The Journey Toward
The Connected Enterprise
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The next industrial revolution is happening right now, and The Connected Enterprise is the reason for this shift. As global pressures for goods and natural resources continue to grow, companies need to find new, innovative ways to use advancing Internet-ready technologies to meet demand. The convergence of information technologies (IT) and operational technologies (OT) is improving global production, sustainability efforts and overall business. If companies aren't on-board with this industrial shift, they will fall behind.

Rockwell Automation, the world’s largest company dedicated to industrial automation and information solutions, understands the evolving industry challenges confronting global manufacturers – because it is one. As an evolution of its decades-long commitment to capturing enterprise data to make better decisions, the company implemented an enterprise-wide strategy several years ago to better connect its global manufacturing facilities and accelerate the business value of its Connected Enterprise.

The Connected Enterprise – converging operations, automation control and IT to access and capitalize on operational, business and transactional data – connects people and processes for better collaboration, faster problem solving, and improved innovation within an organization and its supply chain.

Rockwell Automation has implemented a new approach to manufacturing that includes a standardized, global information system – occurring at nine sites from Asia to North America to Europe. It’ll expand the system, and by 2016, Rockwell Automation will have rolled it out across 95 percent of its manufacturing facilities.

By integrating information across IT and OT, and from the plant floor across the enterprise, Rockwell Automation has optimized its enterprise, plant and supply network performance and business agility. And now it’s helping customers do the same.

Speaking from experience, truly connecting an enterprise is far more complex than simply linking disparate systems. “Enhancements will be made, and improvements will be needed – that’s the point,” said Bob Murphy, vice president of operations, Rockwell Automation. “We’re constantly looking for opportunities to improve operations at individual plants and throughout the enterprise.”
Motivators for Change

Like many industrial and manufacturing companies, Rockwell Automation has a diverse product portfolio. Its plants are spread across the globe and across a variety of manufacturing processes, averaging 200 different part numbers per order and a product life of 20 years. In addition to standard or make-to-stock manufacturing, some sites are geared toward engineer-to-order (ETO) manufacturing. These sites produce custom-made products and parts. Others are configure-to-order (CTO) manufacturing plants that configure all variable parameters associated with a base product chosen by an OEM or end user.

Rockwell Automation plants – and those of its customers – need agility and flexibility to cater to the variety of manufacturing processes and supply chains at a faster rate. They also need to meet quality standards and control cost.

“When we talk about variety, we’re also talking about complexity,” said Ivan Ramirez, Monterrey, Mexico, plant manager, Rockwell Automation. “By having a connected system that provides the right data at the right time regardless of what manufacturing process is occurring, we can make faster, smarter decisions to help control quality and productivity. But figuring out how to achieve this isn’t a simple task.”

Standardization, a main driver in successfully connecting an enterprise, becomes a concern when a company has a wide variation in processes. To be efficient and competitive, the company needed a standard point of reference to gain consistent processes for quality control, purchasing and manufacturing engineering, and measure performance from one plant to the next.

Having a connected system across the globe would allow Rockwell Automation to respond quickly to issues anywhere. For example, if there is a surge in demand in China, its facility in Ohio would have visibility into its Singapore plant to respond and address production needs, and vice versa. The company would have an adequate contingency plan in place – a vital component for a global manufacturer.

The company also identified other areas for improvement. Each factory was running on its own enterprise resource planning (ERP) system and had its own custom applications that captured and analyzed data in different ways. A large number of functional experts was needed to ensure the systems worked, and no single system could be easily adopted by other facilities – both cost-prohibitive concerns.

Knowing this, Rockwell Automation took the opportunity to re-evaluate its approach to manufacturing as it journeyed toward a truly Connected Enterprise.

The Connected Enterprise Opportunities

Nearly a decade ago, Rockwell Automation committed to a global rollout of an ERP system to more easily manage its multiple systems that span the globe. As it was implemented in new plants and regions, the company wanted to make additional improvements within its operations.

The organization developed a five-year plan that would restructure its facilities and supplier network entirely. The plan took into account individual locations and products produced at each facility; new technologies needed to tighten control of the supply chain; and new suppliers that would be needed to support the new layout.

To address and improve the technology component in the five-year plan, the company focused on updating the different manufacturing execution system (MES) solutions throughout its plants and facilities – each customized with little to no integration across the enterprise.
One needed improvement was to decrease the hundreds of applications that were registered through business process mapping. This large amount was due to the variety of products, parts, etc., manufactured by Rockwell Automation globally. It created variation in data collected throughout the system, increasing chance of error and amount of time needed to read and understand the collected information – a challenge not uncommon for large, global manufacturers.

The company made a goal to gain a new view of its enterprise that allowed plant managers, supervisors and operators to read actionable information quickly. By integrating applications into one system, overall production functionality would improve and support the company’s transition toward standardization.

Rockwell Automation developed a plan that noted both the current state of its sites, as well as goals and future plans at each location. This helped identify where the implementation of a new system would kick-start enterprise-wide connectivity. To gain a better, deeper understanding of needs at the site level, the internal delivery team developed flow maps that described each location, transactions that occur at each plant, style of manufacturing deployed, type of products produced, etc., as each site has different needs. With this information, they aimed to answer the questions:

• What are the shortcomings of the current MES system at each site?
• How can we make improvements to gain the best solution possible in tandem with our ERP system?

Reducing variation and increasing information visibility at each site would enable managers and operators to measure production efficiencies and inefficiencies. It also would provide an all-encompassing view into the company’s operations and provide a company-wide benchmark to measure success.

The Enterprise-wide Solution

Rockwell Automation needed a cultural and technological change in order to improve its global manufacturing footprint while operating with speed, quality and consistency – The Connected Enterprise goal.

The company’s strategy focused on three main components to achieve this goal: people, processes and technology. In order to create a unified culture that converges IT and OT, Rockwell Automation needed to develop a centralized process that utilizes a common technology. Each component is interdependent with the others, and each is crucial to success.

Through leadership support, the company was able to focus on creating a culture that encourages sustainable change by leveraging:

1. Integrated Control and Information (ICI): Delivered through its Integrated Control and Information portfolio and a network infrastructure based on EtherNet/IP® – a standard, open, single-network infrastructure that helps facilitate secure interoperability with corporate networks and industrial applications – to help develop and maintain a centralized production strategy that improves productivity, promotes globalization, supports sustainability and cultivates innovation.

2. Industrial Internet of Things (IoT): Industrial IoT plays a crucial role in developing and maintaining a centralized production strategy. Technologies and capabilities from IoT eliminate the need for redundant processes and solutions throughout the global supply chain.
3. A strategic playbook: The company developed a strategy for its enterprise. This detailed playbook addressed the overarching goal that could be carried out at each location – one, singular plan.

With the ERP rollout underway, it was time for Rockwell Automation to decide on a solution that would address its manufacturing footprint goals. The company moved forward with an MES application that could be implemented throughout the enterprise – FactoryTalk® ProductionCentre® software from Rockwell Automation. This solution offered a cost-effective development platform with an extensible workflow engine and operational model that could grow with operations. The flexible system also catered to the company’s various manufacturing styles – standard, ETO and CTO.

FactoryTalk ProductionCentre, coupled with FactoryTalk VantagePoint® enterprise manufacturing intelligence (EMI) software from Rockwell Automation to track and record data and pinpoint production trends, fit the needs of individual sites but also provided enterprise-wide capabilities. “The system acts as a funnel for multiple data sources, feeding out understandable, actionable information for us to use to make improvements,” said Bob Rossoll, project manager, Rockwell Automation. “It pulls information from hundreds of applications, streamlines it into one centralized location, and feeds it into the ERP system.”

The scalable system also provides real-time analysis of key performance indicators (KPIs) to measure quality, consistency and process efficiency. More specifically, FactoryTalk ProductionCentre software provides the following capabilities:

- **Production Dispatching:** Tracks work-order management, confirms ERP orders and provides back-up assistance for ERP outages
- **Production Quality:** Monitors out-of-bounds conditions in real-time, managing rework and defects
- **Production Work-Flow Management:** Monitors verification points on each product during production, delivering compliance and regulatory reporting
- **Production Performance:** Collects test and measure data, providing an enterprise benchmark

Creating The Connected Enterprise

In 2007, Rockwell Automation began construction on two greenfield plants in Monterrey, Mexico. This provided the company with an opportunity to design its manufacturing process in a way that could take advantage of the companywide rollout of the new ERP system and serve as a benchmark for new and existing plants.

To begin the implementation, the Monterrey teams underwent a business requirements analysis to identify all the layers of interactivity that would exist between plant equipment and the ERP. With nearly 3,000 unique products manufactured at the two facilities combined – including printed circuit board assemblies, motors, drives, power supplies and light curtains – connection between each layer was vital for success.

Since the plants were new, the team had the opportunity to implement the MES simultaneously with the new ERP rollout. Rockwell Automation had its internal delivery team configure and extend a comprehensive MES application that would integrate communication between the plant floor and the enterprise.

The application then went through three months of testing and was deployed for the first time in August 2008. “The context-driven system presents work instructions and operator information in English or Spanish, allowing new employees to be easily trained within 30 minutes,” said Dionicio Hernandez, Monterrey, Mexico, manufacturing engineering manager, Rockwell Automation. “And because there is only one system to learn, our operators can be easily cross-trained in other functional areas of the plant.”
The new system provides data collection capabilities that significantly improve product quality. For example, information on each step of the process must be gathered, managed, tracked and made visible to plant operators so that they can identify areas of inefficiency, downtime or diminished quality within the process. Rather than relying on each station on the line to create its own documentation, FactoryTalk ProductionCentre software collects and sorts millions of data points in a systematic, more usable way. If a particular printed circuit board assembly, for example, consistently fails a quality check, plant engineers can now use that data to drive improvements in the process or product design.

“The impact on visibility into production with the FactoryTalk ProductionCentre system was dramatic,” Hernandez said. “The software platform excels at feeding data in and out of the ERP system with the result of consistently reducing issue-resolution times and supporting leaner operations. And, like our customers, our output efficiencies are the key to our profitability in building products.”

The new system creates a set of applications that can be used in all major Rockwell Automation manufacturing facilities. It provides a common manufacturing platform that can be expanded to different regions and different product groups, all while retaining an efficient and accurate way of measuring KPIs.

“This system gives us an enterprise-wide benchmark, which is exactly what we needed,” Rossoll said. “It increases efficiency and improves quality on the plant floor, thereby driving overall improvements in our operational productivity.”

Processes are in constant development when connecting a global enterprise – no workflow is set in stone. For example, the Monterrey teams made some adjustment in 2010 to better align the system with Kronos®, a global workforce management solution. With Kronos integration, they can more closely track labor against jobs completed. It measures labor costs, time and attendance, scheduling and absences – showing successes and opportunities for growth.

Expanding Connectivity

After implementing a new MES at two plants in Monterrey, Rockwell Automation expanded the rollout of the new solution to an existing plant in Twinsburg, Ohio. The plant produces a wide variety of complex products – approximately 2,500 different products each year – and needed better information from the plant floor to enable operators to make more informed decisions to maximize efficiency.

The company used the Monterrey plants’ successes and lessons learned, but ultimately used this rollout as a pilot for implementing the system in an existing plant. The company’s Information Solutions team worked with Twinsburg plant engineers to enhance the Monterrey plants’ implementation plan and process for an existing system migration rather than new construction. For the Twinsburg plant, the new system replaces a homegrown MES system that was becoming difficult to manage and maintain. The new system is user-friendly, straightforward and customizable, which allowed the team to add and/or remove equipment, revise layouts and ensure that the solution fit the plant’s needs.
The Twinsburg team applied a key lesson learned from the Monterrey plant implementations – the cultural impact of the new system.

“As part of the implementation process, we worked with a focus group of operators to pilot the new system,” said Tom Blackburn, engineering and quality assurance manager, Rockwell Automation. “This gave our team a chance to see and use the system before it was rolled out through the entire plant, resulting in a well-accepted cultural change.”

The real-time display of metrics and performance in relation to expected output provided managers a more efficient way to measure success. From a quality standpoint, the system detects issues and provides feedback immediately, allowing managers and operators to address issues quickly and deliver feedback upstream.

Changing the Twinsburg plant layout to accommodate the new system called for a change to its network topology approach, as well. EtherNet/IP enabled a wealth of information beyond what plant operators had anticipated. This increased network traffic and required improved network segmentation, so the Twinsburg team started managing network structure and hierarchy by using the reference architecture framework. This allows them to maintain real-time network performance, and also enables them to add capacity in the future with minimal impact to the network infrastructure.

For example, operators would see periodic delays due to data collisions that would appear as efficiency declines, but they couldn’t see the cause. Now, with the new infrastructure and systems in place, operators don’t need to dig for the ‘why.’

“Previously, workers would estimate efficiency based on past experiences,” Blackburn said. “We’ve eliminated the ‘guess’ factor. Our tools provide validation and allow us to be predictive rather than preventive.”

The new MES system allows operators and engineers to better understand the differences in products, realistic output, cycle times, manufacturing processes and expectations. “It educates workers on the process, so they can focus on the equipment, products and processes to improve productivity rather than manually gathering data from each line,” Rossoll said.
The Connected Enterprise is Delivering Results

People continue to collaborate, ensuring knowledge and information from every department is shared. Processes are focused on lean manufacturing to better manage quality for its customers. Technologies, including cloud, mobility and big data, are leveraged to continue improving the Rockwell Automation production strategy.

Five years after executing its plan, the company has seen success that will continue to grow:

- **Plant Behavior**: The company lowered inventory from 120 to 82 days, and realized 30 percent savings annually in capital avoidance.

- **Supply Chain/Lead Times**: The supply chain has seen an increase in on-time delivery from the mid-80s to 96 percent – and lead times have also been reduced by 50 percent.

- **Customer Service & Quality**: Not only are the company’s operators and engineers experiencing benefits from the MES system, but its customers are, too. On-time-to-want availability improved from 82 to 98 percent, and there has also been a 50 percent reduction in parts per million defects through improved quality.

- **Productivity**: Better and faster decision making enabled by better information helped deliver 4 to 5 percent annual productivity.

A Winning Model

To ensure the transition toward The Connected Enterprise was done safely and securely, Rockwell Automation followed a five-step model. These steps helped the company to boost productivity and profitability while leveraging Integrated Control and Information:

1. **Assessment**: Evaluate all facets of existing IT/OT infrastructure, including information, controls, devices, networks, and security, and ability to leverage IoT technologies.

2. **Network and controls**: Securely update the IT/OT network and controls to prepare for future configurations and technologies.

3. **Working Data Capital**: Determine how to utilize working data company-wide for gains and improvements.

4. **Analytics**: Leverage data from hardware, devices, software, and networks for operational improvements.

5. **Optimization and Collaboration**: Engage with every team involved with the transition, including internal teams, supplier, and customers to extend working data throughout the enterprise and the supply chain.
The Star Player: Collaboration

“The Connected Enterprise is not just about implementing the right system,” said Ivan Ramirez, Monterrey plant manager, Rockwell Automation. “A main component in this journey is our talent. Great automation engineers and operators understand how the equipment works with the systems, which is how we’re able to make the real connections.” Ensuring that the company’s people understand the systems and equipment at each site enables them to understand the same process at a different Rockwell Automation plant.

Collaboration was and continues to be a major component to success. To share insight on the implementation and use of the new system, a team of leads from each location meets quarterly for a Super Users forum with the internal delivery team to discuss best practices, lessons learned and new developments. These meetings provide plant managers and engineers the opportunity leverage one another’s knowledge and talents to help the company grow as one.

“If I notice an interesting process or if certain data points stand apart in the Twinsburg plant, for example, our meetings are the time to discuss these questions,” Ramirez said. “We’re able to learn how and why a site is doing things in a certain way and possibly adopt the same practices at our own locations.” As Rockwell Automation continues to roll out the system, each site will gain visibility into processes in different locations – constantly providing sites with new perspectives that can result in positive changes throughout the company.

Lessons Learned Throughout the Journey

The internal delivery team and individual plant operators agree that the more granular the pre-implementation plans are, the better. “Prep work is key to successful implementation,” said Al Heid, project manager, Rockwell Automation. “Operations, IT and engineering teams all need to take time to understand what they’re trying to establish. Knowing what our output goals are and what information we want and need – these steps all need to be communicated in detail.”

Any company taking on a project of this magnitude needs to do its due diligence by mapping out the project in detail at the forefront. Now Rockwell Automation has best practices that can ease the transition. This decreases unforeseen challenges during or after implementation is completed. “It’s knowing the right questions to ask so that many potential problems are solved before they even occur,” Heid said.

It’s also important to connect as many people as possible to the project so various roles can understand and become familiar with the processes. Rockwell Automation is continuing to build on and improve its culture to ensure IT and OT teams can work together seamlessly. “The more people we connect to this, the better the results,” Murphy said. “Sometimes we can get trapped in thinking it should only go to manufacturing engineers. That’s not always the case. A project with this much impact should loop in as many people as possible.”
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What’s Next for The Connected Enterprise?

This journey continues to expand to more roles throughout the enterprise, adopting new goals along the way. Rockwell Automation is constantly trying to achieve increased speed in production, improved real-time visibility, and better inventory management and tracking and tracing capabilities. To ensure these goals are met, go-forward plans for optimizing connectivity have already been identified by both the internal delivery team and plant managers:

- **Quality**: Rockwell Automation is identifying ways to continuously improve connectivity throughout the supply chain to prevent defects and minimize scrap.

- **Productivity**: There is always more to do. Leveraging information technology to improve efficiencies and drive productivity provides Rockwell Automation – and any company – with a competitive advantage.

- **Training**: To gather, understand, and act on data, a company needs well trained people. A main goal for Rockwell Automation is to leverage its MES system to the fullest so that operators can read and convert data into actionable information in a much more intuitive fashion.

- **Future-proof flexibility**: Expanding the MES system so it can be applied to a wider variety of products and processes around the world is a continuous effort. Every new application results in greater degrees of flexibility within its global manufacturing operations footprint.

Ultimately, people are what make connections happen, and having the right technology enables them to do so more effectively. When those technologies provide contextual information, goals are achieved. “This journey is meant to not only improve a business, but also improve peoples’ lives by providing easier, more stable processes,” Murphy said. “We gain a sense of accomplishment when we have a way to measure success. And that’s possible with our new system, which decreases variation and allows us to focus on what’s best for individual plants and the company.”

The Connected Enterprise journey does not have an end point. There will always be opportunities to improve the system, to enhance production, and to optimize quality. There will always be methods to make easier, faster and more consistent decisions to achieve goals. This is the nature of the industry and the people who continue to ask the question “What’s next?”