Analyst Insight

Aberdeen Group
A Harte-Hanks Company

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Siemens Closes the Gap between Corporate and Industrial Networks

Faced with internal pressures to cut down cost and external demands to be more responsive to customer needs, manufacturers are looking towards adopting the latest networking capabilities as a means to achieve both goals. To overcome these pressures, many industrial companies are migrating to Industrial Ethernet technology to connect their plant assets, manufacturing systems, and business systems to integrate manufacturing data from the plant floor to the front office. In September 2011, Siemens, a leader in industrial communication announced the latest addition to their SCALANCE X Industrial Ethernet switch series, SCALANCE X-500, which will help their customers close the gap between manufacturing and enterprise networks.

Aberdeen's *Industrial Networking: Building the Business Case for Industrial Ethernet* surveyed over 150 executives about the current state of their manufacturing operations and industrial networks. This data revealed how Best-in-Class manufacturers are deploying Industrial Ethernet across plants to improve network performance, operational performance, and corporate performance. This Analyst Insight will give high level analysis of the current market conditions in industrial networking, and it will cover how Aberdeen sees Best-in-Class organizations adopting industrial networking solutions to address these market conditions. It will also analyze how Siemens' new product release, SCALANCE X-500, can help customers address the challenges they are facing.

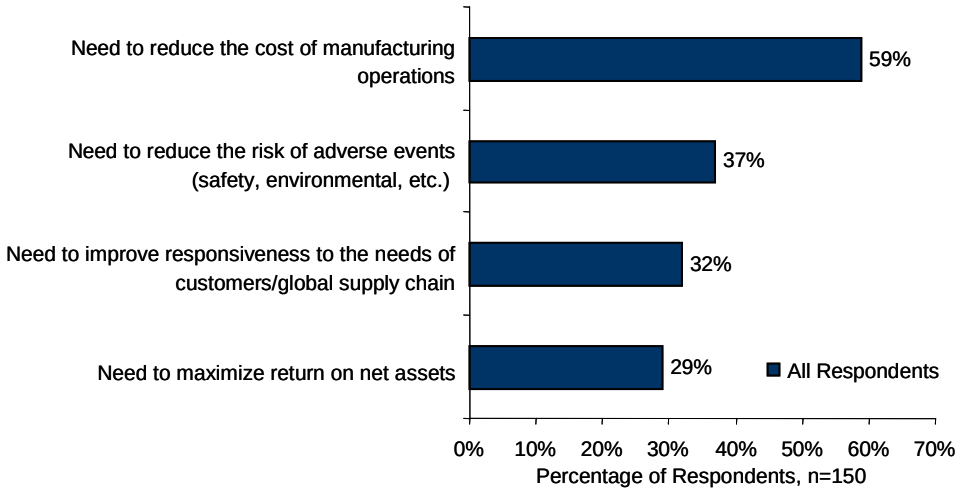
Business Context

An increasing number of manufacturing organizations are looking at industrial networking itself as a discipline. Many of these companies are bringing together both traditional automation engineering with corporate IT to gain a cross functional view of how industrial network performance can be improved. Aberdeen's *Industrial Networking: Building the Business Case for Industrial Ethernet* examined the external pressures driving companies to focus on industrial networks.

Analyst Insight

Aberdeen's Insights provide the analyst perspective of the research as drawn from an aggregated view of the research surveys, interviews, and data analysis

Figure 1: Top External Business Pressures



Source: Aberdeen Group, April 2011

From this data we can see that the top external pressure is consistent with almost every other manufacturing study Aberdeen conducts, the top pressure is to reduce operating costs (Figure 1). Many organizations are still feeling the pinch from the global recession and the fear of inflation in labor and raw material pricing has many firms looking for cost cutting anywhere they can in an already lean environment.

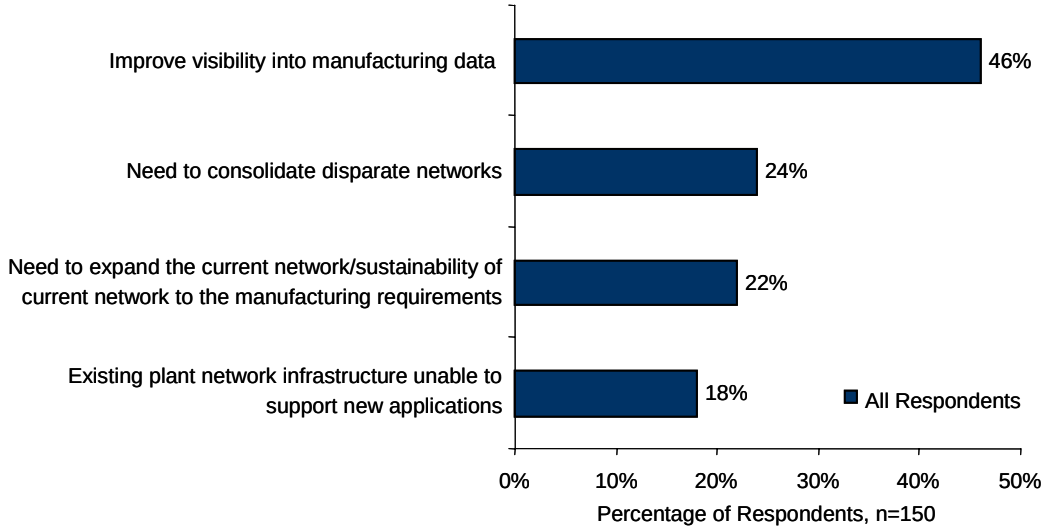
There are also secondary pressures impacting the industry, especially around Environment, Health and Safety (EH&S). In this particular data set there are a relatively high percentage of process industry survey participants; so it isn't surprising that with the recent high profile events in off shore drilling, mining, and power production, that organizations fear another high profile adverse event in their facilities. As our analysis will show, new technologies and approaches in industrial networking and especially Industrial Ethernet, can address these pressures.

Internally, there are also pressures driving the industrial network and we can see that those rising to the top are closely related to the top external pressure, reducing costs (Figure 2). To help companies reduce costs, organizations are looking for improved visibility into manufacturing operations as well as a reduction of disparate networks on the shop floor.

"Our network architecture has been far too piece meal, and it is a challenge that we are currently trying to overcome. We end up with various models and versions of software. Unfortunately, we lack the resources and time to bring all the old platforms up to current standards. It is a very hard system to troubleshoot because equipment is only replaced as they stop working. We have networking equipment built from the mid nineties to 2010.

~Automation Engineer
Water/Wastewater Facility

Figure 2: Top Internal Business Pressures



Source: Aberdeen Group, April 2011

Responding to the Demands of the Market

How then do top companies address both sets of these pressures at the same time? Organizations need to improve the visibility into manufacturing operations, work towards consolidating disparate networks, all while maintaining a competitive advantage in the marketplace. Interestingly, there are companies that are accomplishing just this, and it is not by accident. Aberdeen uses four key performance criteria to distinguish the Best-in-Class from Industry Average and Laggards, where the Best-in-Class are the top 20% of performers, Industry Average are middle 50% of performers, and Laggards are the bottom 30% (Table 1).

Table 1: Top Performers Earn Best-in-Class Status

Definition of Maturity Class	Mean Class Performance
Best-in-Class: Top 20% of aggregate performance scorers	▪ 3 hours of downtime per year (99.97% Uptime) ▪ 5% Reduction in Total Cost of Ownership for the industrial network ▪ 89% Overall Equipment Effectiveness (OEE) ▪ +26.3% Operating Margin vs. Corporate Plan

Definition for the Key Performance Indicators

√ **Overall Equipment Effectiveness (OEE):** Composite Metric accounting for availability, performance and quality

√ **Operating Margin:** Defined as the difference between the actual operating margin and budgeted operating margin

√ **Industrial Network Uptime:** Estimated uptime of industrial network per year

√ **Change in Total Cost of Ownership for the Industrial Network:** Percent change in total cost of ownership (i.e., including software, hardware, integration, support, services, training, administrative staff, etc.) to manage the industrial network over the last 12 months

Definition of Maturity Class	Mean Class Performance
Industry Average: Middle 50% of aggregate performance scorers	▪ 19.7 hours of downtime per year (99.78% Uptime) ▪ 2% Reduction in Total Cost of Ownership for the industrial network ▪ 87% Overall Equipment Effectiveness (OEE) ▪ +3.6% Operating Margin vs. Corporate Plan
Laggard: Bottom 30% of aggregate performance scorers	▪ 75.4 hours of downtime per year (99.14% Uptime) ▪ 4.5% Increase in Total Cost of Ownership for the industrial network ▪ 68% Overall Equipment Effectiveness (OEE) ▪ -1.0% Operating Margin vs. Corporate Plan

Source: Aberdeen Group, April 2011

Best-in-Class companies are able to directly impact the cost of manufacturing operations by reducing the total cost of ownership (TCO) by 5%. At the same time, they are also optimizing their industrial network with an average of 3 hours of network downtime per year as compared to Laggards who experience 75 hours of network downtime per year. Indeed, top performing companies have a significant advantage over their competitors, outperforming them by 10% or more in many of these metrics, so what is their secret? Often it is their ability to bridge the gap between manufacturing and Information Technology (IT) and creating a coherent strategy for their industrial networks that includes standardized best practices for networking hardware, topology, architecture, management tools, and supporting standards. In the next section we will explore these differences in more detail.

Enabling Collaboration between IT and Manufacturing

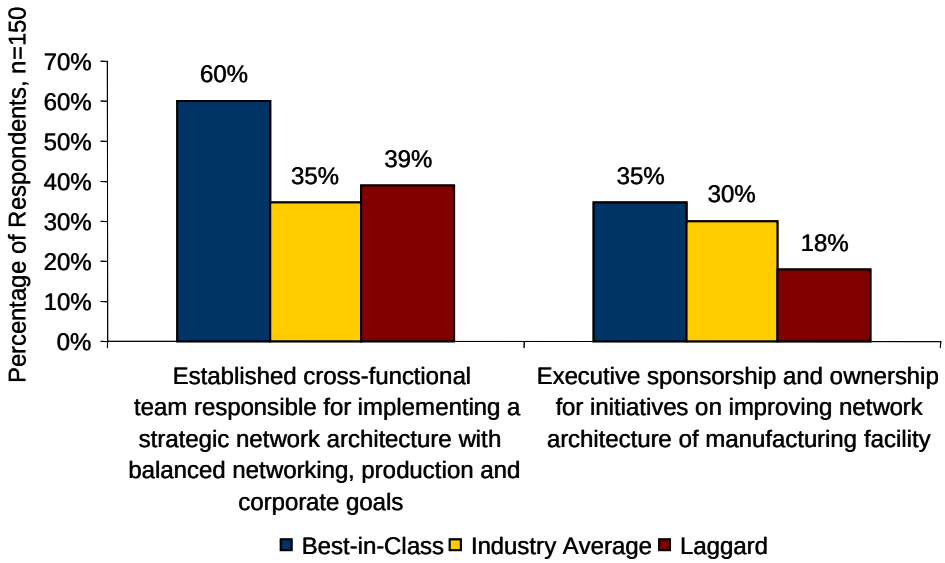
The first piece to achieve the benefits of Best-in-Class companies is to change the culture and enable collaboration between two traditionally disparate groups, IT and Automation.

Strategically and organizationally, manufacturers are now confronted with new issues governing the design, integration, and management of their plant floor networks. These developments blur the traditional lines between IT and the real-time domain of control engineering and operations. In order to manage these groups better, Best-in-Class companies are implementing the following capabilities (Figure 3):

"We were seeing the long term trend that the IT world was becoming more relevant in the process control world. The control group understood that we can either participate – and work collaboratively to design the industrial network, or lose the battle and not have our opinions heard during the design phase of the network."

~ Team Leader
Large Chemical Manufacturer

Figure 3: Organizational Capabilities



Source: Aberdeen Group, April 2011

Historically, in an attempt to keep corporate IT at arms length, control and automation engineers developed their own network infrastructure and skills. They did this to avoid implementing corporate IT network guidelines, which they perceived would only interfere with the design of the industrial network. However, what they failed to understand was that corporate IT brings unique skill sets that can be leveraged to reduce installation and operating costs of the control system.

Best-in-Class companies overcome this cultural barrier by forming cross functional teams consisting of both IT and manufacturing personnel. Best-in-Class companies understand the importance of having collaboration between these two traditionally disparate groups and are bringing them together because of the unique skill sets and industry knowledge that they both bring to the table.

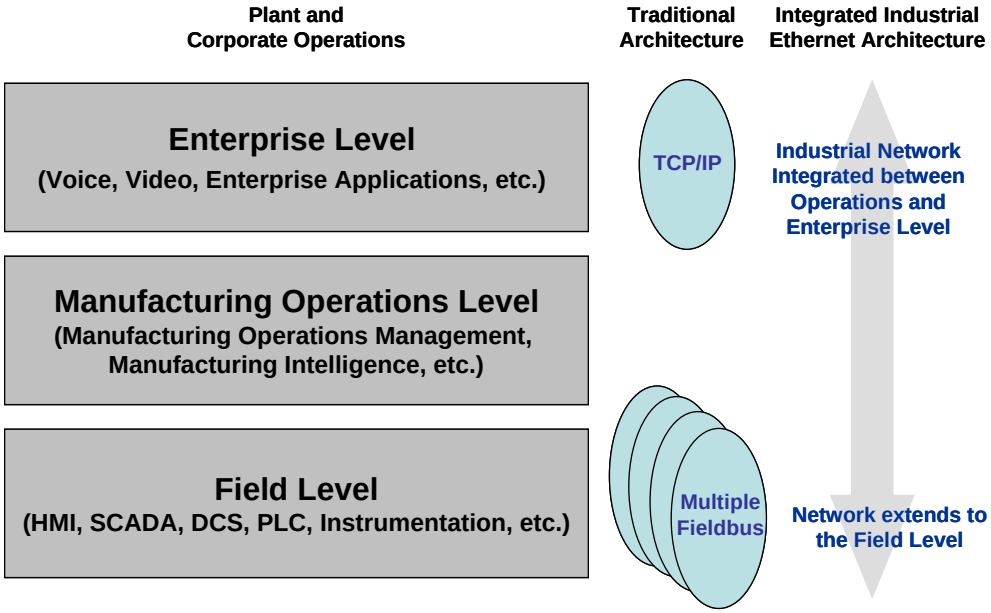
"We are working with our local IT and corporate IT to develop a series of best practices and a structure for our process control. In order to enable collaboration between the control and IT group, we have a quarterly meeting."

~ Team Leader
Large Chemical Manufacturer

Additionally, this cross-functional team is responsible for implementing a network architecture that balances networking, production and corporate goals. The network architecture is key to enabling the ability for manufacturers to gain real-time visibility into operations at the plant floor as well as at the executive level. When the network architecture isn't implemented with these goals in mind, it leads to islands of disconnected networks from the field level to the manufacturing operations level and to the enterprise level. This leads to a problem faced by many manufacturers: having multiple networks at the same layer (with multiple skill sets and software) that do the same thing. As shown in Figure 4, by using Industrial Ethernet as the backbone for the network, organizations have the ability to integrate the manufacturing and enterprise network and are able to connect the various applications from the field level to the manufacturing level to the enterprise level. In the traditional network architecture, there is a gap in the ability to bridge manufacturing and enterprise networks due to the use of

multiple network protocols (for example: some manufacturers use multiple different Fieldbus protocols and at the corporate level they use TCP/IP).

Figure 4: Application and Network Architecture



Source: Aberdeen Group, April 2011

Organizations that are able to build this connection from enterprise level through to all the levels of the network, through the use of Industrial Ethernet and industrial devices, are at a tremendous advantage to better integrate manufacturing and corporate networks to provide critical visibility into manufacturing operations.

In the next section, we will explore how the Best-in-Class are differentiating themselves through their technology adoption and how this enables them to bridge this gap between the field level to the management level to make their operations more efficient.

Key Technology Differentiators

Industrial networks are designed to work in extreme temperatures, vibration and shock. Industrial networks differ from traditional networks in their need for determinism, reliability, and speed in the transmission of data. In addition, for industrial networks most of the network traffic is local, where connections are established between a Programmable Logic Controller (PLC) and I/O devices or between two PLCs. Moreover, industrial networks differ in their need for determinism and consistent transmission of data. Network downtime is intolerable. Any form of disruption in the network is unacceptable, and can lead to waste or contamination of in-process materials. In comparison, IT networks consist of client-server architectures, which are used to establish connections from clients to servers on-demand. When communication is finished, the

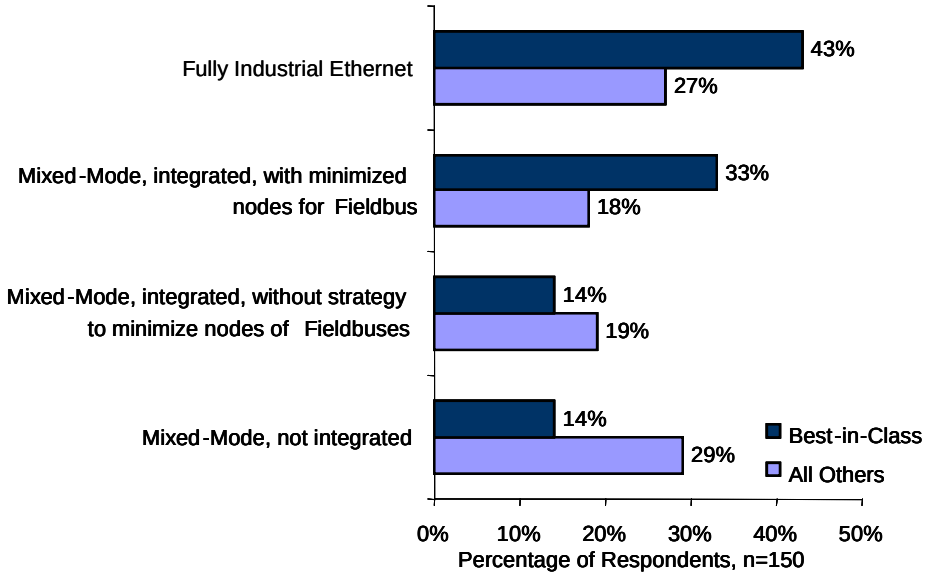
connections are closed. Thus, for IT networks, downtime and reliability is less critical. Therefore, industrial networks need to be designed and implemented with these differences in mind.

Network Architecture

Within our survey, respondents were asked whether their network architecture were (Figure 5):

- Fully Industrial Ethernet architecture, which means that these companies use entirely Industrial Ethernet for communication between industrial control system components
- Mixed-mode architecture of Fieldbus and Industrial Ethernet for communication between industrial control system components, where the number of nodes of Fieldbuses has been minimized for optimal performance
- Mixed-mode architecture of Fieldbus and Industrial Ethernet for communication between industrial control system components, where there is no strategy to minimize the number of nodes for Fieldbuses
- Mixed-mode architecture of Fieldbus and Industrial Ethernet for communication between industrial control system components, where Industrial Ethernet and Fieldbuses are not connected

Figure 5: Industrial Network Architecture



Source: Aberdeen Group, April 2011

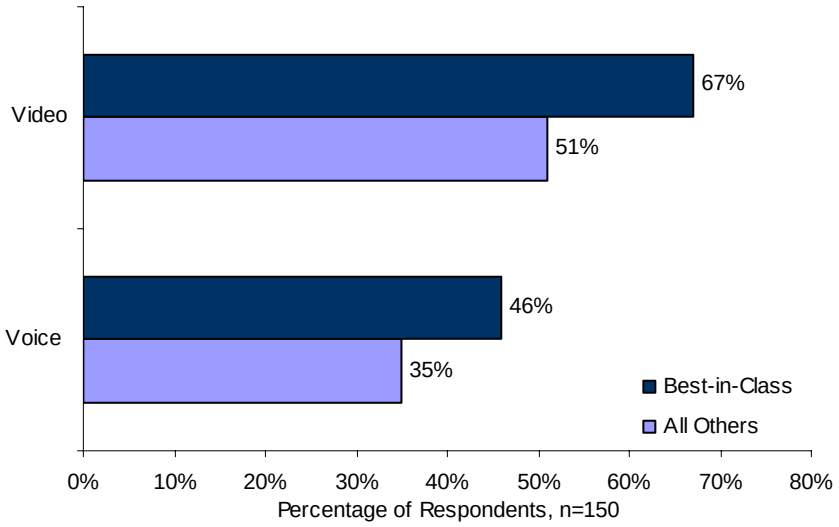
Based on this analysis, we uncovered some interesting trends within the industry. First, it is apparent when it comes to the different kinds of network architectures, there is a mixed bag as to what manufacturers are more likely to implement. For the most part, many manufacturers have a mix of Industrial Ethernet and Fieldbus as the basis of their plant network. The difference is whether or not there is integration between these two networks, or if these networks are disconnected and isolated systems. The Best-in-Class have taken advantage of the latest technology and are more likely than their competitors to implement a fully Industrial Ethernet architecture. In addition, if they were to have an industrial network with both Fieldbuses and Industrial Ethernet, they were more likely to have a strategy to minimize the number of Fiedlbus nodes for optimal use.

With millions of dollars invested in enterprise business and engineering systems, and millions more invested in process control and factory automation systems, companies are looking for ways to unlock the synergies between these two domains. Interestingly, one of the many advantages of implementing Industrial Ethernet is that it provides the ability to achieve connectivity between these two domains by running the following applications (Figure 6).

"The recently purchased equipment has performed very well. We have a wide variety of network switches/ hubs and some have performed well beyond their expected life expectancy. Most importantly the newer models are easily incorporated into our network and function very well with our older equipment. We have had some failures on our network but generally it due to the equipment that is out of date."

~Automation Engineer
Water/Wastewater Facility

Figure 6: Non-Industrial Applications Run on Industrial Ethernet



Source: Aberdeen Group, April 2011

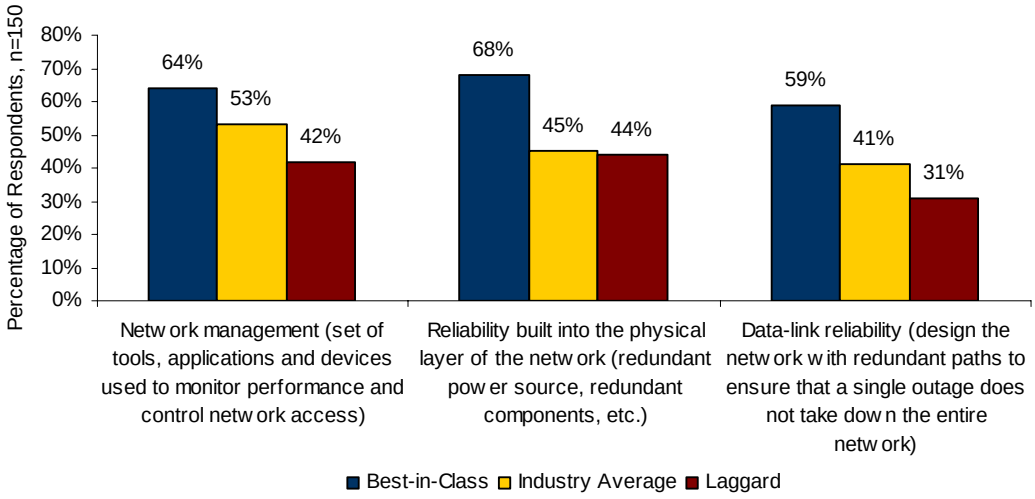
This connectivity enables real-time visibility to critical information and enables collaboration across the value chain. This helps to assure consistent quality and performance across global operations, and reduce the cost of design, deployment, and support of distributed manufacturing and IT systems. It enables companies to more closely link their internal data networks with the factory floor to make the entire operations more efficient. In addition to these applications, Best-in-Class companies are also more likely to run their process control, safety control and motion control on Ethernet. This is further proof that the Best-in-Class are moving away

from having this historical separation between the manufacturing and enterprise network. This integrated foundation provides the ability to bring together sensing devices, controllers, and software to deliver accurate and useful information to decision makers. In large, this ability to connect the plant floor systems to the business systems provides the Best-in-Class the ability to achieve an 89% OEE rate.

Network Management and Reliability

While having the right architecture in place is very important, having the ability to gain intelligence into what is happening on the network and ensuring network reliability is also critical. Best-in-Class companies understand the importance of having key technology enablers in place that offer redundancy and intelligent features to support the network (Figure 7).

Figure 7: Technology Enablers



Source: Aberdeen Group, April 2011

Because manufacturing applications run in real-time, the network must be available to users, with little or no downtown. Manufacturers can ensure network reliability by using effective network design principles. Best-in-Class companies are ensuring reliability and resiliency at both the physical and data-link reliability. Reliability is built on the physical layer by utilizing redundant components (such as power supplies) and redundant devices (such as switches and routers). This ensures that there will always be network access even if there is a media disruption or port failure (on either the end device or switch). In addition, the Best-in-Class are also designing their networks with redundant paths so that a single device or link outage does not take down the entire network.

In addition, Best-in-Class companies are more likely to implement a network management tool, which is used to monitor and maintain the network. This enables the Best-in-Class to have a central source for gathering and analyzing key network variables (such as availability, network

"The most beneficial change we have made is to insist all switches used in industrial control are managed switches, even the 4-port local switches. This allows troubleshooting and updates to be made from a central location without having to open panels and access clean spaces. In addition, hardened switches such as the one that we use are reliable and less likely to fail."

~ Automation Manager
Multi-billion dollar
Pharmaceutical Manufacturer

throughput, utilization and response times) in order to detect issues or faults within the network for easy troubleshooting. Therefore, providing them greater visibility and control over the network. To a great degree this explains why the Best-in-Class, on average, are experiencing only 3 hours of downtime per year, as compared to the Laggards who are experiencing an average of 75 hours of downtime per year (or 12 minutes per day).

In the next section we will examine how one traditional industrial communications vendor is evolving their solution to address these issues and help customers close the gap between the manufacturing and enterprise network with their latest technologies.

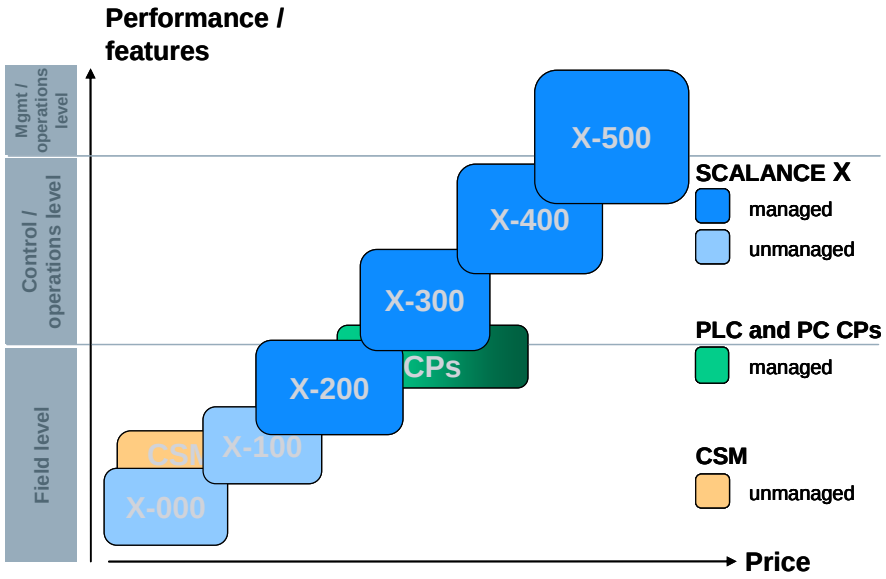
Evaluating Siemens' X-500 Series

In September 2011, the Siemens Industry Automation division announced the release of SCALANCE X-500, which will expand the existing SCALANCE X product lines with a powerful Layer 2 and Layer 3 (management level) rack switch line (Figure 8). With the increasing demand from customers for a fully integrated networking solution from the field level to the management level, Siemens seized the opportunity to deliver a product to the market that bridges this gap. In addition, with the increased adoption of Industrial Ethernet, it means an increase in traffic between the enterprise and the manufacturing network. Therefore, these switches need to also have the following functionalities:

- High transmission rates
- High connection density
- High routing configuration limits

The aim of SCALANCE X-500 is to allow seamless interface with the other SCALANCE X product spectrum from the field level to the operational level to the management level, while ensuring redundancy, security and reliability of the network.

Figure 8: SCALANCE X Product Series



Source: Siemens, June 2011

Prior to the release of SCALANCE X-500, there was a gap in the ability of the SCALANCE X product spectrum to enable the connection from the field level to the management level. The closest product line to closing this gap was the SCALANCE X-400 switch, which closed the gap between the field and management level for smaller and medium sized networks based on gigabit uplink connection. With the release of SCALANCE X-500 and its extended routing performance, the gap between the control level and management level is minimized because the SCALANCE X-500 product sits on top of both layers - and creates a bridge between these two layers. The new release of SCALANCE X-500 will also allow for:

- Improved integration between field level to the management level.
- More efficient user configuration for deployment on the network.
- Easy configuration and creation of "automation specific" and "IT specific" redundancy concepts
- Flexibility in mounting the power supplies in various configurations such as: above, below or behind the switch. When installed above or below, the height of the device increases by one (single power supply) or two (redundant power supply) height units.
- Flexibility in adding and changing modules through the "hot swappable" functionality. Provides customers the ability to replace hardware while the network is running.
- Savings accrued from having the configuration data of the switch stored on the C-PLUG and the on-demand ability to upgrade to Layer 3 software using the KEY-PLUG.

Definitions

√ **Communication Processor (CP)** - a module that adds connectivity and communication functions to a PLC or PC

√ **Compact Switch Module (CSM)** - an unmanaged switch in the design of the respective PLC line that add connectivity to the controller

- Easier network management functions through optimized feature set together with network management tools like Siemens' SINEMA Server. The SINEMA Server provides detailed diagnostics of the SCALANCE product lines and the network.

This new release will help Siemens' customers address many of the challenges faced with gaining critical visibility into their manufacturing operations as well as the many challenges faced with traditional deployment of new equipment on the plant floor. Integration between manufacturing and enterprise network is a critical piece of gaining near real-time visibility into manufacturing operations, which is a Best-in-Class capability.

It also should not be overlooked that Siemens is focusing on improving the network uptime by building reliability in the physical layer (building their switches with redundant power sources) and data link. In our benchmark analysis, this is a differentiating focus area for Best-in-Class organizations and ensures that there will always be network access even if there is a media disruption or port failure (on either the end device or switch). This ensures that a single device or link outage does not take down the entire network. In addition, through the "hot swappable" capability, customers have the ability to replace critical hardware while the network is still running, which translates to minimized network downtime. All the above capabilities, provides Siemens the opportunity to further expand their product portfolio to meet their customer demands and the evolving technology changes.

In conclusion, network performance must be able to match the real-time nature of the plant floor, which can help manufactures gain critical insight into manufacturing performance. Indeed, navigating these many choices and alternatives in the context of a huge installed base of disparate and aging control systems is complex. Nevertheless, the opportunity exists now more than ever to overcome the historic isolation of the control platform from the enterprise. Moving forward, it is time for manufacturers to realize the opportunity of breaking the boundaries between manufacturing and enterprise networks and take steps to lay the network foundation that they need to support it. Indeed, with the release of SCALANCE X-500, Siemens will help their customers overcome this historical isolation between field level, manufacturing operations level and enterprise level networks.

Key Takeaways

Aberdeen's research has seen the progression and adoption of Industrial Ethernet in the manufacturing environment. Best-in-Class companies recognize the many benefits that Industrial Ethernet can deliver. Before an organization plans on implementing Industrial Ethernet, they need to understand that it takes a combination of organization restructure, defined best practices, and the ability to have real-time visibility from the network to the plant level to the executive level. Indeed, a well implemented industrial network can do much more than simply emulate the functions of a traditional industrial network.

"Within our organization, network security, uptime, and availability is critical for the success of our facility. The challenge that we face is matching hardware and application software with the real-time nature of our facility.

~Maintenance
Water / Wastewater Facility

For Siemens' customers looking to take advantage of SCALANCE X-500 series, Aberdeen suggests the following:

- **Drive cross-collaboration amongst traditional disparate groups.** Quick and effective response to issues on the production floor often requires real-time access to information from the field level and the control level as well as the skills and knowledge to take corrective action to optimize processes. Unfortunately, many manufacturers today do not always have the skilled and experienced personnel. Therefore, it is critical to develop teams (consisting of IT and automation personnel) with the domain knowledge to design, implement and manage issues such as network topology, security and network management.
- **Build reliability in the physical layer.** Due to the real-time nature of manufacturing facilities, the network must be available to users on a continuous basis. Therefore, it is critical to ensure reliability on the physical layer by investing in redundant devices, such as SCALANCE X-500, in case of port failure or media disruption.
- **Close the gap between plant floor and enterprise systems.** Network performance must be able to match the real-time nature of the plant floor, which can help manufactures gain critical insight into manufacturing performance. Siemens SCALANCE X-500 interfaces with the other SCALANCE X product lines to enable the connection between the field layer to the manufacturing operations layer to the enterprise layers.
- **Continue to expand the adoption of Industrial Ethernet.** While the Best-in-Class are leading the charge in adopting Industrial Ethernet strategically, less than half of them have done so. Siemens' customers should look to expanding the adoption of Industrial Ethernet and running additional applications such as video and voice over Industrial Ethernet. This will enable companies to close the gap between plant and enterprise systems to help improve asset, process and quality performance.

For more information on this or other research topics, please visit www.aberdeen.com

Related Research	
▪ *Industrial Networking: , Building the Business Case for Industrial Ethernet;* May 2011 ▪ *Operational Intelligence: Aligning Plant and Corporate IT*; February 2011 ▪ *A Risk Management Approach for Improving Safety and Productivity;* February 2011	▪ *Unchained: the Wireless Imperative in Network Integration;* October 2010 ▪ *Manufacturing Operations Management in the Economic Down Turn,* March 2010

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