ARC WHITE PAPER

By ARC Advisory Group

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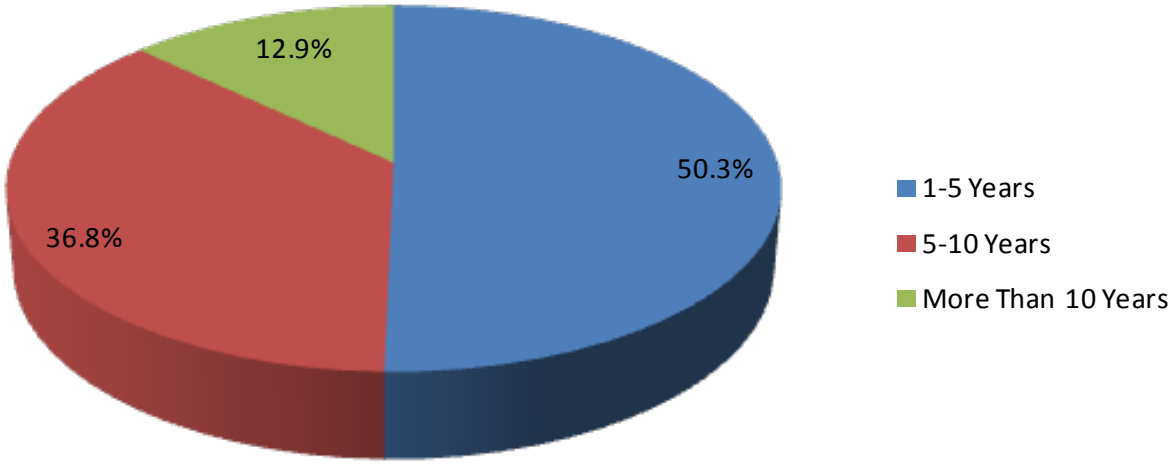
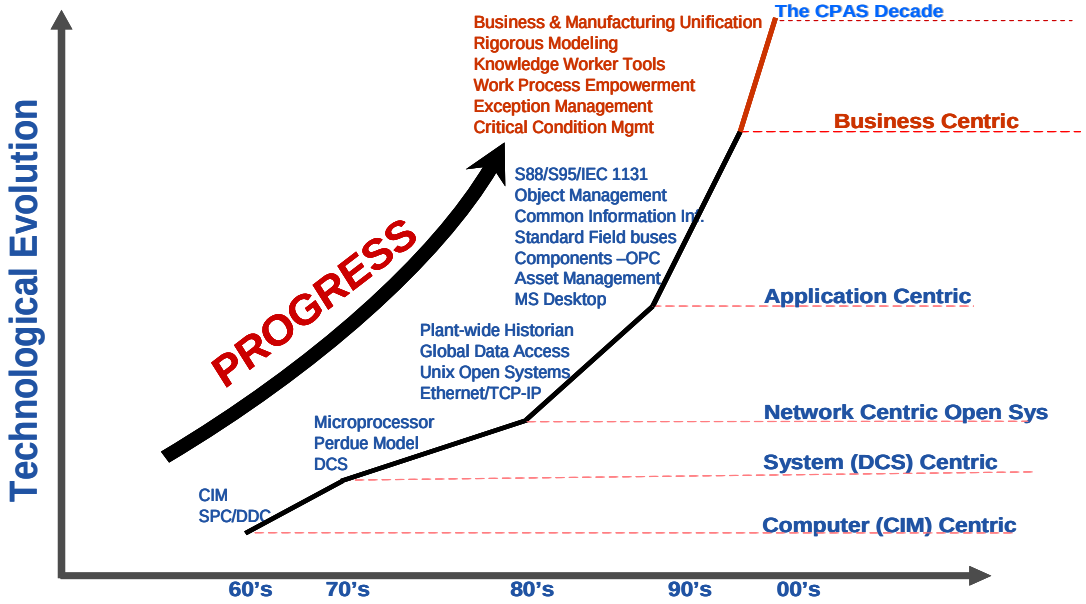
Emerson's Built For Purpose Approach to Commercial-Off-The-Shelf Technology



How Many Years Past the Supplier's Obsolescence Date do you Use your Process Automation System?



Commercial Off the Shelf Components Were Heavily Adopted in the '90s and Paved the Way for the Collaborative Process Automation System

Executive Summary

Process automation end users consistently tell ARC that their primary concerns are reducing total cost of ownership and managing the overall lifecycle of their installed base of systems. A big driver behind this concern is the influx of commercial off the shelf hardware (COTS) into the world of process automation systems. COTS have many advantages, and the technologies can certainly be called disruptive, sometimes negatively so.

While COTS bring reduced cost, standardization, and open data access, they can also bring increased cost of ownership through higher administrative costs and security concerns. Adding to that is usually the fact that there are several different control system vendors with different systems installed at different plants, or within the same plant.

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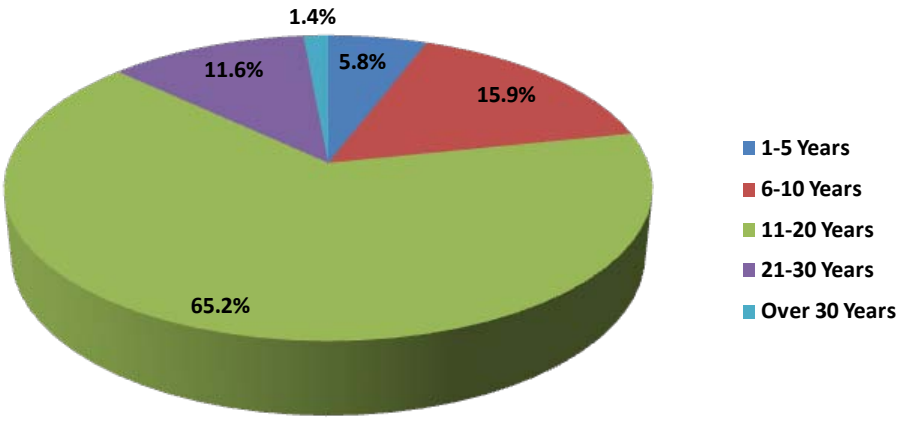
Adding to the overall cost of ownership is usually the fact that there are several different control system vendors with different systems installed at different plants, or within the same plant. Many times, it can be systems from the same vendor with multiple versions running. The lifecycle management of these systems – preserving asset life and modernizing where it makes sense – has a huge impact on lifecycle cost and the value obtained from the automation system.

Emerson Process Management has taken several steps to address these issues with its DeltaV process automation system. The company has taken a "purpose built" approach to COTS, offering standard components such as Ethernet switches, but with built for purpose features that address process automation requirements such as security, version management, and other requirements. The company has extended this philosophy to encompass data management applications such as OPC Xi and other applications. To address the increasingly complex issue of system lifecycle management, Emerson has introduced a comprehensive migration strategy, training solutions such as Virtual Classroom, and Guardian support services.

Users Struggle with Lifecycle Management, Total Cost of Ownership

Process automation end users have struggled with lowering total cost of ownership for years. Although many cite cost of ownership as a primary criterion for their choice of a process automation system, very few have a good perception of what their real cost of ownership is. Many end users have old systems, combinations of systems from different vendors, and a mix of software versions on multiple generations of the same system. Users of process automation systems have struggled with the issue of determining when the useful life of their system is over. In a recent ARC survey, we asked users what the actual average age is of installed process automation systems at respondent companies. Over 65 percent of respondents indicated that their systems were between 11 and 20 years old. Almost 12 percent indicated that their systems were in the 21-30 year age range.



Approximately, what is the Average Age of Installed Process Automation Systems in Your Company?

Modern process automation systems are comprised of many components that each have different life expectancies. Suppliers have worked in concert with their clients to provide replacements for obsolete components that in many cases have extended the life far beyond the original expectation. With many suppliers announcing extended support of their process automation systems to 2012 and beyond, it could be argued that support of process automation systems after their initial introduction can extend as much as 35 years, since the first DCSs were introduced in 1975 and for all intents and purposes are still being supported.

Given this situation, it is easy to understand why developing a good measure of total cost of ownership can be difficult. As a rule of thumb, ARC estimates that the total cost of ownership of an automation asset is 4.5 times the applied cost, where the applied cost is the acquisition cost plus the cost to apply it. One thing is clear, however, relative to total cost of ownership -

- the ubiquitous use of commercial off the shelf (COTS) hardware, operating systems, and other technologies can be a big contributor to TCO.

COTS Technology A Double Edged Sword

The drive toward openness in the 1980s gained momentum through the 1990s with the increased adoption of Commercial-Off-The-Shelf (COTS) components and IT standards. Probably the biggest transition undertaken during this time was the move from the UNIX operating system to the Windows environment. While the realm of the real time operating system (RTOS) for control applications remains dominated by real time commercial variants of UNIX or proprietary operating systems, everything above real-time control has made the transition to Windows.

The invasion of Microsoft at the desktop and server layers resulted in the development of technologies such as OPC, which is now a de facto industry connectivity standard. Internet technology also began to make its mark in automation and the DCS world, with just about all of today's DCS HMI supporting Internet connectivity. COTS adoption only accelerated through the nineties with the adoption of Ethernet-based control networks, the introduction of the IEC fieldbus standard, and the increased focus on cyber security.

The impact of COTS, however, was most pronounced at the hardware layer. Standard computer components from manufacturers such as Intel and Motorola greatly reduced the cost of DCS controllers and I/O. Now we are seeing the collapse of control and I/O networks onto a common Ethernet backbone. Commercial off the shelf workstations from vendors like Dell are the new norm. No longer do you purchase a $3,000 printer from your DCS supplier because it has been certified to work with a vendor proprietary system. The adoption of Ethernet at the control network requires the use of commercially available Ethernet switches.

Implications of COTS - The Good

Reduced Hardware Costs

There are many advantages associated with the adoption of COTS. Overall hardware prices declined dramatically during the period of COTS adop-

tion. The old generation of operator consoles were particularly expensive, some costing $50,000 or more – a stark contrast compared to the $5,000 powerful workstations that are available today from companies like Dell. With standard technologies, inventory costs can be reduced and spare parts costs less.

Standards Promote Choices

Another benefit of COTS is that they are typically standard technologies, meaning they either conform to industry standards or are accepted as de facto standards among end users. The age we live in presents an ever-increasing number of options on a daily basis, however in the future these options are of no consequence if the decisions we make today preclude us from taking advantage of these options in the future. The decisions that are made in evolving CPAS need to keep this in mind and standards-based choices should take precedence over proprietary ones. If the temptation to move toward a proprietary solution is followed, it will take a long time to recover because your destiny is in someone else's hands. Choices should broaden not limit future options. Standards promote choices.

Standards Promote Openness and Interoperability

Standards have many benefits. More choice means more competition. Standards provide conventions in the areas of approaches, methods and terminology. The largest benefits to users are certainty in terms of operation; commercial benefits because supplier's costs will be lower because they are dealing with users on a common basis and will hopefully pass most of their savings on to their customers. Most importantly, however, are the productivity savings enjoyed by users themselves. The productivity benefits extend from functional scooping through start-up and beyond. Because there is a consistent basis, one-of-a-kinds are eliminated and the benefits of reusable technology are capitalized on.

Today's Workers Were Raised in an Environment of Standards

Today's workers are quite IT-savvy. They are used to standard operating system environments such as Windows, Ethernet-based networks, and so

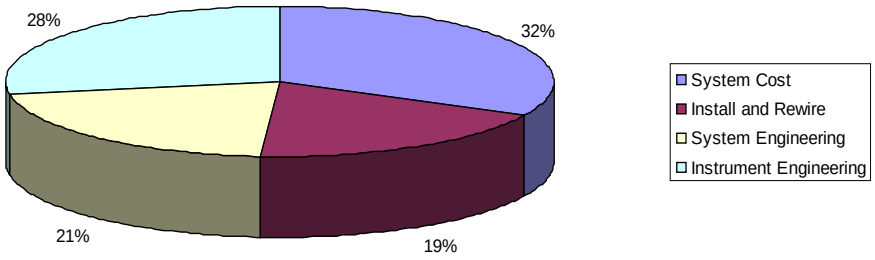
on. Incorporating COTS technologies can bring with it an ease of use that less experienced personnel entering the workforce may require.

It can be difficult to get young employees interested in working on old control systems, since the new generation of workers are more comfortable with new commercial operating systems, more sophisticated graphics, and so on. Close to seventy percent of end users in a recent ARC survey on process automation system lifecycle management responded that they had trouble training the new generation of operators on old control systems. These problems could get worse as more experienced operators leave the workforce.

Implications of COTS - The Bad

The Difficult Task of Integration

The adoption of COTS, however, also has its downside. We mentioned that standards promote choices, but that wide range of choices does not necessarily mean interoperability and easy integration. Engineering related tasks such as installation, rewiring, system engineering, and instrument engineering can account for close to 70 percent of total project cost. Anything that can be done to reduce the overall engineering effort and the cost of custom integration can have a significant impact on overall project costs.



The Greatest Opportunities for Reducing Installed System Cost with a Project Lie in the Engineering Domain, Which Accounts for Close to 70 Percent of Total Project Cost

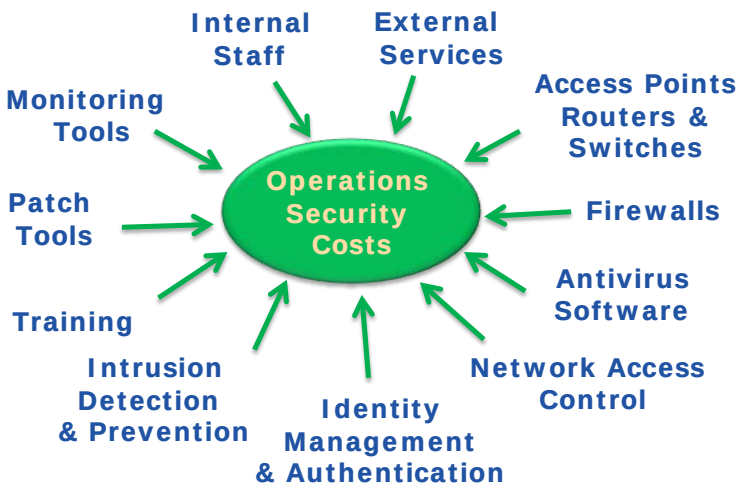
End users are also increasingly integrating a wide range of subsystems with their process automation systems. Plant asset management systems, safety systems, burner management systems, drives and motor control centers, and energy management systems are all becoming increasingly integrated with the process automation system.

Security Becomes a Burgeoning Issue

One drawback to standard COTS technologies is that they often end up becoming the targets of hackers and cybercriminals. Whether it is vulnerabilities in the Windows operating system, viruses transmitted by standard devices such as USB drives, or the vulnerability of plant networks, the market for cyber security solutions has grown in concert with the adoption of COTS technologies. Many of the processes associated with cyber security are not highly automated and can be labor intensive. It can take an entire full time team just to do the task of patch management, for example.

Implications of COTS - The Ugly

This brings us to the ugly side of COTS. ARC consistently hears from our end user clients that the single biggest contributor to the increase in life-cycle cost is attached to the management of COTS, specifically as it relates to the IT infrastructure. This is particularly true for patches and updates related to the use of Windows operating systems, use of open networks such as Ethernet, and maintaining a vigilant cyber security strategy. With old proprietary systems, you could just let them run indefinitely. It was needless to worry about patches, updates, and cyber security because of their completely proprietary and closed nature.



The Vast Domain of Cyber Security Costs in Today's Process Plants is Largely the Result of Adopting COTS Technologies

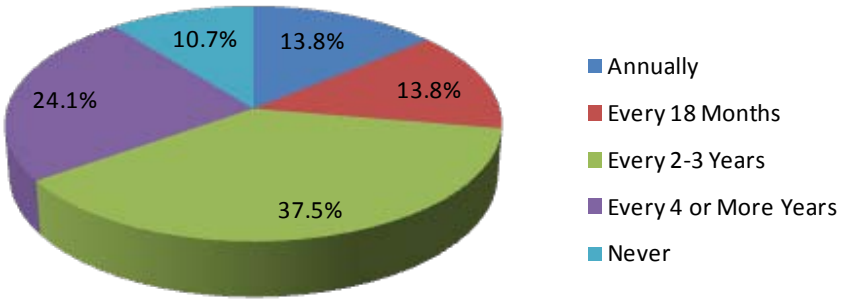
End User Software Update Schedules do not Match those of IT

While most automation suppliers release major updates of their process automation systems every eighteen months, this does not even come close to the update schedule of most major end users in the process industries. Referencing the same ARC Process Automation System Life-cycle Management Survey, we asked users how often they updated their control system software. Most respondents indicated that their update schedule was every 2-3 years, but over 24 percent reported that they only update every 4 or more years. Contrast that with Microsoft's monthly up-

date schedule, combine it with the fact that you have fewer and fewer employees with a greater number of responsibilities at today's process plants, and you have a real problem on your hands.

Different Versions, Different Systems

The huge variety of systems and platforms in today's plants poses still another challenge. Many plants have several different DCS and PLC suppliers in addition to production management, advanced control, and other software application suppliers. Each of these systems and applications could be running different version of Windows. Even if the end user has systems from one or two suppliers, they typically have several versions of the system running in the same plant.



How Often Do You Update Your Control System Software?

Emerson's Answer: Built for Purpose COTS

Emerson was one of the first process automation system suppliers to broadly embrace COTS components with its DeltaV system. The DeltaV system includes specific functionalities with plug-and-play capability, full life cycle support, and integrated security. In a recent customer survey, Emerson found that data integration, total lifecycle costs, and security were the three top issues that end users wanted to see addressed in their automation solutions.

With this in mind, Emerson's approach to COTS, was to make them "Built for Purpose", taking COTS components and building in process automation specific functionality that adds value and reduces total cost of ownership. With a Built for Purpose philosophy, new functionality can easily be deployed with maximum security, minimum process disruption, and minimal maintenance costs. This Built For Purpose philosophy is evident in many

new offerings from Emerson, including the DeltaV Smart Ethernet Switch, Smart Firewall, and OPC Xi technology.

DeltaV Smart Switch Provides Built In Security Features

The DeltaV Smart Switch embodies Emerson's strategy of driving increased ease-of-use into its products and reducing total cost of ownership. Cyber security is not normally something that would be equated with ease of use, but the new switch, made in partnership with Hirschmann, has many features that make security easier. This includes an "Auto Lockdown" port security function that requires no configuration. This allows a user to automatically lock and unlock the port access of all the switches in the network. This lockdown will disable all unused network connections (ports) on the switch.

DeltaV Smart Ethernet Switch

One of the biggest security vulnerabilities in a control system is that network devices, such as Ethernet-based network switches, are located in unsecure locations out in the process and thus easily accessible to everyone. Locking down switch ports will prevent accidental connection, and virtually prevent the deliberate connection of an unauthorized device to the switch.

DeltaV Smart Firewall

The Smart Ethernet Switch has been well received among Emerson customers, so the company decided to apply the same thinking to a new DeltaV Smart Firewall. In many cases, the firewall will plug and play in the network. In the event you need to set up system specific rules, the user interface makes these rules easy to create.

OPC Xi Provides Welcome and Secure Transparency

OPC Xi is a good example of Commercial-Off-The-Shelf technology that has been adapted to fit the requirements of end users in the process industries. The origins of OPC Xi come from Emerson's research into how the .NET platform would affect the DeltaV process automation system. The .NET framework includes the Windows Communication Framework (WCF), which effectively replaced Microsoft COM technology. The problem was that classical OPC technology was built on Microsoft COM technology. For Emerson to incorporate .NET, it had to find a way to get .NET client applications to talk to OPC servers. OPC applications were also coded in C++, while the Windows Communication Framework requires programming in C#.

The C# development environment is written in managed code, which means that the "Memory Model" is actually hidden from developers. This made it very difficult to write an application in C# that could talk to an OPC Server. The fundamental problem was that it was necessary for C# client programs to include C++ code in them to access OPC COM/DCOM servers – a non-trivial programming effort. At the same time, the OPC Foundation was developing OPC UA (Universal Architecture), which had a much bigger scope and extended the reach of OPC to embedded systems and enterprise systems. While the extended reach of OPC UA is good, it still does not address the more fundamental issue of COM/.NET incompatibility. Readers should note that the Memory Model is Microsoft-specific and therefore OPC Xi is exclusive to Windows and does not support any other operating system.

A number of companies had previously developed their own proprietary versions of a .NET wrapper, which could have led to even bigger problems down the line. Emerson joined with these other companies to develop a common solution to the problem. It seemed clear that the industry needed a new standard interface for .NET applications.

OPC Xi Provides Full Compatibility with other OPC Technologies

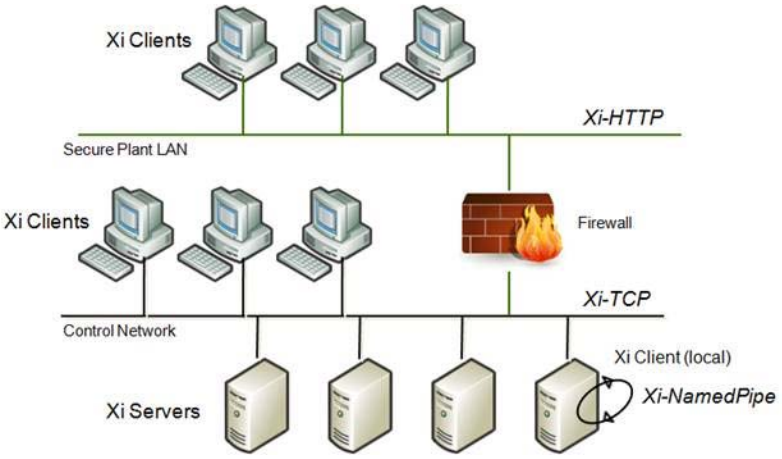
OPC Xi is backwards compatible with OPC servers and may be used in the same system as OPC clients and servers. Xi and classic OPC DCOM communications are compatible on the same network. Although OPC has been developed for Microsoft platforms, XI clients and servers offer basic plat-

form-independent SOAP/XML Web Service interfaces. Therefore, it is possible for Xi clients and servers to be written for non-Microsoft platforms using these Web Service interfaces.

OPC Xi is Firewall-Friendly

Many end users like to remain connected to their plants even when they are not on the site. This often means accessing the automation system through a smart phone, laptop, or other remote device that is probably outside of the plant firewall. COM technology makes it somewhat difficult to go through firewalls, and the other security aspects of COM can be difficult to implement.

In developing OPC Xi, Emerson wanted to build in reliability and security mechanisms, rather than layering these on top. OPC Xi addresses current OPC authentication and security issues. OPC Xi technology incorporates a security mechanism that gives plant administrators the ability to restrict access to servers based on, but not limited to, the location of the client.



For example, an operator who wants to check the status of the process remotely via a Blackberry or iPhone may encounter issues with current OPC. Xi facilitates data exchange between the control system and the business system and supports the same OPC servers that many suppliers already support. The difference is in the underlying protocols used to control the flow of information. Xi uses the firewall-friendly HTTPS protocol.

OPC Foundation Formally Adopts OPC Xi

With the permission of each member company in the OPC Xi project, the technology has recently been adopted by the OPC Foundation, making it part of the non-proprietary OPC suite of applications, one of the most widely accepted technologies in the automation business. Readers can learn more about OPC Xi at:

www.opcfoundation.org/Default.aspx/Xi/Default.asp?MID=AboutOPC.

OPC Xi Supports Fault Tolerance and Redundancy

With fault tolerance and redundant communication, OPC Xi can provide the same level of security as controllers sitting on Ethernet-based control networks. Since OPC Xi is inherently fault tolerant, when paired with fault tolerant communications it can extend that fault tolerance. This is a function of the automation supplier's design.

Conclusions and Recommendations

There is definitely a place for Commercial Off The Shelf (COTS) technology in the world of automation, but process automation end users need more than just "out of the box" COTS technology. The safety, security, and regulatory requirements of the process industries require a little more than what most COTS technology has to offer.

However, there is no reason why users should not avail themselves of COTS technology when it is available, provided it has the features necessary to make it applicable to process automation applications. As we mentioned earlier, nobody is going to pay thousands of dollars for a printer just because it has been certified to work with a proprietary automation supplier's DCS, and the days of $50,000 workstations are past. However, nobody wants to risk plant safety because of the lack of security features in a COTS based Ethernet switch.

While many users may not have a good view into their total cost of ownership, they can at least make significant reductions with built for purpose COTS.

This is why Emerson's strategy of built for purpose COTS makes sense. In many cases, the fit for purpose functionality is not built on top of the offerings, but it is built in from the beginning, as is the case with the DeltaV Smart Switch developed in conjunction with Hirschmann. Built for purpose functions do not necessarily mean an increase in cost either, as we saw with Emerson's donation of the intellectual property associated with OPC Xi to the OPC Foundation.

Traditionally, ARC has taken the position that "out of the box" OPC is not appropriate for use in mission-critical applications. However, it appears that OPC Xi has the potential to be mission critical if automation suppliers plan to support it with the same level of robustness as they do their own redundant platforms. OPC Xi also provides for security with remote access

to applications running in the plant, and it prevents loss of data should communications be lost. OPC Xi is a valuable addition to the current suite of OPC technology.

The real value associated with build for purpose COTS, however, is the reduced total cost of ownership. Having that built in functionality reduces the impact of unplanned downtime as well as many of the day-to-day maintenance and cost of ownership headaches that come with COTS technology. While many users may not have a good view into their total cost of ownership, they can at least make significant reductions with built for purpose COTS.

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Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/Research/IndustryTerms/

API	Application Program Interface
B2B	Business-to-Business
BPM	Business Process Management
CAGR	Compound Annual Growth Rate
CAS	Collaborative Automation System
CMM	Collaborative Manufacturing Management
CPG	Consumer Packaged Goods
CPM	Collaborative Production Management
CRM	Customer Relationship Management
DCS	Distributed Control System
DOM	Design, Operate, Maintain
EAM	Enterprise Asset Management
ERP	Enterprise Resource Planning
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
ISA	International Society of Automation
MPA	Modular Procedural Automation
OpX	Operational Excellence
OEE	Operational Equipment Effectiveness
OLE	Object Linking & Embedding
OPC	OLE for Process Control
PAS	Process Automation System
PLC	Programmable Logic Controller
ROA	Return on Assets
RPM	Real-time Performance Management
SFC	Sequential Function Chart
SHE	Safety, Health and Environment

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