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Industrial Cyber Security

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tripwire®

David Meltzer
Jeff Lund



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Introduction

Industrial control systems (ICS) are the workhorses of our physical world. These systems are becoming more Internet-connected, more virtualized in many cases, and more remotely accessible by the day. In fact, Gartner Research estimates that 5.5 million devices were being added per day in 2016, leading to an estimated 21 billion Internet-connected “things” running our world by 2020.

As information technology (IT) and operations technology (OT) converge, the interconnections and crossover between them result in increased risks that can quickly turn into physical outcomes with the potential for disruption and harm. Many security experts worry that organizations’ dependence on connected devices is developing more quickly than their ability to secure those devices. The challenge is how to secure physical and cyber assets in a constantly connected, digital world.

About This Book

Industrial Cyber Security For Dummies, Belden/Tripwire Special Edition, discusses the basic concepts of cyber security in ICS environments and will help both IT and OT determine the foundational security controls appropriate to each unique industrial environment. In this book, we help you understand the industrial cyber security landscape and the basics of getting started with an industrial cyber security program. We show you how the security concerns of IT and OT convergence are related to ICS and how real-world industrial breach scenarios put availability, safety, and resilience at risk.

This book is a very brief overview — a truly high-level introduction to industrial cyber security. Whether your role is within OT or IT, there’s something here for everyone’s interest and benefit. We hope this small start will pique your interest to delve far deeper into the topic.

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Chapter 1

Understanding the Industrial Cyber Security Landscape

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In This Chapter

- ▶ Understanding industrial cyber security and cyber threats
 - ▶ Introducing control systems
 - ▶ Considering critical infrastructure
 - ▶ Determining responsibility
-

Before the Internet brought almost universal connectivity, industrial security was very different from what it is today. Now you need to be concerned with far more than simply physically protecting your resources. Connected devices face a broad range of threats, which are often invisible. This chapter discusses how the landscape has changed and what you need to do to protect your organization.

Defining Industrial Cyber Security

Traditional industrial and critical infrastructure organizations had no Internet as we know it today. Perimeter defense typically meant physical security — gates, fences, barriers, and guards. Control systems and plant networks were specialized, and built for reliability and automation. Communications were proprietary, not designed for IP-based standards like Ethernet and TCP/IP. Firewall technology didn't exist and wasn't seen as necessary. A demilitarized zone (DMZ) separation between

plant and corporate enterprise networks wasn't typically in place. Minimal security controls may have been present, but anyone who had access to the control system level and was wearing a hard hat was assumed authorized to be there.

Internet connectivity changed the whole security landscape because that connectivity enabled attacks that didn't require physical access. Now organizations need to think about cyber security. *Industrial cyber security* is the process of keeping industrial control systems (ICS) free from intentional or accidental cyber threats that disrupt or cause harm to people, processes, equipment, or the environment.

Cyber threats to industrial systems can come from insiders or outsiders. These threats are often transmitted electronically, such as through email or through stolen or shared login credentials, and the consequences can be digital or physical. The threats include

- ✔ **Intentional acts:** These are typically deliberate and malicious cyber threats from an insider or an outsider. They are designed to disrupt or harm systems, processes, equipment, or people.
- ✔ **Accidental events:** These events can occur from acts of nature or loss of power, such as power lines being knocked out by a hurricane or high winds. They can also be from insider errors, such as an employee or trusted contractor choosing an incorrect configuration option, missing the right key on a keyboard, or updating the wrong systems — any of which may result in ICS failure.

Chapter 2 discusses current threat details, defensive strategies, and steps to take.

Although malicious insiders are less common, when they go rogue they can have a more potent impact because of their inside knowledge. Consider, as well, that internal threats aren't always intentional; one of the most common sources of virus or malware infections within industrial environments is the use of a USB device that is unknowingly infected.



Industrial cyber security is a process similar to industrial safety programs, and with a similar lifecycle. It requires people and technology to build and enforce governing policies and processes, establish baselines, monitor, maintain, and continuously improve the process.

To better understand cyber threats, consider a real-world example. In April 2016, the Michigan Board of Water and Light (BWL) was infected with a variant of ransomware that was contained in a malicious attachment an employee inadvertently opened. The malware spread quickly and encrypted files on other computers throughout BWL and ultimately caused a shutdown of the utility. BWL worked to rid itself of the infection from its business systems with the help of authorities and for a total cost of approximately \$2.4 million.

Understanding Industrial Control Systems

Industrial control systems (ICS) are technologies and systems that monitor and control the actual operation of physical equipment and plant process automation and production. ICS are process- and event-driven and run real-time software applications or operate devices with embedded software. These specialized systems exist throughout global industrial automation and critical infrastructures. Effectively applying principles of classic IT cyber security to these complex systems can be difficult or problematic.

Within the controls systems industry, ICS and related networks and endpoints are often referred to as operational technology (OT) systems. Historically, the majority of OT systems were proprietary, analog, and vendor supported, and most of them were not internet protocol (IP) enabled. Most current ICS systems and subsystems are now a combination of OT and information technologies (IT).

As industrial networks, endpoints, and control systems increase Internet connectivity, the operations environment is becoming an entry point into other industrial processes and operations and even enterprise systems.



The National Institute of Standards and Technology Special Publication 800-53, Revision 4 (NIST SP800-53 R4) defines ICS to be “a computer-based system used to control industrial processes such as manufacturing, product packaging and handling, production and distribution.” Industrial control systems also include supervisory control and data acquisition (SCADA) systems that control assets and communications in widely dispersed geographies. SCADA typically includes

human-machine interfaces (HMIs). HMIs interface with control system operation, firmware, software and hardware components, distributed control systems (DCSs), and smaller control systems using programmable logic controllers (PLCs) to control localized processes.

Industrial control systems (ICS) and industrial automation and control systems (IACS) include these and other types of applications within industrial and critical infrastructures:

- ✔ Supervisory control and data acquisition (energy, water, wastewater, pipelines, airfield lighting, locks, and dams)
- ✔ Distributed control systems (process and manufacturing)
- ✔ Building control systems and automation systems
- ✔ Utility management control systems
- ✔ Electronic security systems
- ✔ Fire, life safety, and emergency management systems
- ✔ Exterior lighting and messaging systems
- ✔ Intelligent transportation systems

Understanding Critical Infrastructure

In addition to ICS, cyber security also must consider critical infrastructure. In 2013, Presidential Policy Directive/PPD21 designated 16 critical infrastructure sectors “whose assets, systems, and networks, whether physical or virtual, are considered so vital to the United States that their disruption or destruction would have a debilitating effect on security, national economic security, national public health or safety, or any combination thereof.” The directive’s goal was “to advance a national policy to strengthen and maintain secure, functioning, and resilient critical infrastructure.” U.S. critical infrastructure sectors include

- ✔ Chemical
- ✔ Commercial facilities
- ✔ Communications
- ✔ Critical manufacturing

- ✓ Dams
- ✓ Defense industrial base
- ✓ Emergency services
- ✓ Energy
- ✓ Financial services
- ✓ Food and agriculture
- ✓ Government facilities
- ✓ Healthcare and public health
- ✓ Information technology
- ✓ Nuclear reactors, materials, and waste
- ✓ Sector-specific agencies
- ✓ Transportation systems
- ✓ Water and wastewater systems

Assigning Responsibility

So who's to blame for security breaches? Who's responsible for industrial cyber security? The subject has become a bit blurry. We can call it IT-OT convergence, or blame it on the Industrial Internet of Things (IIoT), or use the new label preferred by some analysts, *pervasively connected devices*. The fact is, the line between the IT and OT domains used to be very clear, but it isn't any longer.

The 2016 annual *State of ICS Security* survey of global ICS professionals by the SANS Institute indicates that 27 percent had experienced an attack in the preceding 12 months. A surprising 52 percent responded "not that we know of." Of the breaches that ICS professionals knew about, more than half had occurred 1–5 times. In other words, even professionals probably aren't fully aware of the extent of the problem.

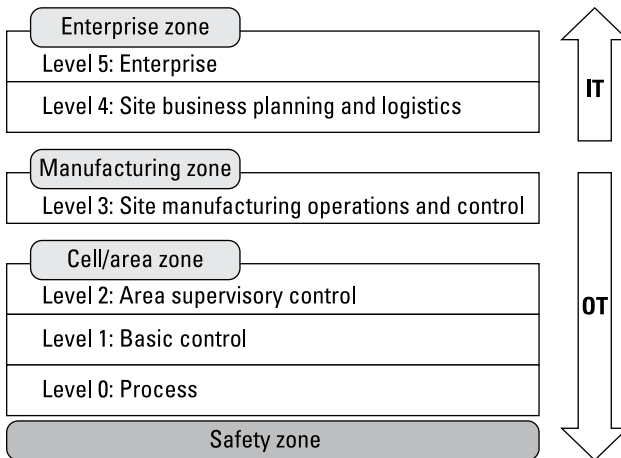
Several factors account for these problems:

- ✓ ICS products from vendors increasingly use of commercial-off-the-shelf (COTS) products such as Windows and Linux OS.
- ✓ Many organizations have adopted standards-based communications using industrial Ethernet and TCP/IP.

- ✓ Internet connectivity for ICS is increasingly used by employees for remote access to work resources and by vendors for troubleshooting and equipment maintenance.
- ✓ More organizations have implemented wireless access points across the enterprise, including plants.

IT organizations have typically managed industrial enterprise domains, as seen in Figure 1-1, as Levels 4 and 5. IT has generally been concerned with securing systems that house data such as financial and customer information, intellectual property, and corporate future-looking information. These systems may consist of servers, workstations, email systems, applications, and databases.

The domain of the OT organization is the plant floor, process automation, and production systems. These systems can include equipment spread throughout wide geographies, such as at water pump stations or electric transmission substations. The overall OT domain is shown as Levels 3–0 in Figure 1-1. OT teams are most concerned with safety and availability of their physical and cyber assets because disruption could cause human harm or production losses.



Purdue Model for Control Hierarchy logical framework. Source: SANS Institute (www.sans.org/reading-room/whitepapers/ICS/secure-architecture-industrial-control-systems-36327)

Figure 1-1: The traditional split between IT and OT.

Most commonly, IT has a head start on cyber security skills within its domain and frequently has some type of headcount and budget dedicated to IT security. However, the IT team

usually has little understanding of the unique setting and requirements within industrial networks, endpoints, and control systems. Standard IT best practices and technology solutions do not automatically apply in OT, and often the IT staff can't take the time to learn OT's requirements, processes, production demands, or criteria for measuring success.

A good way to picture the differing priorities of IT and OT is with a network/information security model called the CIA Triad. Despite its name, this model isn't about the Central Intelligence Agency. Instead, the letters *C*, *I*, and *A* represent three important security priorities: confidentiality, integrity, and availability. As Table 1-1 shows, IT and OT teams traditionally rank these priorities differently.

<i>IT</i>	<i>OT</i>
Confidentiality	Availability (and safety)
Integrity	Integrity
Availability	Confidentiality

If IT has to shut down systems and user or customer access because of a malware attack, so be it. Protection of confidential information overrides availability. OT would say downtime is not an option. System safety and availability trumps security for most production environments. Table 1-2 shows how each organization handles typical security topics.

<i>Security Topic</i>	<i>Information Technology (IT)</i>	<i>Control Systems (ICS)</i>
Anti-virus and mobile code	Very common; easily deployed and updated. Users have control over customization and can be asset-based or enterprise-based	Memory requirements can have an impact on ICS; organizations can only protect legacy solutions with after-market solutions; usually requires "exclusion" folders to avoid programs quarantining critical files

(continued)

Table 1-2 (continued)

Security Topic	Information Technology (IT)	Control Systems (ICS)
Patch management	Easily defined; enterprise-wide; remote and automated	Long timeline to successful patch installation; OEM-specific; may “break” ICS functionality; asset owners required to define acceptable risk.
Technology support lifetime	Two to three years; multiple vendors; ubiquitous upgrades	Ten to twenty years; usually same vendor over time; product end-of-life creates new security concerns
Testing and audit methods	Use modern methods; systems usually resilient and robust to handle assessment methods	Tune testing to the system; modern methods can be inappropriate; equipment may be susceptible to failure during testing
Change management	Regular and scheduled; aligned with minimum-use periods	Strategic scheduling; nontrivial process because of the impact on production
Asset classification	Common and performed annually; results drive expenditure	Performed only when obligated; accurate inventories uncommon for nonvital assets, disconnect between asset value and appropriate countermeasures
Incident response and forensics	Easily developed and deployed; some regulatory requirements; embedded in technology	Focused on system resumption activities; forensics procedures immature (beyond event re-creation); requires good IT/ICS relationships
Physical and environmental security	Can range from poor (office systems) to excellent (critical IT operations systems)	Usually excellent for critical areas; maturity varies for site facilities based on criticality and culture
Secure systems development	Integral part of the development process	Historically not an integral part of the development process; vendors are maturing but at slower rate than IT; core/flagship ICS solutions difficult to retrofit with security
Security compliance	Definitive regulatory oversight depending on sector (and not all sectors)	Specific regulatory guidance depending on sector (and not all sectors)

Source: U.S. Department of Homeland Security National Cybersecurity and Communications Integration Center (NCCIC) and Industrial Control Systems Cyber Emergency Response Team (ICS-CERT), Recommended Practice: Improving Industrial Cyber Security with Defense In-Depth Strategies (September 2016).

Chapter 2

Understanding an Industrial Cyber Attack

In This Chapter

- ▶ Understanding how cyber attacks happen
- ▶ Considering a real-world industrial incident

To protect your organization, you first need to understand the potential threats. This chapter discusses what you need to know to recognize the signs of an industrial cyber attack.

Looking at the Anatomy of a Cyber Attack

Prevention begins with understanding. It's much easier to defend against a threat when you know what to look for. Cyber attacks generally have three phases:

- ✔ **Discovery:** This is a probing or reconnaissance stage where the attacker tries to discover assets, what hardware and software is in place, and what vulnerabilities or weaknesses may be present. This phase often starts at the perimeter with firewalls and Internet-facing assets, often identifying the manufacture and configurations to help determine which attack methods to use.
- ✔ **Attack:** In this stage, the threat actor tries to exploit any avenue possible using a range of tools. The attacker figures out which people, processes, and components are the most vulnerable and will allow the easiest way in. During this period, the threat actor makes attack choices

and begins the campaign. Common attack methods include

- **Internet-connected industrial control system (ICS) devices**, allowing access from the Internet
- **Remote access using stolen or misused credentials** from the organization's authorized ICS users
- **External business web interface vulnerabilities**, allowing threat actors to pivot into the ICS data historian that provides data to the web server applications
- **Infected USB and other connected media** used by threat actors to transfer malware to organizations
- **Phishing and spear phishing email** for malware transfer to an enterprise user's computer
- **Weak and unauthenticated communication protocols**, allowing threat actors to create malformed frames, conduct "man-in-the-middle" attacks, and even update ICS firmware

✓ **Intrusion:** In this stage, the threat actor has succeeded in capturing valid credentials and has frequently established connectivity with specific assets so that he or she can command and control (C2) those assets. The attacker can even keep the system "calling home" for malware updates. Left undetected and undeterred, attackers have at this point usually gained deep access into industrial networks, endpoints, and control systems.



Weaknesses within protocols have long been a useful tool for attackers. ICS operations frequently use insecure protocols such as FTP and Telnet, often sending passwords in the clear. Some supervisory control and data acquisition (SCADA) and ICS communication protocols for control devices such as Modbus/TCP, EtherNet/IP, and DNP3 do not typically require authentication to remotely execute commands on a control device, and some vulnerabilities within these protocols are publicly documented.

Risks can come from outside attackers, malicious insiders, or even employees or contractors who make simple but serious mistakes. You can find good background information on threat sources, attacker types, motivations, and typical targets or goals at <https://ics-cert.us-cert.gov/content/cyber-threat-source-descriptions>.

Looking At a Real Incident

A water district that we'll call "KWC" — that's the pseudonym given to the unfortunate utility by Verizon's *2016 Data Breach Digest* — experienced unexplained patterns of valve and duct movements over a period of at least 60 days. KWC discovered that attackers were manipulating the chemicals used to assure safe drinking water, as well as altering the water flow rates, thus causing disruptions to water distribution. Many other activities went unnoticed, including theft of more than 2.5 million unique data records.

In this case, physical safety was at risk, but luckily nothing bad happened because alert functionality caught and reversed the chemical and flow-control issues. A forensic investigation found that three known threat-actor IP addresses had gained access multiple times to the following technology (OT) and information technology (IT) assets:

- ✔ The SCADA application, including valve and flow-control applications and access to programmable logic controller (PLC) systems
- ✔ IT management systems
- ✔ An Internet web server application
- ✔ Financial and customer account information

KWC had multiple foundational security control weaknesses or vulnerabilities that made it a great candidate for hacking:

- ✔ **Weak password hygiene:** Water customers used an Internet payment application to access their accounts from laptops, desktops, or mobile devices. This application required only weak credentials (user name and password — no second authentication factor) to gain access to customers' personally identifiable information (PII), payment data, and water usage information.
- ✔ **Direct Internet access to ICS:** The Internet-facing web server that hosted the customer payment application was directly connected by cable to the AS400 system, which in turn housed the SCADA management application, giving the administrator (and threat actors) access to interact with the control level. In addition, three known threat-actor IP addresses were found to have access. Threat actors used the water district's valve and

flow-control application on the AS400 to manipulate the PLCs and water chemistry.

- ✔ **Privileged administrative user:** The lone AS400 system administrator had no corporate oversight. For convenience, he was using the same login credentials to remotely access both the AS400 and the payment application web server from his laptop.
- ✔ **Login credentials in cleartext available from the Internet:** What's a simpler way to say this? "Hey, here's how to log on to our AS400!" The AS400 login credentials and IP address were found in cleartext within an initialization file (.ini). The same credentials worked to log in to the payment application web server.
- ✔ **Single point of failure:** One AS400 served as the water district's SCADA application system. The system was old, and operating system updates were not installed, nor were patches. Again, one lone administrator was working to make things easier, but not with security in mind.
- ✔ **Unnoticed data exfiltration:** More than 2.5 million unique records were stolen from the AS400. This was the good news; the bad news was that the attackers' activities showed a greater interest in disrupting and denying the water district the ability to conduct its business — up to and including the potential to cause public harm.



A lingering relic from “the good old days” is *security by obscurity* — the belief that internal operations and procedures could be kept private and thereby known only to the workgroup. An example of this practice is hiding account passwords in binary files or scripts. In addition, some control system engineers and administrators feel their old, proprietary control systems are immune to cyberattacks. These assumptions have been proven to be false.



It's easy to believe “it could never happen to us.” But as you review the basic security control mechanisms that were weak or not present, you may not realize similar risks are likely present in your own environment. Maybe it wouldn't be a stretch to catch your OT engineers or contractors charging their phones or tablets on your PLC or human-machine interface USB ports, or allowing a contractor or family member wireless access from the hidden router in the back room. Most security practitioners recommend taking a risk-based approach to evaluating your site through a third-party cyber security assessment.

Chapter 3

Using Defensive Strategies to Secure ICS

In This Chapter

- ▶ Understanding the importance of an ICS security risk assessment
 - ▶ Seeing why defense-in-depth layers are necessary
 - ▶ Considering five critical industrial security controls to give you an 85 percent risk reduction
 - ▶ Finding the right cyber security partner
-

Your organization's cyber security strategy should protect the assets most critical to successful business operations. There's a world of security advice, frameworks, regulatory requirements, technology, and disciplines to learn and apply when prioritizing the security of your industrial or critical infrastructure organization.

This chapter provides a brief look at what you need to know about protecting your organization by conducting an industrial control systems (ICS) security assessment. It gives you some points to consider, as well as some tips on finding the right industrial cyber security partner to ensure your success.

Considering an ICS Security Risk Assessment

One of the most commonly recommended proactive steps any organization can take is a cyber security assessment and analysis of gaps. Whether you start with a self-assessment or bring in outside resources, you need management buy in.

You also need a cross-functional team to help prioritize, analyze, and make decisions on the findings.



The 2016 SANS ICS survey recommends quarterly assessments at a minimum. The survey also recommends that many organizations look first to internal resources in the information technology (IT) or operations technology (OT) department to take responsibility. However, you typically should not undertake this project alone. Many organizations find that bringing in a third party is extremely helpful.

A good first step is to download the Department of Homeland Security's Cyber Security Evaluation Tool (CSET), which is available at https://ics-cert.us-cert.gov/sites/default/files/FactSheets/ICS-CERT_FactSheet_CSET_S508C.pdf. This self-assessment tool is flexible; you can adjust it to your industry and environment, as well as the security posture you're aiming for. It helps you identify the frameworks or standards against which you want to assess, indicates what industry-specific standards may apply, and walks you through a series of questions for your team to answer. In the end, this tool gives you a report to help you identify and prioritize your security gaps.

Applying Defense-in-Depth Strategies

Defense-in-depth is a term that comes from historic military engagements where defensive layers were strategically placed as barriers to halt or impede adversaries. The defenses slowed the attackers' advance, and gave the defenders time to deploy countermeasures. Applying the same strategy to industrial cyber security delivers the capability to detect and respond to the intrusion in a way that limits the impact.



ICS architectures can be complex, and you need defense-in-depth strategies to detect when a potential vulnerability is or could be exploited. Unless you have extensive background in this subject, you'll likely want to call upon an expert to make sure that your solution provides the necessary level of protection for your organization.



The Department of Homeland Security has a list of defense-in-depth strategy elements to consider for your environment. You can find the detailed descriptions at https://ics-cert.us-cert.gov/sites/default/files/recommended_practices/NCCIC_IC3-CERT_Defense_in_Depth_2016_S508C.pdf.

Using Critical Security Controls

Using proven critical security controls can reduce your risks by an estimated 85–95 percent. With so much at stake, using expert advice makes sense.

What we now know as the CIS Critical Security Controls (aka the SANS Institute’s Top 20 Critical Security Controls) has quite a history. Participating in its creation and validation over the years are the following organizations:

- ✔ U.S. Department of Defense
- ✔ National Security Agency (NSA)
- ✔ SANS Institute
- ✔ Center for Internet Security (CIS)
- ✔ U.S. State Department
- ✔ Center for Strategic and International Studies (CSIS)
- ✔ United Kingdom’s Centre for the Protection of National Infrastructure (CPNI)
- ✔ Idaho National Lab (home of the National SCADA testbed for the U.S. Department of Energy)
- ✔ Members of the Central Intelligence Agency (CIA) and an illustrious and informed international consortium

The CIS Critical Security Controls (CIS Controls) are “a set of internationally recognized measures developed, refined, and validated by leading security experts from around the world.” What sets these critical security controls apart is not only a broad base of collaboration and contribution from U.S. and international participants, but how effective these controls have proven to be:

- ✔ Application of just the first five CIS Controls — some experts call them the Foundational Security Controls — can

reduce the risk of successful cyberattack by approximately 85 percent in enterprise/IT environments.

Given that so much convergence is underway, these controls should be assessed for applicability to the industrial control networks, endpoints, and ICS.

- ✔ Implementing all 20 CIS Controls reduces cyber risk by approximately 94 percent. However, within industrial settings, many of the controls are not applicable — so focusing on the first five at a minimum may offer the largest benefits.
- ✔ Organizations implementing the controls increase operational efficiencies and reduce risk through standardized measurement and automation tools provided with the framework.



Many frameworks and standards requirements are applicable to industrial environments. The problem is, they're inches deep and incredibly dense. You'll need to invest quite a bit of time to wade through the recommendations, analyze them, and determine which ones offer the best wins. Consider using the CSET. All sorts of standards are available there including some of the best: NIST SP800-82, ANSI/ISA99 IEC-62443, The NIST Cyber Security Framework, NERC CIP, IEC 61850, and others.

Although the top 20 controls are important, the top five controls are generally considered to be vital and are also components of nearly all other standards given their foundational nature. The top five CIS Critical Security Controls (CSC) are

- ✔ **CSC 1:** Inventory of authorized and unauthorized devices
- ✔ **CSC 2:** Inventory of authorized and unauthorized software
- ✔ **CSC 3:** Secure configurations for hardware and software on mobile devices, laptops, workstations, and servers
- ✔ **CSC 4:** Continuous vulnerability assessment and remediation
- ✔ **CSC 5:** Controlled use of administrative privileges

The CIS Controls are cumulative. Ideally, you would start with #1, then go to #2 and so on, up to #20 if applicable. However, another aspect of this framework is its flexibility. Many organizations begin with the control that they know they need first.



The full CIS document is available for download at <https://www.cisecurity.org/critical-controls/Library.cfm>. You may notice its IT and enterprise roots, but many of the controls are applicable to industrial networks, endpoints, and control systems. And remember, CIS calls these the *Top Five* — the truly foundational short list that can deliver an 85 percent risk reduction for most organizations.

Figure 3-1 shows the top five Critical Security Controls, each control's NSA impact rank, and the overall industrial solution support that Tripwire and Belden provide for each control.

Critical Security Control	NSA Impact Rank	Overall Tripwire Industrial Solution Support	Overall Belden Industrial Solution Support
CS1: Inventory of authorized and unauthorized devices Reduce the ability of attackers to find and exploit unauthorized and unprotected systems.	Very high		
CS2: Inventory of authorized and unauthorized software Identify vulnerable or malicious software to mitigate or root out attacks.	Very high		
CS3: Secure configurations for hardware or software Identify weak or misconfigured systems and software settings to help to harden their configurations and services.	Very high		
CS4: Continuous vulnerability assessment and remediation Proactively identify and repair software vulnerabilities reported by security researchers or vendors.	Very high		
CS5: Controlled use of administrative privilege Protect and validate administrative accounts on desktops, laptops, and servers to prevent two common types of attack: <ul style="list-style-type: none"> • Enticing users to open a malicious email, attachment, or file, or to visit a malicious website • Cracking an administrative password and thereby gaining access to a target machine. 	High		

Figure 3-1: The top five Critical Security Controls.

Considering a Partner for Industrial Cyber Security

Applying the necessary cyber security controls and methods can be complex and confusing — especially if you don't have an extensive background to guide your path. Rather than trying to do the job yourself and risking your organization's assets, you may want to think about bringing in a partner.

In choosing a partner, consider if their solution portfolio maps to the CIS Controls and offers important features such as

- ✓ Visibility and monitoring with operational context
- ✓ Safety, availability, and resilience
- ✓ Faster audit success with built-in security and compliance policies



A comprehensive approach to industrial cyber security should be aligned with a defense-in-depth strategy. A vendor that is confident of its capabilities will be willing to discuss its portfolio in depth, showing you how its solutions map into industrial environment priorities. Your vendor should be able to deliver a risk-based approach and meet the most foundational security controls with the highest protection, such as those in the first five of the CIS Critical Security Controls framework.



Don't underestimate the importance of appropriate network segmentation for reliability, safety, and resiliency. IEC-62243-3-2 provides guidance on how to do this. Belden's Tofino Xenon delivers this capability simply by installing it.

For more information about Belden's industrial cyber security portfolio, see www.belden.com/products/industrialnetworking/lp/cyber-security-for-industrial-application.cfm and www.belden.com/products/industrialnetworking/security/tofino-xenon.cfm.

Chapter 4

Ten Ways to Improve Your Industrial Cyber Security

In This Chapter

- ▶ Ten important things to remember

If you've read Chapters 1–3, you're ready to get started improving your organization's industrial cyber security. Before you go, here's a list of ten very important things you need to do to ensure that you have the proper industrial cyber security solution to suit your needs:

- ✔ Get an industrial cyber security assessment and prioritize the security gaps for action.
- ✔ Establish and maintain an asset inventory of all hardware and software, including documenting ports, services, and protocols in use and then prioritize according to your most critical assets.
- ✔ Secure all network and Internet connections to the control systems and minimize this connectivity wherever possible.
- ✔ Secure wireless and remote access and minimize who has authorization to use it.
- ✔ Secure and harden the configurations of industrial networks, endpoints, and control systems, and continually assess for change and new vulnerabilities.
- ✔ Continuously monitor and respond to change at the endpoints and control system levels.
- ✔ Implement strong authentication mechanisms and educate your employees on how to protect those credentials.

- ✔ Establish, apply, and communicate security policies and then monitor changes against those policies.
- ✔ Increase defense-in-depth layers to secure industrial control system (ICS) systems, including network segmentation and the creation of secure zones, maintaining logging, and controlling who has access (physical and electronic).
- ✔ Increase cyber security awareness with training and enforce policies with employees, contractors, and visitors to your facilities.



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- **Be strategic** — *conduct a risk assessment, apply defense-in-depth methods, and choose the right security controls*



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- Why securing critical infrastructure matters
- Ten ways to improve your organizational cyber security

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