure the uptime of not only the network, but all the devices on the network.

Traditionally, typical networking tools are often extended from enterprise environments to perform the important roles of configuring and monitoring the switch networks. But, these tools may be familiar to non-IT personnel, such as the technicians on the plant floor. This can be a major challenge when issues arise on the

plant floor because the typical first responders are technicians who understand the devices, but may not have a great deal of network experience. Thus, it is important to have a tool that can provide enough details about an issue so the device can be effectively reset, repaired, or replaced, but not too much information about the network that it appears overwhelming to the technician. IntraVUETM software addresses this fine balance of information by providing network details through easy-to-view, real-time interactive graphics. As shown in Figure 3, the red line indicates a disconnected device. Additional details about the port on the switch where the device should be connected are available by hovering over the line. As a result, from one web-based application, automation and controls engineers and technicians can visualize all the network's devices through a simple interface all the way to the edge of the network from a single location.

Automated Analytics

Issues with deployed plant equipment are significantly more expensive to resolve than machinery issues discovered during design or development (Figure 4). As the plant floor becomes more connected as a result of IIoT, there are more points where issues can occur. Thus, automation and controls engineers need to provide information to electricians and technicians so they can easily support all the interconnected pieces.

To simplify this process, automation and controls engineers can use a tool such as IntraVUETM Reports to automatically generate written reports tailored to the skills and responsibilities of the employee receiving the reports. Deeper levels of visibility can be provided based on the stakeholder group receiving the reports. These reports can identify issues and offer suggested courses of action for many common problems that can occur on Industrial Ethernet networks, including:

- Device failures
- Duplicate IP addresses
- Broadcast or multicast storm
- Intermittent connection problems
- Devices that were accidentally moved
- Foreign computers momentarily linking to the network (security issues) o Large file transfers between devices
- Accidental cable loops
- Switch resetting
- Overloaded or misbehaving devices

With these reports, plant engineers can deep dive and probe into data, or they can pull together general information to share with their technicians.

The Advantages to Understanding All of the Plant Floor

As the plant floor becomes increasingly sophisticated and interconnected, the need for plant automation and controls engineers to have visibility into their entire network and simplify support all the

way to the edge is rising. Having a tool that can reduce the potential for intermittent communication disruptions, enable continuous real-time monitoring, and provide remote support can offer valuable time and cost savings to manufacturing facilities of all sizes. With tools such as IntraVUETM software, automation and controls engineers can continuously view, analyze, diagnose, and document the plant floor to avoid issues. Industrial controls professionals can have visibility into the plant's entire Ethernet connectivity landscape where connectivity issues are occurring, and plant technicians can access the root of the problem faster, improving uptime and significantly decreasing network support costs and response times.

Resources

For more information on how Panduit® can help increase the plant-level awareness of your industrial network or request a live demonstration with a Panduit Industrial Automation expert, visit www.panduit.com/intravue or email iai@panduit.com.

About Panduit

Simplifying Robust Industrial Network and IoT Deployment

Panduit is a world-class developer and provider of physical infrastructure solutions that improve reliability, security, and safety of Industrial Automation Infrastructure systems while reducing deployment and operating costs. Working with industry leaders, Panduit helps bridge the gap between IT and Controls Engineers by providing optimized building- block architectures for connecting enterprise, industrial networks, and control systems.

Panduit is simplifying robust industrial network deployments, providing our customers confidence and peace of mind through our enterprise, data center and industrial automation expertise, tools, and comprehensive offering.

Pre-Configured Industrial Distribution Frame (IDF)

The Pre-Configured IDF is specifically engineered to deploy and protect rack mount Ethernet switches in industrial applications. Extra-depth allows room for cable management, power management, and switch stack cables and accommodates up to 5 switches. The innovative design provides consistent equipment deployment with faster installation and can significantly lower the risk of downtime due to switch overheating.

3 Steps to Effectively Manage the Plant Floor Network

Introduction

The manufacturing plant floor is a complex environment with plenty of physical resources to measure and manage, ranging from large drives and motors to smaller components such as sensors and batteries. It is common for facilities to have a preventive maintenance program in place for these high-wear items that is based on certain measurements, but what about the plant floor network? How can this important asset be measured?

Plant floor Ethernet networks have become a critical link between manufacturing and automation systems, and business systems, and the standard communication link between automation devices. Two essential needs accompany the growth and standardization of Ethernet within automated facilities—first is the need to offer controls and operations teams an awareness of what devices are attached in each location on the Ethernet network, and second is how these devices are performing. It is important to monitor and measure device performance to properly manage the overall health of the plant floor network. This white paper explores three best practices for determining what to measure so management and operations can effectively and efficiently run the entire industrial network.

Step One: Understanding the Importance of Key Performance Indicators

The first step to adequately managing the plant floor network is to determine the factors that need to be measured, then consolidate the list to determine which items are the most crucial to organizational goals and the health of the systems. These essential measurements are known as key performance indicators (KPIs). A KPI is a quantifiable measurement a company uses to determine how well it meets its operational and strategic goals. KPIs are unique to the organization and based on each department's expected performance to ensure the entire organization is successful. Several combined measurements could equal a single KPI.

The basic characteristics needed to establish an effective KPI include:

- Easy to understand
- Measurable
- Actual (up to date)
- Not many in number

Source: http://www.measurebusiness.com/the-choice-of-kpis-in-bsc-implementation.htm

Step Two: Developing Key Performance Indicators

To develop the most effective KPIs, organizations should first have well-defined goals and established benchmarks in place. One common way to begin is to explore the overall equipment effectiveness (OEE) in an organization to identify the percentage of planned production time that is productive. To determine an organization's OEE score, observe the ratio of fully productive time to planned production time, noting that scheduled downtime is not included in this equation. Figure 1 illustrates the industry standards for separate

manufacturers.

With the emergence of Industrial Ethernet turning disparate systems into a connected plant, world-class producers realize that they must account for uptime of the industrial network infrastructure as a key driver of OEE. With this realization, management at these organizations are seeking to change how they run their operations.

For example, for the plant floor network infrastructure, many organizations have a break/fix mentality, so when there is network downtime, it has to be addressed immediately to get the plant running again. This directly results from reviewing KPI data for a segment of the plant, (e.g., a machine or a cell) that does not necessarily address the interconnected nature of today's industrial operations. This is a crucial practice for companies where incidents on the industrial network impact plant production. Instead of searching for an interruption on a cell or machine where the impact is obvious while the root cause may be obscure, a more effective approach might be to observe the performance of the overall industrial network infrastructure, and its interactions throughout the various machines on the plant.

To establish a KPI that will help an organization move towards the ideal 100% network uptime, operations should first decide which devices within the industrial network are required to run constantly, such as the human-machine interfaces (HMIs), programmable logic controllers (PLCs), input/output (I/O) controllers, industrial switches, and drives that, if taken down, would stop production. Figure 2 illustrates the many types of devices that can be included in a single industrial network.

Next, it is important to establish which network events to record and which events will trigger an immediate alert. While all network events should be recorded, alerts might only be triggered if the network capacity drops below a specific threshold. It is important that this threshold is not a full "break" of the network that results in downtime. Finally, organizations need to determine a time frame, such as daily, where key operations and controls manage-

IntraVUE

Automation networks are susceptible to interruptions which often result in downtime, and lost production. While conventional tools are frequently unable to detect many types of network interruptions, IntraVUE provides the capability to identify and report information critical to improving uptime of the Industrial Ethernet infrastructure.

ment will review network reports. Using this approach, controls and operations managers can see trends in the network over time and can identify when the network is operating even slightly below target efficiency. These issues will not cause a noticeable problem with the network, but they can be early indicators of future network issues.

Step Three: Making Informed Decisions Based on KPI Data Reports

For any business, having data to make informed decisions is vital. Often, continuous improvement is overlooked in an organization because it is difficult to provide data that shows the benefits of the improvements versus the costs. For a plant floor network, available data to show where degradation is occurring and where improvements are needed to appropriately manage the network and output of the plant is key. For example, the network KPI can show that although network uptime is still above goal, the number of events occurring on the network is increasing rapidly, pointing towards network instability. Exploring this data may show an intermittent connection to a critical I/O module that can be identified and resolved quickly, even before failure.

This information can help controls and operations management justify the expense of capital improvements needed for proactive maintenance instead of relying on a reactive maintenance approach. To gather the appropriate data, a tool is needed that can easily show controls and operations management a snapshot of the industrial network's health based on the pre-determined KPIs. Controls and operations management can remotely observe the KPIs using an easy-to-understand, web-based interface. Tools such as the new KPI report feature in IntraVUETM industrial network and visualization software by Panduit allow management to make informed, data-driven decisions by providing visibility into how the network is performing (Figure 3).

Reducing Plant Downtime by Properly Managing the Industrial Network

The devices that comprise the industrial network within an automation system are a key asset to the success of the plant output, which drives profitability for manufacturers. Proper metrics for industrial network infrastructure performance allow controls and operations teams to make informed data-driven decisions to manage network uptime and mitigate the cost of unplanned disruptions. This simple shift from a reactive to a proactive approach to manage the industrial network can drive improvements in time-to-resolution of separate downtime events by as much as 75%, while providing objective measurement on the uptime of important devices to drive improvement in overall plant effectiveness.

References

[1] Source: http://www.measurebusiness.com/the-choice-of-kpis-in-bsc-implementation.htm

[2] Source: http://www.leanproduction.com/oee.html

Resources

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Panduit is simplifying robust industrial network deployments, providing our customers confidence and peace of mind through our enterprise, data center and industrial automation expertise, tools, and comprehensive offering.

Increase Your Network Security

Prevent unauthorized access or accidental breaches by establishing a robust physical network infrastructure that offers barriers to network-wide security risks through the use of an integrated physical and logical architecture that includes Panduit Micro Data Centers

Manufacturing Data as a Motivation and Empowerment Tool

The more understanding an operator has about his impact on the process and, ultimately, the performance of the line, shift, and plant, the more likely the operator is to make better decisions.

By Brian Briggs, Consultant, Avid Solutions Inc.

One of the often-overlooked aspects of a manufacturing execution system (MES) is its use as a motivational tool. Many of us now have digital reader boards, information kiosks, or other methods of providing production and safety information to our employees to keep them informed on a day-to-day basis. With the addition of an MES in your manufacturing facility, many additional key performance indicators (KPIs) can be exposed and available for distribution across your enterprise.

Empowering an employee to review data and perform on-the-spot analysis can have many benefits, including giving some ownership of the process to the operator.

Following is a sample of the important metrics that can be exposed to your operators via an MES:

Operational Metrics

- Yield;
- Suppliers' incoming quality;
- On-time delivery to commitment;
- Inventory turnover: The number of times the average investment in inventory is sold each year; and
- Manufacturing cost as a percentage of revenue: A ratio of total manufacturing costs to the overall revenues produced by a manufacturing plant or business unit.

Performance Metrics

- Changeover: The time between product changes;
- Manufacturing cycle time: A calculation of the time it takes to create product from work order release to finished good production;
- Percent of planned vs. emergency downtime; and
- Overall Equipment Effectiveness (OEE).

Imagine the possibilities of an operator receiving near real time updates of lab tests to measure against the material they are currently processing. Production and plant management can review quality data against current throughput volumes and make adjustments and decisions without having to wait until the end of a run or shift to adjust as needed.

I have seen the beneficial results of doing this through my work as a systems integrator. For instance, at a cheese plant producing 40–50 vats of curd per day, yield is tracked and adjustments to ingredients, temperatures, and step duration for in-process vats are made in near real time to hit yield targets on a constant basis.

Continued
Manufacturing Data as a Motivation and Empowerment Tool

In another example, we were able to use MES data to implement performance tracking within 13 separate oriented strand board (OSB) plants. Reviewing MES data with performance KPIs such as OEE and statistical process control (SPC), we found that operators were habitually running materials through the press with much higher levels of wafers, wax, and resin than needed to ensure the panels would meet quality specifications. After showing the MES data directly to these operators and working with them to make the necessary adjustments, we were able to produce panels that achieved the same quality specifications using significantly fewer raw materials. At the end of the project, our estimated ROI for each plant was approximately $750,000 annually.

While opening up this information to an operator can play an important part in optimizing direct production activities, it should also be noted that by opening up this data across a facility, campus, and even the entire enterprise, the benefits can cascade out to touch all aspects of your business.

The Value of Looking Within

There is a wealth of useful information that can be gleaned by connecting a manufacturing execution system with a local system from within the production facility.

By Brian Briggs, Consultant, Avid Solutions Inc.

A manufacturing execution system (MES) can be a powerful tool in your organization's quest to follow the continuous improvement trail. It can help expose gaps in your process, lower costs, improve quality and reduce data errors.

A lot of focus and effort are put into the integration of an MES with an enterprise resource planning (ERP) system, but there is also value in looking the other way to focus on integration at the process level. By adding process data to your company's analytics, it is possible to open paths into the process that you might have never known existed.

When you connect process data to in-process quality results, the exact reason for out-of-spec material can become crystal clear. Not only that, but you can also gain the ability to look back in time and determine what variables caused the out-of-spec episode. This principal can also be applied to alarm conditions, overuse of raw materials, startup/change over events, etc.

Eventually, it is possible to reach that state of nirvana where you can begin practicing the dark arts of machine learning and predictive manufacturing.

Imagine getting to the point where you can run a report that flags variables like motor runtime, maintenance records and current quality trends to indicate an impending out-of-spec period. When that happens, you will be able to make informed decisions. You will know immediately, for example, if you will be able to fill orders for lower-grade material or if it will be necessary to take a downtime hit to correct the issues and get back on track making A-grade materials.

In addition to those benefits, there is a wealth of useful information that can be gleaned by connecting an MES with a local system from within the production facility and gathering additional data that might not be pertinent in a corporate environment.

For example, I had the opportunity to work with a solar panel manufacturing client's R&D department, where we used a mixture of quality data, process data and MES data to refine the process trimming materials and develop a solution that not only saved money but also resulted in a faster manufacturing approach.

A lot of enhancements can be revealed by narrowing the focus onto specific functions on the plant floor. Once there are systems in place integrating those functions together, finding the resulting opportunities becomes a matter of prioritizing.

By adding process data to your company's analytics, it is possible to open paths into the process that you might have never known existed.

One area that is important to consider is the final product release. In many industries, the time gap between final product production and the resulting release to the customer can vary depending on in-process testing requirements, process reconciliation and other

variables. By implementing solutions that remove the human element, reduce the steps required, and/or increase the speed at which these requirements can be met, the product can go out the door and into your customers' hands that much more quickly.

Not all analytics belong at the corporate level. The previous examples would have been either impossible or very difficult and time-consuming if the associated data had been transmitted to a centralized data warehouse or to an MES data store.

To be successful, it is necessary to spend the time to determine what improvements to chase at what level, since this can result in multiple dividends. Some items to consider:

- Process orders
- Bill of materials
- Material transfer
- Material status (quarantine, expiry)
- Operator training status
- Equipment preventive maintenance status
- Equipment calibration status
- Process order status
- Material consumption
- Material produced
- Final product release

Trying to implement a system for tracking orders, production levels and order planning at the production facility level is much more complicated and cost-prohibitive than moving a select number of data points to a centralized data store and comparing them plant by plant. In this case, the corporate solution gives a better overall view and greater control.

It is possible to track machine-level overall equipment effectiveness (OEE) at the corporate level. But it is important to ask the question, "Will we get better results from having this at the local level?" In many cases, a "yes" answer is obvious. The operator, supervisor and possibly the plant manager need to know the OEE on a device-by-device basis in order to make split-second decisions and to identify bottlenecks and opportunities. The corporate level can also benefit from seeing a dashboard that lays out a plant or line OEE and performs analytics to determine higher-level bottlenecks and opportunities.

In all of these cases, the true value of looking within can be realized when the resulting MES data is used to improve processes.