Plant Services
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mission control FOR MANUFACTURERS

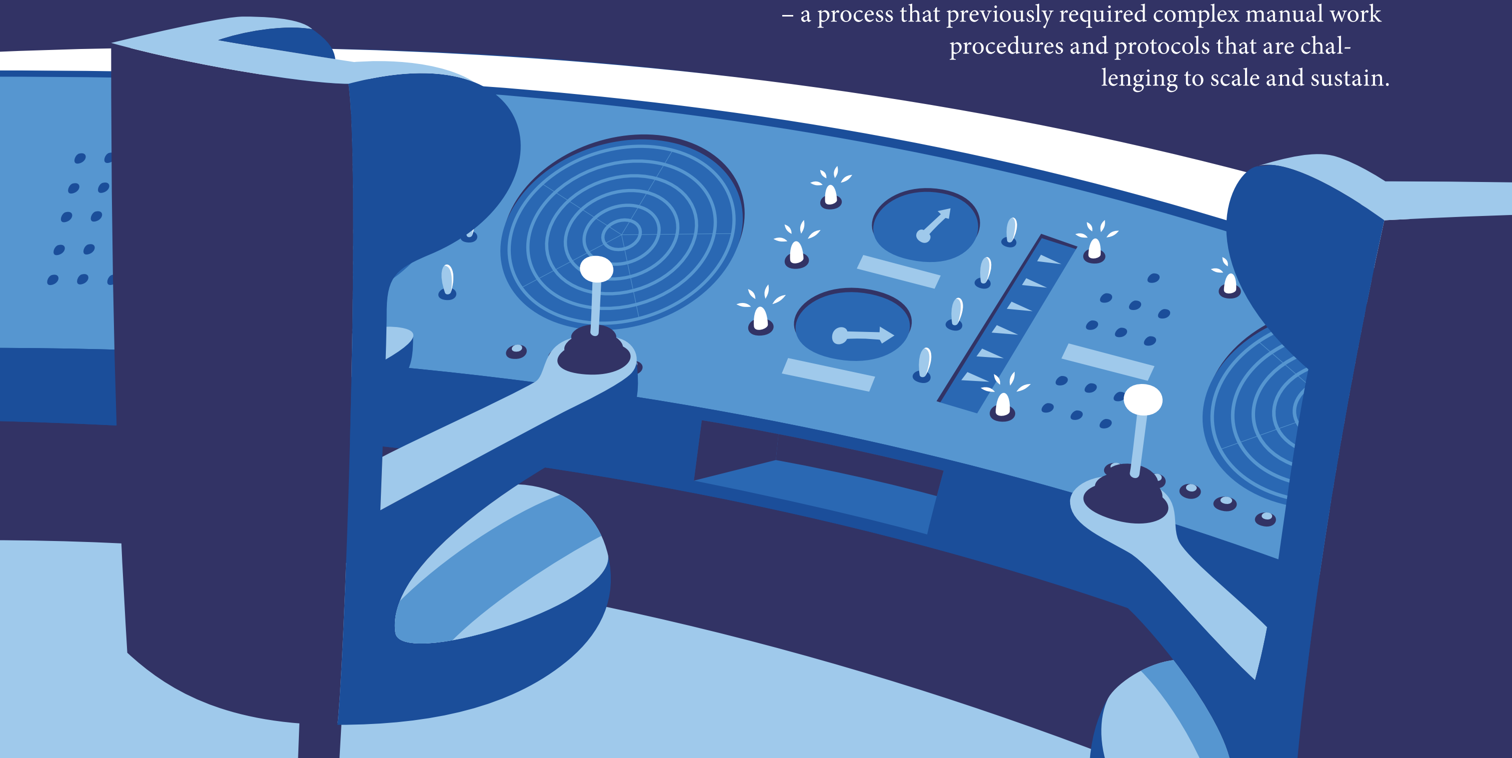
How harnessing the digital revolution will improve asset reliability and performance

by Mike Boudreaux, Emerson Process Management

Across our industry, you hear people talking about the digital transformation of manufacturing – what it looks like and how it's happening in a variety of ways. Much effort is being spent to define the scope and vision behind individual initiatives, whether they're labeled under the umbrella of the industrial internet of things (IIoT), Industrie 4.0, intelligent energy, or some other term, but the fundamental concept is the same: Technology is enabling new business models that promise to deliver significant value in the areas of operations performance and reliability while addressing long-standing and unresolved issues.

One such model – performance and reliability monitoring as a service – leverages streaming data and analytical models to detect problems that might otherwise go unseen. Rather than relying on infrequent route-based data collection, sensors and gateways can securely stream data to service providers. Wired and wireless gateways can be installed in dedicated monitoring networks that are isolated from other networks and require higher levels of security and performance. Data from these networks can be combined with process historian data for contextualization and more-advanced analytical models. Service providers can develop analytical models and offer deep expertise with a focus on specific equipment types and industry applications that can be deployed across an entire fleet of equipment across multiple sites.

Early detection of potential equipment failures or process upsets can result in better planning for maintenance, avoidance of unplanned downtime, increased process availability, and reduced maintenance costs. New technologies such as innovative sensing, wireless networks, inexpensive microprocessors, flexible messaging protocols, cloud computing, advanced analytics, and mobile tools provide opportunities to improve asset performance and reliability. These technologies enhance early fault detection and improve the capability to automate workflows to take corrective actions – a process that previously required complex manual work procedures and protocols that are challenging to scale and sustain.



PERVASIVE SENSING: MORE MEASUREMENT POINTS, BETTER MONITORING

The most basic method for reliability monitoring is built on route-based data collection. This approach can deliver incremental value in focused areas, but it involves manual activities that are costly, subject to failure, and performed infrequently. Work processes in this kind of environment generally lead to on-site equipment inspection, which relies heavily on the technician or operator in the field.

Preventive, predictive, and corrective maintenance programs are increasingly dependent on instrumentation for online monitoring of critical process equipment. New sensing tools are making it possible to get increased visibility of assets or processes by providing more measurements at a lower installed cost. These measurements – for vibration or corrosion, for example – can help organizations detect a variety of undesirable conditions: leaks, overheating, equipment damage, and more. Connecting these sensors to networks that are independent of control and safety systems can mean faster deployment and reduced cybersecurity risk. In some cases, these monitoring networks operate completely separately from other networks.

ON-SITE EXPERTISE IS HARD TO COME BY

Many plants are looking to improve the performance and reliability of their operations, but they lack the scale to support the investment in technology and expertise that is required to be successful. For those facilities that have invested in instrumentation for data collection, hiring and retaining qualified experts can be difficult and costly. Most plants are attempting to accomplish more with fewer people. Even if a plant has trained engineers on site, the majority of their time is dedicated to urgently solving complex problems in the plant rather than studying data in an office. In either case, a lack of focused domain expertise can cause valuable data to go unused.

In many cases, having enough qualified engineers to staff every plant is an unrealistic proposition. In addition, experienced workers are retiring from the workforce at a staggering rate, making it difficult to find replacements. Whether the organization simply doesn't have the resources or skilled engineers aren't available, staying ahead of the curve in production means finding new ways to put data in the hands of experts.

For manufacturers with multiple production sites, the problem of thinly stretched resources can be remedied by centralizing reliability and performance monitoring experts in a center of excellence. This approach is becoming common in the oil and gas, power, and mining industries. Advances in wireless technology and video collaboration have made it possible for engineering experts employed by the company to be centralized in a physical location where they can monitor data across the enterprise, receiving information in real time. This allows all plant locations to have the benefit of expert analysts tracking data trends for predictive maintenance while still limiting the number of engineers the company needs to employ and keeping travel to a minimum.

A center of excellence can take on many different forms, but the most common iteration involves co-location of experts in a facility that is designed for collaboration. Experts have desks with as many as four monitors where they can easily combine information from multiple software applications for quick decision-making. It is typical to have shared screens on a video wall for situational awareness, with dashboards, trends, and KPIs being displayed for common viewing and collaboration.

However, the center of excellence does not necessarily need to exist as a physical location. In many cases, the ideal solution can be a virtual team of subject-matter experts that can collaborate without being in the same location. Virtual teams are becoming increasingly popular because they allow organizations to make effective use of in-house engineers wherever the engineers are located. This approach also enables collaboration with service providers from outside the company.

> Advanced analytical models can be applied to streaming data to generate notifications.

In some application areas, plant operators are looking to service providers to perform data collection and analysis. For simple applications that don't require a high level of interpretation, technicians are trained to inspect equipment and record status based on mobile test equipment. When a high level of analytical expertise is required, data is collected locally by trained technicians and routed to experts in service centers. This can be an effective model for condition monitoring of mechanical equipment where failures are infrequent and detectable long before they eventually occur. Machinery condition monitoring services based on remote analysis of vibration data are commonly available from vibration technology vendors.

Condition monitoring services are also being offered for critical process equipment other than machines. In the case of control valves, rich sensor data can be collected from digital valve controllers using handhelds and laptops or online through digital protocols such as HART and fieldbus. Trained experts can monitor control-valve sensor data to detect the early onset of excessive wear, growing friction, and other factors that can lead to performance degradation or a catastrophic failure.

THE FUTURE OF CONNECTED SERVICES

For health monitoring services where a fast proactive response is required to address an urgent problem, connectivity can enable a service provider to receive real-time equipment alerts that can be acted on quickly. This kind of service can be integrated with product support services by automatically dispatching support technicians when a problem is detected while filtering out alerts that require no immediate action from operators or maintenance technicians.

An application of this type of service is control-system health monitoring services. Control systems are critical assets with many complex electronic components. Event data from process controllers, I/O, servers, workstations, and network switches can be collected by secure gateways. Event data is routed to the control system vendor for monitoring and rapid response. Even failures beyond the control system – such as a loss of cooling in a server room, which could cause the servers to overheat and the system to shut down – can be detected. The service provider gives operators the information they need to respond to developing issues on control-system equipment to avoid major process disruptions.

Similarly, condition and performance monitoring services can be enhanced with predictive notifications that enable collaboration with plant operators when anomalies are detected. Rather than depending on experts periodically looking at route-based data, advanced analytical models can be applied to streaming data to generate notifications. With increasingly accurate anomaly detection models, failures and abnormal conditions can be predicted earlier and with better consistency. Expertise may still be required to fully diagnose root causes, predict future impacts, and recommend corrective actions, but advanced analytical models can be used to automate this as well.

A high level of domain expertise and data modeling support is required for this kind of service, which most companies cannot develop in-house unless they have the scale of operations that justifies a centralized remote monitoring and diagnostics center. This service model has typically been focused on highly critical equipment such as gas turbines for pipelines and power plants, but it has the potential to be extended to other types of critical process equipment, including pumps, heat exchangers, compressors, and control valves. Only the largest of companies in any given industry are able to support this extended model with an in-house approach, because they have the scale of operations to justify the investment.

Additional measurements often are needed to deliver these service models. Measurement technologies can be connected into a company's existing data infrastructure, or they can be provided as an integrated part of a service contract. In this model, the monitoring equipment is owned, installed, maintained, and operated by the service provider. A vendor-owned monitoring network can publish data to the remote service provider, where software tools and analytics are used to create actionable information. This model requires no up-front capital investment by the customer – only a monthly fee for information from the service provider. The business model becomes one of cash flow savings as the customer realizes saving on energy costs, improved product quality, and improved reliability, which are the outcomes of the monthly service.

Connected services promise to deliver unprecedented access to expertise and quick problem resolution in the focus areas of top-quartile-performing organizations. They represent the potential of the industrial internet of things, and while businesses are already realizing benefits today, we are only scratching the surface of what is possible.

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