ARC BRIEF

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Virtualization and Industrial Control

By Harry Forbes

Barriers to Better Manufacturing

The industrial control systems (ICS) that automate production equipment in today's factories and plants can also be a formidable barrier to modernization and flexibility. Manufacturers usually don't modify these systems for years at a time because they were designed for a single purpose, and because they can be difficult and risky to modify or replace.

Industrial control systems have only begun to tap the potential benefits of virtualization, because earlier virtualization products did not address the real-time and small footprint requirements of industrial automation systems. A new generation of virtualization technologies and products eliminates these barriers. These will have a huge impact on future industrial automation system architectures, which will make far more extensive use of virtualization than is the case today.

Manufacturers rely on automation system suppliers to support these products for many years, and support services for these systems is a $20 billion-dollar business, just counting the services of the top suppliers. Automation systems operate very much in the world of OT (operational technology) where change occurs very gradually as opposed to IT (information technology) where change is far more rapid.

The slow evolution of ICS creates challenges for both manufacturers and automation suppliers. For suppliers, the challenges center around providing replacement parts and effective support services for products that were developed and installed 10-20 years ago. End user manufacturers face inflexibility and difficult integrations with new equipment or new production processes. Besides the loss of efficiency, this can represent a safety issue as well. Some plants maintain manual lists and procedures for temporary modifications to their systems, and oftentimes these are made using manual paper processes and temporary field wiring changes rather than electronically documented programming changes.

This paper was written by ARC Advisory Group on behalf of Wind River. The opinions and observations stated are those of ARC Advisory Group. For further information or to provide feedback on this paper, please contact the author at hforbes@arcweb.com.

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In such a situation with old equipment, it's not surprising that many plant engineers adopt the attitude that *"if it ain't broke, don't fix it"*. That attitude certainly contains some wisdom. However, an environment where engineers can test new automation solutions relatively easily and with low risk is the kind of manufacturing operation that facilitates a climate of continuous improvement, which over time leads to superior performance.

Today's Information Technology Revolution

By contrast, today IT is entering a new era driven by several important developments that are occurring simultaneously. The most important of these is extensive system virtualization. In addition, cloud computing, much wider use of open source software (OSS), new software technology integrating software development and deployment (DevOps), and ultra-high availability deployment platforms are having a huge impact.

"ARC believes the influx of new Industrial IoT technologies now entering the industrial automation market has the potential to be a major disruption to existing business models that have been relatively stable for decades. An excellent example is Wind River Titanium Control platform, which combines Wind River's long experience in real-time operating systems with extensive low latency virtualization and on-premise cloud computing technology that has been proven in mission critical applications."

—Harry Forbes, Research Director, ARC

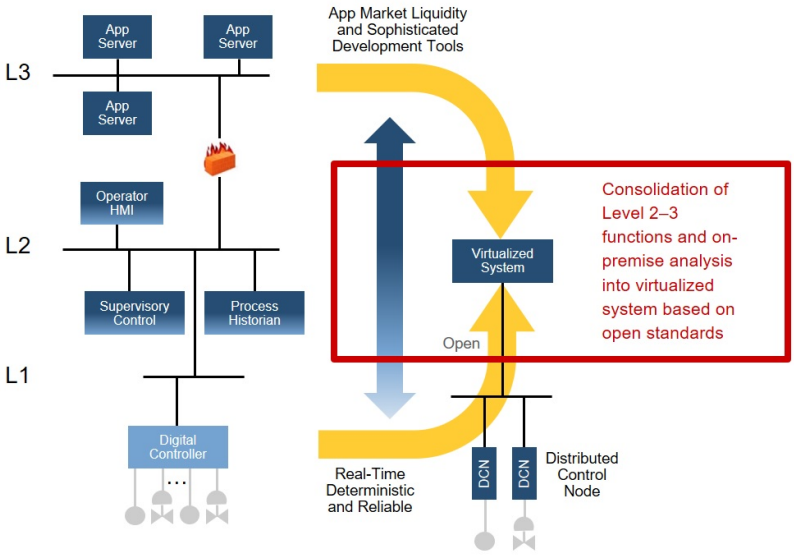
Thus far industrial automation systems have made very limited use of virtualization, and have not adopted these other IT change drivers. Today, by using virtual machines to run factory floor MES applications and human interfaces, manufacturers have avoided constant replacements of short-lived PC hardware on the factory floor. But factories have a long way to go in terms of adopting the new tech of IT. However, these new technologies will reach and impact industrial automation soon, because many of them can easily scale down to the level of today's critical automation equipment – DCS and PLC controllers. This ability to scale down is the critical factor that will drive new virtualized products into the industrial automation space.

The Next Wave of IT/OT Convergence

The critical question for existing factories and plants concerns the migration of existing systems to new technologies. Manufacturers cannot replace their installed base of ICS wholesale; that is far too disruptive to operations and the existing systems contain a large repository of intellectual property that because of its implementation in proprietary systems is difficult to document or migrate to new platforms. Manufacturers need non-disruptive

paths that enable them to update their existing systems. Two examples come to mind.

First, industrial automation suppliers are already defining a new generation of products in which industrial control systems will be virtualized and "software defined" to a much greater degree than today. This trend is epitomized by the Open Process Automation Forum, an effort initiated by ExxonMobil in 2016. Under management of The Open Group, this initiative seeks to define "*a standards-based, open, secure, and interoperable process control architecture that applies across multiple process industries*". In a nutshell, the functions of any DCS and PLC in today's plants could be replaced by these new systems, which consist of both servers and of far smaller and more numerous automation edge devices. ExxonMobil sees their existing ICS applications moving gradually from the installed DCS/PLC systems to these small devices or to on-premise high availability servers that can virtualize them (see figure).



Future ICS Functions Become Virtualized (Source: ExxonMobil)

A second example is the growing set of ICS products for application software development and system testing in a fully virtualized environment. To shorten and simplify field integration work, DCS and PLC suppliers have developed these virtualized solutions and use them today so that they can fully develop and test an ICS installation without requiring any of the target system hardware. With this capability in hand, the ability to virtualize an operational (proprietary) ICS is not far off. ARC expects multiple suppliers to offer it soon. In fact, examples are already on the market. In 2017 GE introduced a new "Industrial Internet Control System" (IICS). While most attention has focused on GE's new Predix platform, their IICS virtualizes many industrial automation functions that formerly were implemented in proprietary GE hardware. ARC expects many future automation products to be similar.

Additionally, as greater connectivity and cloud computing becomes more commonplace within industry, the potential for greater vulnerabilities and exposure to cyber-attacks will increase. It will be more important than ever to ensure appropriate security across the entire IIoT landscape, including the communications and data within the industrial automation system and the cloud.

The Business Benefits

The benefits of greater ICS virtualization for end users are clear. Lower TCO, longer ICS life, fewer disruptive changes, improved ability to manage change and implement continuous improvement. The result (and the largest payoff) comes in the form of improved operations.

For suppliers, the transition to virtualized automation is more challenging, as it will reduce the end user's level of commitment to any single ICS supplier. Their challenge is to utilize new virtualized products as a means to deliver much more comprehensive yet cost-effective end user support throughout the system life cycle. End users crave deeper levels of ICS support, but they can't afford many of today's more labor-intensive services.

Recommendations

End user manufacturers should study the virtualization strategies of their potential future ICS suppliers, with special attention to supplier plans for migration of existing installations to a future virtualized environment.

ICS suppliers should focus on how their existing virtualized products for ICS development can evolve into operational solutions for their existing customers. They should also focus on how virtualized solutions will enable them to grow their ability to monitor and manage automation system operations during their operating life.

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