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Modernize Your Plant with IIoT at Your Own Pace

Jonas Berge **outlines the road map on how plants can get an IIot architecture work with new practices and business models.**

Industrial Internet of Things (IIoT) and Industrie 4.0 enables richer process and asset data for more effective operation. You may be wondering how to get started. Take a phased approach to implementation; starting within the plant, connecting to the Internet much later. Many plants have already started.

Phased approach

Some plants already use digital networking at the sensor level and bring the data across the Internet to central operations benefitting from IIoT, but most plants are not. A plant can deploy IIoT step by step. The first several steps do not connect to the Internet so the I&C department can launch this initiative right away. The IT department gets involved when access across the Internet is implemented.

Figure 1: Phased approach

Step 1: Plant-wide digital sensor networks

Many plants have already started adding wireless sensors integrating with the existing control system to make the plant more efficient and reliable by covering measurements left out in the original design, proving the technology works. Modern plants built on fieldbus allow easy connection of additional sensors but also deploy wireless sensor networks. Some plant data is collected manually hampering condition monitoring and energy management. Deploying 4-20 mA transmitters would be very costly and may damage existing cable. Start deploying WirelessHART (IEC 62591) networks in each plant unit. Using the correct protocols gateways connect to the DCS, historian, and condition monitoring software.

The IIoT solution must be an extension that is backwards-compatible with the existing networks in the plant. Fieldbus and wireless instruments form the base layer for IIoT. Once the WirelessHART network is deployed, sensors to meet the needs of the reliability, maintenance, energy efficiency, operations, HS&E and integrity departments follow.

If the plant has not yet tried WirelessHART, identify a problem and deploy wireless sensors to demonstrate the technology as soon as possible.

Step 2: Instrumenting assets

If the plant is using fieldbus, sensors can easily be added. Conduct a plant modernization audit to identify opportunities to improve plant operability and maintainability. Speak to each department about their challenges: manual data collection, inability to predict failures, prioritize maintenance, optimize corrosion control, pinpointing fouling, energy overconsumption and leaks.

From the needs identified in the modernization audit, determine what sensors are required to instrument each piece of equipment. Applications include multiple domains: reliability, maintenance, integrity, energy efficiency, HS&E and productivity. Some measurements will be displayed in the historian and some in the control system. Simple applications like data collection do not need specialized software. Applications can grow domain by domain. Many plants have started with a single sensor per piece of equipment but later add more sensors to gain additional insights.

Once the WirelessHART networks and sensors are in place the personnel spend less time on manual data collection, can predict failures, prioritize maintenance, optimize corrosion control and detect leaks. Personnel are usually surprised to detect so many failures when the system is turned on because it was not visible in the past. This drives maintenance activities and operations, reducing cost, downtime, losses and incidents.

Step 3: Deploy predictive analytics software on-premise

Plants store lots of process data but analyze little. Plants do not capture much equipment data. Some plant challenges require more advanced solutions with more than one measurement to diagnose the health, determine the performance and detect overconsumption of the equipment. For instance, vibration alone is not enough to get a complete picture of equipment health.

By deploying sensors and software, equipment becomes smart connected equipment; pumps become smart pumps. Software provides actionable predictive information from raw sensor data. For instance, the duty of each heat exchanger bundle is trended to visualize how fouling responds to product blend and anti-fouling chemical. Software can run on a server on-premise. There is no need to connect to the cloud yet. Some applications can even run on an appliance similar to a controller.

Make sure to budget for the engineering and commissioning cost.

At this stage it is still not IIoT so IT department need not provide Internet connection. The resulting IIoT solution must be an extension backwards compatible with the existing software. OPC applications form the software layer for IIoT.

With special software, the plant additionally gets the ability to pinpoint fouling and energy overconsumption, and to optimize fan speed. This drives maintenance and operations ensuring high availability at low cost, spending less time as well as reduced energy consumption etc.

Step 4: Review work processes

Software and sensor data must be used in the daily operation and maintenance of the plant for the benefits to materialize.

First, maintenance should get predictive alarms before operations and before trip. Second, maintenance alarms should only be configured for significant issues. Alarms should indicate the urgency, and contains a clear description and help. The Standard Operating Procedures (SOPs) should be modified to include use of the software and data. Lastly, staff must be trained to use the new information.

Once software is setup properly the plant will get into a "check the software first" mentality, which saves time and helps realize the benefits.

Step 5: Enable IntRAnet of Things

The site may not have sufficient staff with vibration analysis, corrosion or fouling skills. It can be difficult to attract people to work in remote sites away from their families.

By connecting the systems to the enterprise, Intranet the data from the site can be accessed across the Internet by company employees anywhere in the world, such as an onshore office or from a global center of excellence with vibration analysis and corrosion experts. Access is not granted to external vendors and service providers. This is more of an "Intranet of Things" than an "Internet of Things".

Intranet connectivity enables part of the personnel to work in an office near their home rather than on an offshore platform or in the bush. It also lowers the capital and operational cost as offshore installations can have smaller living quarters, and less transport logistics are required.

Step 6: IntERnet of Things business models

The plant may have fieldbus and wireless but without an Internet connection it is not yet IIoT.

The equipment manufacturer's expert knows the equipment best but is not at site. A site may not have sufficient personnel to carry out the maintenance tasks.

Figure 2: Instruments on offshore platform can be accessed from onshore facility.

By connecting the systems to the Internet, access to data from the site can be granted to selected external vendors and service providers anywhere in the world. This is the full IIoT architecture. Digital sensors and IIoT enable a digital transformation of outsourced business models.

Business models

Independent service providers and original equipment manufacturers can remotely monitor the health of equipment in plants. Their experts in a central location watch the status of equipment for which access has been granted. This can be subscription-based services where the plant pays a monthly fee per asset. The service provider alerts the plant to developing equipment issues and generates reports for equipment health and performance, which drives maintenance action in the plant. The instrumentation and software can belong to the plant, but the other variation of this model is that the service provider also provides this instrumentation and software. In this model there is no upfront capital investment for the plant. Instrumentation and software is included in the subscription fee which is an operational expense.

Further, the manufacturer's factory-trained personnel or a maintenance service provider can also carry out the maintenance tasks to ensure availability and efficiency of the equipment; an outcome-based model, possibly with bonus payment when agreed level of service is attained.

Using the data from the equipment, the service provider can predict developing issues before failure or trip, avoiding downtime and help troubleshoot equipment, getting production back to capacity sooner.

Cybersecurity and IT/OT integration

Considering all the asset classes in a plant, several manufacturers should be granted access to equipment data. This requires security to be developed with specific access rights for each vendor. Such solutions already exist. Since IIoT involves both the Internet and instrumentation, the IT and I&C departments (IT/OT) must work together. Like the saying goes, "good fences make good neighbors", therefore define a clear boundary of responsibility between IT and I&C; usually a Demilitarized Zone (DMZ) with firewalls at level 3.5 of the enterprise architecture.

In some plants the equipment monitoring system is separate from the control system. The wireless sensors send their data through the wireless gateway and a 3G mobile router straight to the software in the cloud bypassing the DCS. This architecture is used for outsourced remote monitoring services. Since there is no connection to the control system or plant networks, the plant IT department need not provide a network connection.

Implement IIoT

Develop a three-year plan for IIoT for the plant and arrange a plant modernization audit. The later steps of the IIoT strategy need not have much detail initially. With IIoT in place, the plant can be ran and maintained in a more proactive and a less reactive manner. Personnel will spend less time collecting data, and have more time to work on the data. **CEA**

Jonas Berge is Director of Applied Technology, Emerson Process Management, Singapore.