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The Future-proof Plant: Impact of Evolving Operations, Technology, and Workforce Changes

by Peter G. Martin

Executive summary

Industries today face critical challenges to process operations: operational acceleration; evolving technologies; and a changing workforce. Modern automation systems offer real solutions to these challenges through new functionality that, in essence, can result in a future-proof plant. First in a series of three, this paper explores these challenges and explains how process automation systems can address them.

Introduction

Globalization; energy markets that change in real time; variations in materials and prices; aging of the industrial workforce; inability to attract the next generation of talent; and difficult regulatory pressures are all challenges that face industrial companies. These trends contribute significantly to the high level of stress present within today's industrial business environment.

New tools and updated automation systems help address these challenges by enabling organizations to keep pace with accelerating operational and market requirements. The benefits of evolving the business through use of these tools include enhanced productivity derived from the new technologies, attraction to the firm of qualified new employees, and the ability to then support these employees with the required knowledge.

This paper is the first in a series of three, and focuses on how these modern automation systems can equip industrial organizations with the infrastructure they need to succeed. The other papers in this series include *The Protected Plant: How an Automation System Mitigates Risks to Operational Integrity* and *The Enlightened Plant: How an Automation System Delivers New Insight to Plant Operations*.

The speed challenge

Only a decade ago, basic manufacturing processes operated with what was then an acceptable production pace: within the limits and constraints of their material and energy storage boundaries. This storage capacity was viewed as a necessary aspect of production value chains, ensuring that materials and energy would be readily available when required. But storage-based value chains also added cost to the business and removed agility from the operation.

Over time, critical business variables associated with industrial production have begun to fluctuate with more frequency. For example, today the price that an industrial firm pays for electricity might change every 15 minutes. This increase in speed has also impacted the frequency in variation of the production value and material costs of an operation. Now the speed of business is so fast that industrial operations must be able to respond to market changes in real time. Unfortunately, the energy and materials storage points in the storage-based value chains of a decade ago are becoming the limiting factor in these operations.

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A number of industrial businesses are working to change their process designs by improving their agility. Automation systems must be designed from inception to be extremely agile, adapting to process changes quickly and easily. As these process changes are implemented, object-based industrial service-oriented architecture (SOA) can help industrial companies to adapt flexibly – therefore future-proofing the operation while maintaining the operational integrity of the plant.

As the speed of business continues to accelerate, many traditional functions that industrial operations have performed in transactional business systems will require execution in real time. Therefore, business functions such as real-time performance measures, real-time activity-based accounting, and profitable safety and asset performance management will need to operate in a real-time system.

The technology challenge

As well as helping companies meet business challenges by future-proofing their operations, modern process automation systems also future-proof their technology. Control room components such as operator consoles and engineering tools have much shorter lifecycles than process-connected components such as transmitters and control software. Process manufacturers need the flexibility to upgrade all components to meet emerging business requirements, without having to upgrade everything at once.

To accomplish this goal, the most effective automation systems embody a "continuously current" approach, which allows a plant to evolve to the latest state-of-the-art technology while preserving existing hardware, software, and applications. Industrial businesses can therefore protect their engineering investments, and in many cases, use emerging technology to drive more value from their automation solutions.

From an architectural perspective, three key features of such an automation system are:

- Providing a distributed software architecture that operates in standard operating system environments such as UNIX and Windows NT
- Utilizing industry standards where available
- Building a distributed object-based communication infrastructure

In recent years, the concept of continuously current technology has been taken to a new level by extending the basic system design to become an industrial service-oriented architecture (SOA). Incorporated into the process automation system, the SOA design is based on a two-layer set of services that wraps around Microsoft's Windows NT kernel and utilizes open web technologies.

The first layer consists of operating system services that extend Windows NT for highly distributed and secure industrial usage (see). These services include distributed object management, common name space, inter-process communications and security services, among others. Adding these extended operating system services to the Windows NT kernel means that users experience the full benefit of the Windows NT system services as well as of the industrial context provided by these extensions.

Figure 1

Industrial service-oriented architecture (SOA) – layered system design

The second layer provides a set of application services that are common across all industrial systems. These services include common human machine interfacing, historical data management, and a real-time workflow engine. (See the Schneider Electric white papers *Considerations for Integrating Historian Tools and Industrial Human Machine Interface (HMI)* and *How Human Machine Interface (HMI) Impacts Business Performance in Industrial Sites*).

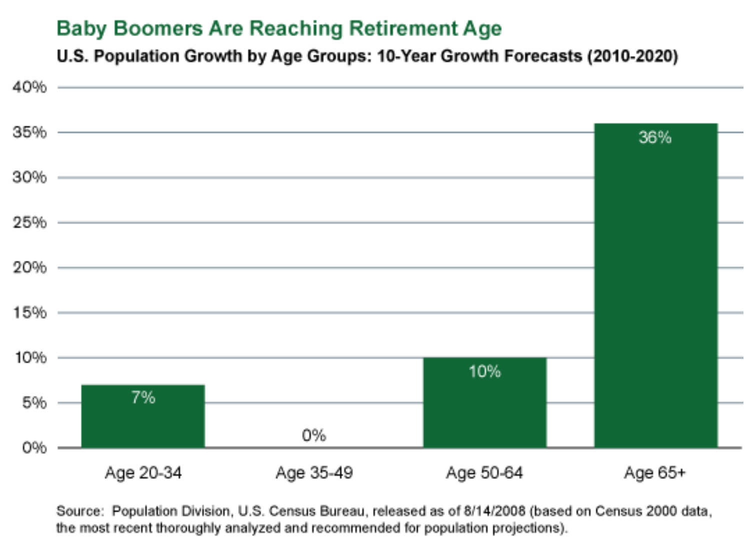
This application layer of services is based on the desire among industrial companies to have common approaches across their systems to simplify system design, implementation, and operation, as well as to offer operational insight and encourage collaboration across their operations.

The people challenge

An aging workforce is also an important issue to (see Figure 2). This will impact industrial companies in three ways. First, critical expertise and experience will be displaced from the workforce. Second, new, younger workers must be readied to replace the talent that is leaving. Third, industrial companies will need to develop plant environments that attract younger talent. Automation technology can help future-proof industrial operations within each of these three areas in a number of ways.

Figure 2

On average, today's most experienced workers will retire at an average rate of 10,000 per day in the USA alone.



Properly designed automation software can help capture the intellectual property of both engineers and operators before they depart. On the engineering side, applying an advanced object infrastructure and taking full advantage of the technology-independent characteristics of modern applications can enable these applications to migrate forward easily on new technology platforms, effectively preserving their design intelligence over time.

"An automation system can help bring new and younger employees up to an acceptable level of effectiveness in the shortest time possible, to replace retiring personnel."

Software workflow engines at the system platform layer allow intellectual property originating with engineering, operator, and maintenance veterans to be embedded into the system environment. These assets can be accessed on demand. Thus these workflows can offer to new hires operational insights from more experienced contributors who may actually have left the organization. Highly complex and error-prone operations such as plant and unit startup and shutdown can be directed down optimal operational paths. Also, operators and maintenance workers can be guided through unexpected and perhaps unsafe events via intellectual property embedded in automatically triggered workflows

A properly designed automation system can also address bringing new and younger employees up to an acceptable level of effectiveness in the shortest time possible, so they can replace retiring personnel. Tightly coupled, first-principle-based operator training simulators used in conjunction with contextualized virtual reality training systems can help new operators achieve certification levels in less than half the time of traditional methods.

Changing workforce

More information regarding the changing workforce is available in the Schneider Electric white paper:
"3D Virtual Reality and Other Workforce Enablement Technologies for Safer Oil & Gas Operations"

Experience demonstrates that operators can become proficient in short order on the day-to-day, repeatable functions they are expected to perform. The challenge has been to train for infrequent and unexpected events. Now these can be programmed into simulation and virtual reality software, enabling operators to practice responding to these events in a repetitive manner and getting them to proficiency very quickly. But reaching proficiency is only the first step. Once operators reach certification levels, they must continue to build on their performance. The advanced automation answer is to embed lifetime training capability into the online environment through performance feedback mechanisms and performance prediction software. Since people learn by feedback control, providing these capabilities within the operational insight environment drives them to even higher levels of performance than that of their predecessors.

"Automation software can help future-proof industrial operations by capturing the intellectual property of retiring personnel, which can help in training new talent."

In the final component of the people challenge, potential employees from the X, Y and millennial generations may not be attracted to industrial careers because they view them as "old and dirty." But the industrial environment can be made more appealing by system features such as visualization software that can run on a traditional CRT console, a display wall, or a smartphone and that can be adapted to operate in new human interfacing technologies as they are introduced. Coupling such user-friendly high-technology environments with advanced learning environments based on a deeper understanding of how people learn could be a major attractor of new talent into the operation.

Conclusion

Future-proofing automation technology is only one of the issues industrial companies face as they move forward. Many critical challenges and changes that are expected to impact industrial operations will require similar efforts.

Automation system technologies cannot address every aspect of future-proofing industrial plants, but they can help in three critical areas: protecting the operational integrity of plants, enhancing the operational insight of people, and enabling plants to adapt easily and affordably to change. Companies that deploy object-based industrial SOA will gain significant capabilities for addressing all of those objectives.

For more information on related industrial productivity white papers, download the titles listed below:

- The Protected Plant: How an Automation System Mitigates Risks to Operational Integrity – This paper focuses on the process-connected aspects of a system that impact business continuity by mitigating risks to operational integrity.
- The Enlightened Plant: How an Automation System Delivers New Insight to Plant Operations– This paper explains the new operational insight that can be delivered to plant operations after meeting basic needs for reliable, secure performance.

About the author

Dr. Peter G. Martin is VP of Strategic Ventures and Marketing and an Invensys Fellow within Schneider Electric's Process Automation Industry business. He has worked for Foxboro and Invensys for over 35 years in training, engineering, product planning, marketing, and strategic planning. Peter holds multiple patents for dynamic performance measures; real-time activity-based costing; closed-loop business control; and asset and resource modeling. He is a published author, was named one of Fortune magazine's "Hero of U.S. Manufacturing" and one of InTech magazine's 50 most influential innovators of all time in instrumentation and controls. He is an ISA Life Achievement Award recipient, recognized for his work in integrating financial and production measures that improve the profitability and performance of industrial process plants. Peter has a bachelor's and a master's degree in mathematics, a master's degree in administration and management, a Master of Biblical Studies degree, a doctorate in industrial engineering, and doctorates in biblical studies and theology.

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