WHITE PAPER

# IT/OT Collaboration: Protecting Networking Equipment in Diverse Manufacturing Environments

David Knapp
Product Marketing Manager
Chatsworth Products

Sam Rodriguez
Sr. Product Manager
Industrial Enclosure Systems

Published: August 2019

**US & Canada**
+1-800-834-4969
Toronto, Ontario, Canada
+905-850-7770
chatsworth.com

techsupport@chatsworth.com

**Latin America**
+52-55-5203-7525
Toll Free within Mexico
01-800-01-7592
chatsworth.com.co

**Europe**
+44-1628-524-834
chatsworth.com

**Middle East & Africa**
Dubai, UAE
+971-4-2602125
chatsworth.ae

**Asia Pacific**
+86 21 6880-0266
chatsworth.com.cn

CHATSWORTH PRODUCTS

## Introduction

As more organizations continue to pursue the promise of intelligent, data-driven business decisions, the importance of properly deploying and managing the physical networks that connect manufacturing environments to the rest of the organization intensifies. This may seem like the exclusive role of the Information Technology (IT) department at first glance, but the entire organization, including those in Operational Technology (OT) are key stakeholders as well.

This is especially true for systems control/automation engineers, manufacturing engineers, maintenance engineers or facilities managers with specific, first-hand knowledge that can help IT and the rest of the organization realize the potential of data-driven decisions. These specialists know what data to capture, where to best capture it and how to manage the facility where the physical network that collects and connects that data must be built and maintained.

This paper, then, provides key considerations to help drive meaningful IT/OT collaboration for those actively engaged in the design, deployment and continuous maintenance of the data capture network in the manufacturing environment.

## Top Use Cases in Industrial IoT

Industrial Internet of Things (IIoT) is the term used to identify all the monitoring technologies used to collect data from the manufacturing process, and the analysis, reporting and archiving of that data. It also includes all the hardware used to collect, process and store said data.

According to the survey Internet of Things Study[1] conducted by The MPI Group, Industrial IoT adoption is increasing with most respondents reporting increases in productivity and profitability. Manufacturers are focusing on production and manufacturing monitoring, predictive and condition-based maintenance, and inventory management and monitoring to improve product quality, increase the speed of operations and decrease manufacturing costs. Emerging IIoT for connected workers and intelligent logistics will further increase safety and compliance and improve coordination with suppliers and customers. In which of these projects are you participating?


Manufacturing Goals

- Improve product quality
- Increase speed of operations
- Decrease manufacturing costs
- Improve maintenance/uptime
- Improve agility and responsiveness
- Improve information for production decisions
- Improve safety
- Improve coordination with customers and suppliers
- Improve information for business analytics
- Improve compliance


Top IIoT Use Cases

- Production and manufacturing monitoring
- Predictive and condition-based maintenance
- Inventory management and monitoring
- Connected workers
- Intelligent logistics

Overall, the survey shows strong adoption of IIoT initiatives. In kind, these programs depend on reliable infrastructure and networks to collect and process the data. In practice, the team tasked with implementing IIoT initiatives will need to create more space in the facility for compute, data storage and networking equipment, and plan for more and faster network connections to manufacturing equipment.

## Building the Team

If IT assumes all the planning, design, cost, risk, management and accountability for data and networks, then the result may be too restrictive when it is time to deploy new manufacturing technologies. This might cause delays or invalidate some of the future benefits of newer manufacturing technology investments or services.

While an IT team has expertise in network design, systems administration and software integrations, they are not as well versed in specific manufacturing technologies and systems. This is where the control systems, automation, manufacturing and facilities engineers can provide valuable input on specific manufacturing systems and software integration. They can provide what data is critical for operational decisions, the limitations of the facility, and the ideal procedures, workflows and responses to daily events. If these factors are identified early in the design phase, the information architecture and corresponding data network can be designed to allow more flexible response.

Consider a team of related disciplines and how each member can contribute:

- **Systems control/automation engineers (operational technologists)** – know what data is available, where to get it, and how it relates to overall processes; how to connect automation equipment and interfaces between automation network protocols and IT network protocols

- **Manufacturing engineers** – well attuned to the operational procedures and workflows, and which data is most useful to operational decision making and upstream reporting; also how and when the production equipment will change

- **Logistics (planners)** – excellent awareness of material requirements, order points and critical inventory control metrics; and have the ability to set the capacities that drive the most critical processes

- **Facilities managers (maintenance engineers)** – experts in the building subsystems, and establishing cabling pathways, delivery of power and cooling for automation and production equipment

- **Information technologist** – maintain a strong understanding of the Ethernet network, networking equipment, computing, and database integration of manufacturing control and enterprise planning systems

## What are the challenges?

Once the team of cross-functional expert stakeholders has been defined, there are four main challenges to creating and maintaining a robust, reliable network in the manufacturing environment:

- **How and what data to capture, store, sort and report from operations.** What data is needed for the current project? What data might be needed for future projects? If all data is captured, but only some or fractions of it is being used or analyzed, does the cost of storage quickly exceed the benefit of archiving? These questions require a cross-functional understanding of what data is available, what reporting is important and whether integrations are possible.

- **Understanding how (and where) logistics and manufacturing are inextricably linked.** Consider the overall workflow, not individual machine or maintenance requirements. If there is downtime in one area or a material shortage, then how does the operation adjust? Does data exist that is important to identifying and making the decisions for these adjustments?

- **Progressively increasing network speed and bandwidth to enable more integrated systems and automation.** Because of the interdependencies of automated machines and the numbers of sensors reporting, the manufacturing environment typically requires faster networks than office networks[2]. The team may need to add local compute and storage to improve network performance. Additionally, as an organization transitions from general reporting and standard sensor connections to integrated automation, even faster network connections are necessary.

  This requires a regular update of network equipment and network cabling in the manufacturing environment. New equipment may also require increased power and cooling. Additionally, if service providers are engaged, the team will need a process to allow service providers access to the network and equipment in the manufacturing space. What is the roadmap for upgrade? Does it match the data needs of planned systems?

- **Creating a flexible physical network that can quickly adapt with manufacturing changes.** Manufacturing environments are much more fluid than office spaces. Manufacturing equipment is moved, upgraded and replaced often. This means the network connections need to be able to adapt to these changes. For example, having the flexibility to move cable drops and wireless access points without recabling the entire facility. There are also distance limitations for different types of network cabling and connections. This most likely means the need to place networking equipment into the manufacturing environment.

**Fast Fact**

*For assistance with your physical network, contact a BICSI-certified designer or installer near you: https://www.bicsi.org*

*The Building Industry Consulting Service International (BICSI) is a professional credentialing association for designers and installers of low-voltage cabling systems (networking, voice, alarms, access control, building automation, audio, video).*

## Practical Concerns for the Physical Network

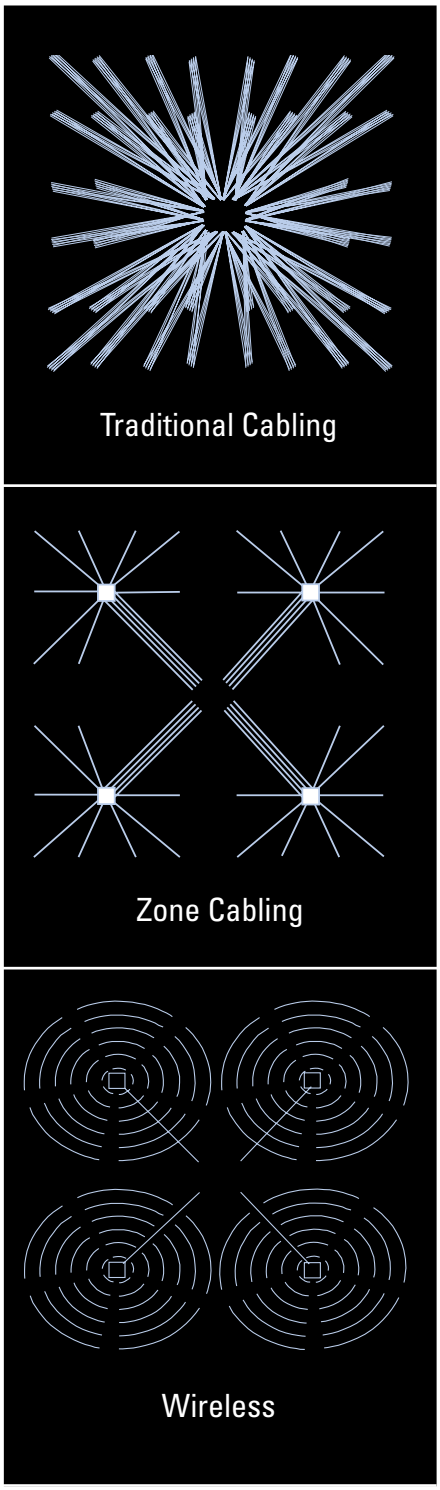
Although each facility has unique networking requirements, there are a few universal concerns to take into consideration when designing or upgrading a physical network in a manufacturing environment.

- **Floorspace is limited**. Floorspace in the manufacturing environment is limited. It is firstly reserved for manufacturing equipment and secondly for material logistics. This may not leave much or any space for networking. Overhead may be the best option. It may offer the least obstructed path for cables, be high enough to avoid incidental damage from material handling and provide excellent physical security because a lift or ladder is needed to reach equipment.

- **The need for flexibility.** As mentioned, the manufacturing environment is fluid. Manufacturing equipment changes and floorspace is reset to new production practices and models. This is a continuous process. Additionally, as an organization increases the amount of integrated automation, faster network connections are required to keep equipment connected and synchronized correctly. Zone cabling is the practice of dividing the space into zones and supporting connections in each zone from a centralized telecommunications enclosure. This allows easier moves, adds and changes and typically limits cabling and networking changes within the affected zone.

- **Environmental impact on IT equipment.** The manufacturing environment is usually not as clean as an office environment. It may be dirty, wet, or otherwise expose sensitive networking equipment to environmental hazards. It's certainly feasible to store networking equipment in the manufacturing environment, but it is also necessary to then create protected spaces for equipment using industrial/environmental enclosures. Industrial enclosures protect equipment from dust and liquid, can be modified to support traditional computer and networking equipment instead of panel mount automation electronics, and can be conditioned to provide the right operating temperature for equipment.

- **Physical access to equipment to work around production process.** If equipment is stored on the manufacturing floor, will the team be able to easily access it? How often will access be needed? And when it is accessed, does it interrupt the production process? For example, if data networking equipment or connections are stored overhead, can the team access those locations without having to shut production equipment down or block material flow on the production floor?




**Fast Fact**

*Zone cabling divides the manufacturing floor into zones, with a central enclosure in each zone to aggregate nearby network connections. The advantage is that cabling changes are typically just between the enclosure and manufacturing equipment as opposed to all the way back to telecommunications equipment rooms. Would a zone cabling approach work for your site?*

## Creating Spaces for IT Equipment

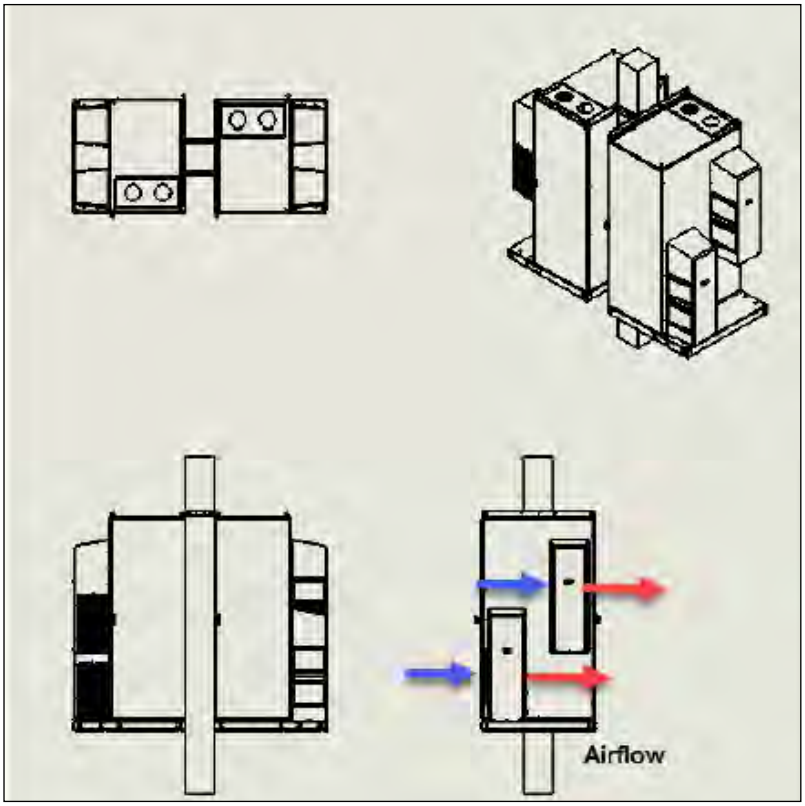
As the network design is finalized, there is likely a need to create spaces within the manufacturing environment to house networking equipment and cabling connections. The length of network cabling connections is limited by the media and signal type. As a result, this may require the specification of unique enclosures that can protect IT equipment in the manufacturing environment. Standard office-space enclosures don't block particulates and liquid that will surely damage the network equipment.

In most instances, the team can modify an industrial/environmental enclosure, like the enclosures that are used for automation and controls, to support compute, storage and networking equipment. Start with the standard enclosure and add 19"EIA mounting rails, cable management, power monitoring and cooling. Manufacturers that design enclosures may be able to modify and kit standard enclosure solutions to meet specific networking applications.

In one example, Chatsworth Products (CPI) worked with a customer to create networking spaces in a new preparation and fulfillment facility. Although not traditional manufacturing, the space has special environmental requirements, a mix of interconnected conveyors and packing equipment, and each product needs to be quickly processed, tracked and shipped.

The customer did not have enough floorspace for the IT equipment, but the size of the facility dictated the need for telecommunications enclosures to house networking switches and connections within the floorspace. Additionally, the networking switches required high capacity and redundant cooling. CPI worked with the customer to design a solution that would mount to the building's support columns, so the networking enclosures are located about 30 feet above the space (Figure 1).

*Figure 1: Modified enclosure design to support network equipment overhead of manufacturing operation. Includes method of attachment to building support columns, redundant air conditioning units, modified gland plates for cable entry, and internal kit for 19"EIA rack-mount IT equipment.*



A NEMA Type 12 (IP55) enclosure was selected to provide a seal and modified with 19"EIA equipment mounting rails for network equipment. Two air conditioners were added to the side of the enclosure in a staggered orientation to allow unrestricted airflow. Large sealed gland plates with prepunched dual 6-inch conduit openings were added to the top of the enclosure to allow cable ingress/egress. A special shelf and top anchor bracket were designed to mount and secure the enclosures to the building columns (Figure 2). Two sizes were configured that are now standardized solutions for this type of facility design. Standardization will help scale the network.

*Figure 2: Prototype of modified enclosure on display at International Manufacturing Technology Show conference, Chicago, 2018.*

Other approaches include the use of a standard wall-mount enclosure with filter fans to locate network switches within the production space (Figure 3) or the use of a floor-mount enclosure as a standalone, central wiring closet within the manufacturing or warehouse space (Figure 4). These enclosures house network switches that connect all the IIoT sensors, wireless access points and hardwired network connections in the surrounding area and use a minimal number of fiber cable connections back to the main computer room. Additionally, evolving networking technologies such as Power over Ethernet (PoE) continue to increase thermal loads within enclosures, making cooling, power and cable management key considerations with each IT or network enclosure design.

*Figure 3: Standard Swing Wall-Mount Enclosure mounted overhead of a workspace. The fan was added to remove heat from network switches. This style of enclosure provides front and rear access to equipment.*

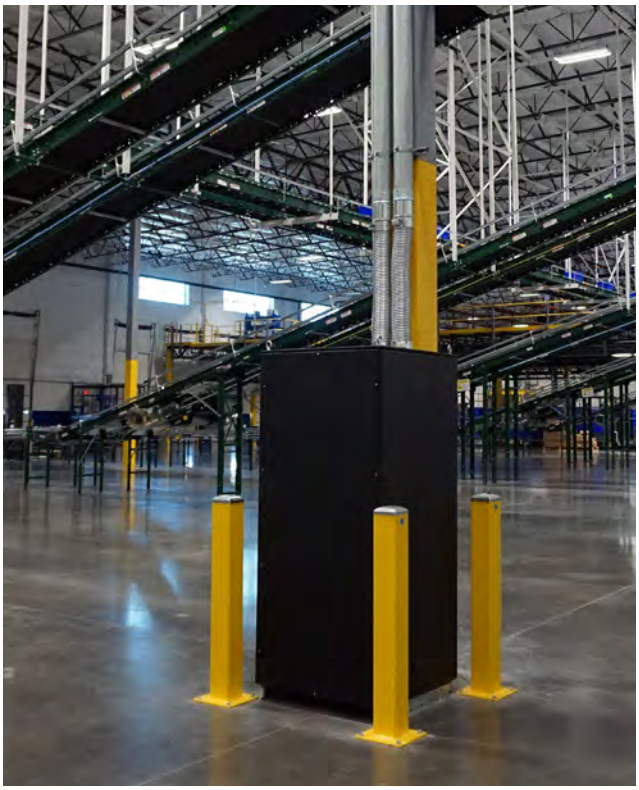


*Figure 4: Standard Modular Enclosure floor mounted by a building column in a warehouse space. Fans were added to remove heat from network switches. The top of the enclosure was modified with gland plate for cable entry.*

These examples highlight an assortment of industrial/environmental enclosures designed to meet various protection classes (NEMA 12/IP 55, NEMA 4/IP 66, NEMA 4X, etc.) that can be adapted/kitted to meet the support requirements for networking and computer equipment. It is important to consider mounting rails/system, cable access and management, power delivery and cooling as part of the total solution. Networking equipment and supporting air conditioners may need 5 kW or 8 kW power connections. But if enclosures are carefully placed, and cables then run to surrounding zones, the result is a network that is more adaptable to manufacturing changes.

**Fast Fact**

*To learn more about specifying industrial enclosures for networking applications, read the companion paper Extending the Network Into Nontraditional Spaces: An Enclosure Selection Guide for IT Systems Administrators That Support IoT: https://www.chatsworth.com/en-us/documents/white-papers/extending_network_into_non_traditional_spaces_wp-p.pdf*

## Conclusion

Many organizations are updating their manufacturing networks in support of digital transformation projects. Digital transformation depends on data, and a reliable network to deliver that data quickly and efficiently. Industrial networks are unique because of the harsh environmental conditions in the manufacturing space. With input from a cross-functional team and the assistance of a certified designer, organizations can now create a reliable, flexible and robust network. This may include the creation of new spaces to house network, compute and storage equipment on (or above) the manufacturing floor.

The novel application of traditional industrial environmental enclosures, custom-adapted to traditional compute and network requirements, and the use of a zone cabling approach is the ideal solution. Enclosures create a small, secure space for equipment, environmentally protect equipment and can be mounted on the floor, wall or overhead.

### Why select CPI to assist with enclosure design?

The CPI Product Designer speeds enclosure selection by providing a simple, online tool that lets users select the style, size, material, protection rating and accessories for a standard enclosure in just a few clicks. The CPI Product Designer also guarantees compatibility between enclosure and accessories and gives users the ability to ship the solution as a single kit.

Additionally, if modifying a standard enclosure to meet specific site or networking application requirements is needed, CPI engineers are available to help. CPI has over 25 years of experience designing enclosures, thermal management, monitoring and security solutions. CPI supports small and mid-sized customers, and our manufacturing lead times for modified standard enclosures are generally short.

## References

[1] The MPI Group. May 2017. Internet of Things Study. *https://mpi-group.com/internet-things-study/*

[2] RCR Wireless. IoT Enterprise Insights. James Blackman. May 2019. Digital Factory Solutions: Industrial LTE & 5G. How Incoming Cellular Technologies Will Transform Smart Manufacturing. (sponsored by Huawei and KPMG, original data from Nokia). *http://content.rcrwireless.com/digital_factory_5G_connectivity*

## Organizations

Building Industry Consulting Service International (BICSI): *https://www.bicsi.org/about-us/about-bicsi/who-we-are*

BICSI Certifications: *https://www.bicsi.org/education-certification/certification*

## Contributors

**Sam Rodriguez, RCDD | Sr. Product Manager, Enclosure & Industrial Solutions**
Sam Rodriguez has more than 26 years of experience in the communications market and has been an employee owner for 21 years. He has held several progressive roles including Sr. Product Manager for Cabinet and Thermal Solutions, Technical Services Supervisor and Technical Support. In his current role, he is focused on developing CPI's RMR Industrial Enclosures and Thermal Solutions to support the increasing requirements for edge deployments, IoT and IIoT applications.

**David Knapp | Product Marketing Manager**
David Knapp has more than 20 years of experience in the telecommunications industry. He has been employed at CPI since 1997 and has held various roles including Technical Support, Technical Writer and Product Marketing Manager. He is currently focusing on data center, enterprise networking and power management solutions.

CHATSWORTH PRODUCTS