

## Reskilling Today's Industrial Workforce for OT-IT Convergence

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### Keywords

Smart Manufacturing, Workforce, OT, IT, Industrial IoT, Information, Ethernet/IP, Industrial IP Advantage

### Summary

Representatives from Cisco, Panduit and Rockwell Automation recently briefed ARC Advisory Group on behalf of [Industrial IP Advantage](#). The topic for the briefing was the need to reskill the industrial workforce in this age of information-enabled operations. According to Paul Brooks of Rockwell Automation, this “reskilling” will involve new industrial network

The industrial sector is forecasted to have over fifty billion Internet-connected devices by 2020.

With more manufacturers converging their OT devices with their enterprise-based IT systems, ensuring connectivity and collaboration between these historically separate disciplines is central to business success.

design skills, new training approaches, and greater collaboration among information technology (IT) and operations technology (OT) personnel.

Analysts forecast that the industrial sector will have over fifty billion internet-connected devices by 2020. In this connect-

ed environment, OT and IT professionals will have to collaborate on all aspects of design to create fully converged architectures. For this to succeed, however, manufacturers and other industrial organizations must ensure that their IT and OT professionals have the critical knowledge and skills required to design, deploy, and manage high-value industrial network architectures.

### Transformative Times

According to Paul Taylor of Cisco, “Manufacturing will change more in the next five years than it has in the previous 20 as a result of greater connectivity and an explosion of internet-connected, ‘smart’ devices.” This is being made possible by the convergence of IT and OT systems leveraging com-



mon IP networking standards or using a single networking technology, as well as by enabling forces such as the Industrial Internet of Things (IIoT) and Big Data analytics.

Smart manufacturing with information-enabled operations offers virtually infinite potential to improve business performance. Companies will be able to use data that has long been stranded inside machines and processes to quickly identify production inefficiencies, compare product quality against manufacturing conditions, and pinpoint potential safety, production, or environmental issues. Remote access connectivity and mobile technologies will immediately connect operators with off-site experts to be able to avoid or more quickly troubleshoot and resolve downtime events. IP-connected cameras using advanced video-analytics software will both enhance physical security via facial recognition, perimeter violations, thermal identification, etc., and support enhanced asset availability and performance.

### Opportunities and Challenges Worldwide

The move to information-enabled operations is taking place at a crucial time for many industrial organizations. Within today's highly competitive global marketplace, manufacturers are seeking to retain footholds in established markets while capitalizing on a worldwide middle-class population

When manufacturers are unable to fill roles, more than 70 percent report at least a 5 percent increase in overtime costs, more than 60 percent report an increase in production downtime of 5 percent or more, and two-thirds report an increase in cycle time of 5 percent or more.

*Source: Out of Inventory: Skills Shortage Threatens Growth for U.S. Manufacturing, Accenture and The Manufacturing Institute*

that is growing by 70 million people every year, driven largely by emerging economies. Regulatory requirements are also increasing, including increasingly stringent safety standards and emerging regulations that require greater product traceability and supply chain management aimed at reducing the spread of counterfeit products.

At the same time, manufacturers around the world face a workforce dilemma as older, highly knowledgeable workers retire and younger, less experienced workers take their place. A 2014 study by Accenture and The Manufacturing Institute found that US manufacturers may be losing up to 11 percent of their earnings per year due to increased production costs resulting from a shortage of skilled workers.

Connected operations and Internet-ready technologies will help manufacturers address these challenges and opportunities through greater insights into their operations and by seamlessly connecting people, processes, and machines across the enterprise. This can only happen, however, if their employees are armed with the knowledge and skillsets needed to design industrial networks, as well as deploy, manage and sustain them for the long term.

### Blurring of Roles

Converged network architectures bring together IT and OT systems that have long remained separate. As a result, IT and OT professionals who previously only oversaw their own individual systems now must also understand the counterpart technologies. IT professionals must be able to transfer their experience of enterprise network convergence and ubiquitous use of Internet Protocol into manufacturing applications. OT professionals must be able to migrate from yesterday's islands of automation to today's plant-wide, information-centric architectures to enable the secure flow of information throughout the manufacturing enterprise and beyond.

Dan McGrath of Panduit feels that manufacturers should be proactive to equip workers with these skills and knowledge. They also must improve collaboration between IT and OT workers and improve training for each.

Manufacturers should be proactive to equip workers with these skills and knowledge. They also must improve collaboration between IT and OT workers.

IT training has traditionally been virtual-based and certificate-based, with the goal to enable IT professionals to demonstrate their knowledge through tests or assessments to help them advance their careers. OT training, on the other

hand, has more often been provided through the employer and conducted in the classroom and/or "on the job." It is not certificate-based, and the outcome is to equip workers with the necessary skills for their specific jobs.

Today, training programs are being recalibrated to meet the needs of both IT and OT workers as their roles and responsibilities increasingly become blurred. More blended and consumable training offerings have been created, with a greater reliance on online courses to better serve both groups and more knowledge-centric courses to help OT workers become more knowledgeable on IT systems.

## Reskilling the Workforce: Nine Key Areas of Focus

Designing high-value network architectures with anywhere from hundreds to thousands of connections requires skills and knowledge in a number of key areas. The specific knowledge and skills needed will depend on each company's specific situation. However, all professionals responsible for deploying scalable, end-to-end network infrastructures should be well versed in the key fundamental areas of industrial network design. Industrial IP Advantage believes that these involve nine key areas:

**EtherNet/IP:** EtherNet/IP enables manufacturers to use one standard network for safety, motion, process, batch, and other high-availability applications. Understanding key protocol functions and services is critical for users seeking to converge their networks using this widely used Ethernet protocol.

**Physical Infrastructure:** The network provides the physical foundation that enables IT and OT convergence. Knowing how to design this physical infrastructure to maximize the logical network design for each cell or area zone is imperative. This includes recognizing network distribution install issues, adhering to standards to reduce downtime risks, and selecting the right media for the application.

**Wireless Technology:** Wireless technology is increasingly being used in the manufacturing world for critical applications that demand reliable data transmission with low levels of latency and jitter. When designing WLANs, IT and OT professionals must account for crucial factors, including autonomous vs. unified topologies, quality of service, high availability, security etc.

**Security:** Industrial network security must be designed into an infrastructure and addressed at different levels. Workers should know how to deploy a defense-in-depth (DiD) approach to system security and be familiar with the tools that can be used at the network layer to provide defense within the cell or area zone.

**High Availability:** In the smart manufacturing era, network downtime typically equals production downtime. Those responsible for designing high-availability network infrastructures should understand the full range of factors that can influence network availability, including standard and pro-

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prietary resiliency protocols, switch stacks, Virtual Switching Systems, EtherChannel, etc.

**Segmentation:** A move from physical to logical segmentation drives efficiency in both acquisition and operational phases of the infrastructure lifecycle and acts as a platform for deploying a DiD security strategy.

**Secure Remote Access:** Remote access is changing how manufacturers operate, from connecting off-site experts with plant operators for faster

Remote access is changing how manufacturers operate, from connecting off-site experts with plant operators for faster problem solving to remote monitoring of critical or dispersed assets.

problem solving, to remote monitoring of critical or dispersed assets. Those responsible for designing and deploying remote-access solutions should be familiar with key design considerations for internal and external access to converged plant-wide networks within the industrial zone, and understand

how factors such as business practices, corporate standards, security policies and procedures, and risk tolerance impact their approach for achieving secure remote access.

**Mobility:** The ability to incorporate voice, video, and data on mobile devices can improve communications across functions, enhance levels of expertise, and even help overcome language barriers. Getting the most from mobile technologies requires that IT and OT professionals understand the best practices for deploying these in conjunction with plant-floor systems.

**Virtualization:** Virtualization decouples a computer's physical hardware from its operating system and software. This enables manufacturers to create pure software instances, or virtual machines, of their physical computers. This can extend the useful life of computing assets, reduce server sprawl, and improve productivity by reducing maintenance requirements. Designers should understand important client-server concepts such as the network implications of multiple servers deployed on a single virtualized hardware platform.

## Conclusion

Clearly, the need for industrial network design skills will only grow as manufacturing operations become increasingly connected and as the number of connected devices continues to grow. Industrial organizations must

If the fifty billion internet-connected devices are truly going to be connected by 2020, all barriers between IT and OT must come down, and IT and OT professionals must collaborate and receive the appropriate training.

ensure their IT and OT teams are properly equipped to make the migration to a converged network infrastructure smooth and help ensure those teams are getting the most from their smart manufacturing technologies in the long term.

ARC dedicated multiple sessions to OT/IT convergence at our recent Industry Forum in Orlando. For this convergence to succeed, all barriers between IT and OT must come down and IT and OT professionals must collaborate and receive appropriate training in relevant study areas.

Industrial IP Advantage is an educational community created to help manufacturers and other industrial organizations better leverage connected, information-enabled operations through the use of standard, unmodified IP and Ethernet. Industrial IP Advantage has developed several [online training courses](#) that combine the knowledge, best practices and application-specific expertise of Cisco, Panduit, and Rockwell Automation to help engineers build a holistic IP-based network architecture. The courses are based on validated reference architectures and include more than 40 interactive and scenario-based training modules.

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