TECHNICAL REPORT

ISO/IEC TR 27103

First edition
2018-02

Information technology — Security techniques — Cybersecurity and ISO and IEC Standards

Technologies de l'information — Techniques de sécurité — Cybersécurité et normes ISO et IEC

Reference number
ISO/IEC TR 27103:2018(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 27, *IT Security techniques*.

Introduction

Security on the Internet and other networks is a subject of growing concern. Organizations around the world, in both government and industry sectors, are seeking ways to address and manage cybersecurity risks, including via baseline cybersecurity measures that can be implemented as requirements or guidance. The demonstrated security and economic value of utilising existing best practices to develop approaches to cyber risk management has led organizations to assess how to use and improve upon existing approaches.

Perspectives, and consequent approaches, to risk management are affected by the terminology used, e.g. “cybersecurity” versus “information security”. Where similar risks are addressed, this different perspective can result in “cybersecurity” approaches focusing on external threats and the need to use information for organizational purposes, while, in contrast, ”information security” approaches consider all risks whether from internal or external sources. There can also be a perception that cybersecurity risks are primarily related to antagonistic threats, and that a lack of “cybersecurity” can create worse consequences to the organization than a lack of “information security”. Thus, cybersecurity can be perceived as more relevant to the organization than information security. This perception can cause confusion and also reduces the effectiveness of risk assessment and treatment.

Regardless of perception, the concepts behind information security can be used to assess and manage cybersecurity risks. The key question is how to manage cybersecurity risk in a comprehensive and structured manner, and ensure that processes, governance and controls exist and are fit for purpose. This can be done through a management systems approach. An Information Security Management System (ISMS) as described in ISO/IEC 27001 is a well proven way for any organization to implement a risk-based approach to cybersecurity.

This document demonstrates how a cybersecurity framework can utilize current information security standards to achieve a well-controlled approach to cybersecurity management.

Information technology — Security techniques — Cybersecurity and ISO and IEC Standards

1 Scope

This document provides guidance on how to leverage existing standards in a cybersecurity framework.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
information security
preservation of confidentiality, integrity and availability of information

[SOURCE: ISO/IEC 27000:2016 2.33]

4 Document structure

This document provides background on the reasons why having a risk-based, prioritized, flexible, outcome-focused, and communications-enabling framework for cybersecurity is important. It then describes the objectives of a strong cybersecurity framework and includes mapping to existing standards that can be used to achieve these objectives.

5 Background

5.1 General

Cybersecurity is a relatively new discipline. ISO, IEC, and ISO/IEC standards developed over the last 25 years can be applied to help solve the challenges of cybersecurity. Existing and emerging cybersecurity frameworks throughout the world reference ISO, IEC, and ISO/IEC standards as useful sources of information.

Implementing cybersecurity framework, or a cybersecurity programme, requires a consistent and iterative approach to identifying, assessing, and managing risk and evaluating implementation of the framework. ISO/IEC 27001 already provides a risk management framework that can be applied to prioritize and implement cybersecurity activities within an organization.

5.2 Advantages of a risk-based approach to cybersecurity

A risk-based approach to cybersecurity:

— enables organizations to measure the impact of cybersecurity investments and improve their cybersecurity risk management over time;

— is prioritized, flexible, and outcome-focused;

— enables organizations to make security investment decisions that address risk, implement risk mitigations in a way that is most effective for their environments, and advance security improvements and innovations;

— facilitates communication across boundaries, both within and between organizations;

— is responsive to the actual risks faced by an organization, while recognizing that organizational resources are limited;

— reflects a clear understanding of the organization's particular business drivers and security considerations;

— allows an organization to manage risks in ways that are consistent with their own business priorities;

— enables organizations to have flexibility in a rapidly changing technology and threat landscape, and helps to address the varying needs of organizations and sectors.

More detailed and prescriptive guidance (e.g. detailed standards and guidelines) required by specific stakeholders for specific purposes can be provided on demand. Organizations that implement a risk-based cybersecurity framework can therefore take advantage of the benefits without being limited by the need for a full set of detailed implementation guidance.

5.3 Stakeholders

Stakeholders need to play an active role, beyond protecting their own assets, in order for the organization to realize the benefits of a connected global environment. Internet-enabled systems and applications are expanding beyond the business-to-business, business-to-consumer, and consumer-to-consumer models, to include many-to-many interactions and transactions. Individuals and organizations need to be prepared to address emerging security risks and challenges and effectively prevent and respond to misuse and criminal exploitation.

5.4 Activities of a cybersecurity framework and programme

The activities of a cybersecurity framework and programme are:

a) describe the organization's current cybersecurity status;

b) describe the organization's target state for cybersecurity;

c) identify and prioritize opportunities for improvement;

d) assess progress toward the target state;

e) communicate among internal and external stakeholders about cybersecurity risk.

6 Concepts

6.1 Overview of cybersecurity frameworks

A cybersecurity framework captures a set of desired cybersecurity outcomes that are common across all sectors and organizations. A framework facilitates communication about implementation of these desired outcomes and associated cybersecurity activities across the organization, from the executive level to the implementation and operations levels. The framework should consist of five functions, or high-level descriptions of desired outcomes, which are concurrent and continuous:

— Identify;

— Protect;

— Detect;

— Respond;

— Recover.

When considered together, these functions provide a high-level, strategic view of an organization's management of cybersecurity risk. Within each function, there are also categories and sub-categories, a prioritized set of activities that are important for achieving the specified outcomes.

Categories are the subdivisions of a function into groups of cybersecurity outcomes closely tied to programmatic needs and particular activities. Sub-categories further divide a category into specific outcomes of technical and/or management activities. They provide a set of results that, while not exhaustive, help support achievement of the outcomes in each category.

Organizing a cybersecurity framework into multiple levels, such as functions, categories, and sub-categories, helps to enable communication across boundaries. While many executives can seek to understand and make investments to more effectively mitigate organizational risk at the level of functions, operational practitioners can benefit from the more nuanced description of desired outcomes at the category or sub-category level. Importantly, though, if high-level and more nuanced descriptions of outcomes are organized within a single reference point that uses a common language, communication between executives and practitioners is facilitated, supporting strategic planning.

NOTE Annex B provides an example of another cybersecurity framework.

6.2 Cybersecurity framework functions

6.2.1 Overview

Functions organize basic cybersecurity outcomes and activities at their highest level. Important functions to include in a framework, as noted previously, are:

— Identify;

— Protect;

— Detect;

— Respond;

— Recover.

Each of these functions represents an area that an organization can use to express how it manages cybersecurity risk. These functions aid in organizing activities, enabling risk management decisions, addressing threats, and improving by learning from previous experiences.

The Identify function develops the organizational understanding to manage cybersecurity risk to systems, assets, data and capabilities. The activities in the Identify function are foundational for effective use of the framework. Understanding the business context, the resources that support critical functions, and the related cybersecurity risks enables an organization to focus and prioritize its efforts, consistent with its risk management strategy and business needs.

The Protect function develops and implements the appropriate safeguards to ensure delivery of critical infrastructure services. The Protect function supports the ability to limit or contain the impact of a potential cybersecurity event.

The Detect function develops and implements the appropriate activities to identify the occurrence of a cybersecurity event. The Detect function enables timely discovery of cybersecurity events.

The Respond function develops and implements the appropriate activities to take action regarding a detected cybersecurity event. The Respond function supports the ability to contain the impact of a potential cybersecurity event.

The Recover function develops and implements the appropriate activities to maintain plans for resilience and to restore any capabilities or services that were impaired due to a cybersecurity event.

Annex A examines each of the categories and breaks them down into possible outcomes and activities (sub-categories), demonstrating how to leverage existing ISO and IEC standards to better support the implementation of relevant activities.

6.3 Identify

The Identify function develops organizational understanding to manage cybersecurity risk to systems, assets, data and capabilities. The activities in the Identify function are important for effective use of the framework. Understanding the business context, the resources that support critical functions, and the related cybersecurity risks enables an organization to focus and prioritize its efforts, consistent with its risk management strategy and business needs. Within this function, there are activities that are vital to successful cyber risk management. To be able to identify these activities, an organization should understand its organisational objectives and risk management strategy.

Within the Identify function, the categories that can be included are:

Table 1 — Identify categories

Category	Description	References
Business environment	The organization's objectives, stakeholders, and activities are understood and used to inform roles, responsibilities and risk management decisions. Comprehensive security measures are necessary covering the company itself, its group companies, business partners of its supply chain and IT system control outsourcing companies.	ISO/IEC 27001:2013, Clause 4 ISO/IEC 27001: 2013, Clause 5 ISO/IEC 27036 (all parts) ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.2.1 ISO 31000:2009, 5.3
Risk assessment	The organization understands the risks to the organization's operations and assets. The management are required to drive cybersecurity risk measures considering any possible risk while in proceeding with the utilization of IT.	ISO/IEC 27001:2013, Clause 6 ISO/IEC 27014 ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.2 ISO 31000 ISO/IEC 38505
Risk management strategy	An organization's approach, the management components and resources to be applied to the management of risk.	ISO/IEC 27001:2013, 9.3 ISO/IEC 20243:2015, Clause 4 ISO 31000, Clause 4
Governance	To monitor and manage the organization's regulatory, legal, environmental and operational requirements. This information is then used to inform the appropriate levels of management.	ISO/IEC 27002:2013, Clause 5 ISO/IEC 27002:2013, Clause 6 ISO/IEC 38054 ISO/IEC 38505-1 ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.3.2.3
Asset Management	Identification and management of the systems, data, devices, people and facilities in relation to the business.	ISO/IEC 27002:2013 ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.2.3.4 ISO/IEC 27019:2017, Clause 7

6.4 Protect

The Protect function develops and implements appropriate safeguards to ensure delivery of resilient products and services. The Protect function also supports the ability to limit or contain the impact of a potential cybersecurity event.

Within the Protect function, the categories that can be included are:

Table 2 — Protect categories

Category	Description	References
Access control	Limiting access to facilities and assets to only authorized entities and associated activities. Included in access management is entity authentication	ISO/IEC 27002:2013, Clause 9 ISO/IEC 29146 ISO/IEC 29115 IEC 62443-2-1:2010, 4.3.3.5
Awareness and training	Ensuring users and stakeholders are aware of policies, procedures, and responsibilities relating to cybersecurity responsibilities.	ISO/IEC 27002:2013, Clause 6, 7 ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.3.2.4.2
Data security	Responsible for the confidentiality, integrity, and availability of data and information.	ISO/IEC 27002:2013, Clause 8
Information protection processes and procedures	Security policies, processes, and procedures are maintained and used to manage protection of information systems.	ISO/IEC 27002:2013
Maintenance	Processes and procedures for ongoing maintenance and modernization	ISO/IEC 27002:2013, Clause 11 ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.3.3
Protective technology	Technical security solutions (such as logging, removable media, least access principles, and network protection)	ISO/IEC 27002: 2013 ISO/IEC 27033 series IEC 62443-2-1:2010,

Annex A examines each of the categories and breaks them down into possible outcomes and activities (sub-categories), demonstrating how to leverage existing ISO and IEC standards to better support the implementation of relevant activities.

6.5 Detect

The Detect function identifies the occurrence of a cybersecurity event in a timely fashion.

Within the Detect function, the categories that can be included are:

Table 3 — Detect categories

Category	Description	References
Anomalies and events	Detection of anomalies and events and understanding of the impact of those events.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5
Security continuous monitoring	Systems being monitored on a regular basis to validate the effectiveness of security measures in place.	ISO/IEC 27002:2013, Clause 12
Detection process	Processes and procedures to ensure timely awareness and communication of events.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5

Annex A of this document examines each of the categories and breaks them down into possible outcomes and activities (sub-categories), demonstrating how to leverage existing ISO and IEC standards to better support the implementation of relevant activities.

6.6 Respond

The Respond function develops and implements appropriate activities to take action regarding a detected cybersecurity event. The Respond function supports the ability to contain the impact of a potential cybersecurity event.

Within the Respond function, the categories that can be included are:

Table 4 — Respond categories

Category	Description	References
Response Planning	Plan for how to respond to events in a timely manner including processes and procedures for responding to events.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5
Communications	Processes and procedures for communicating the timely information to relevant parties. Companies need to communicate appropriately with relevant parties by, for example, disclosing information on security measures or response on regular basis or in times of emergency.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) ISO/IEC 27014 IEC 62443-2-1:2010, 4.3.4.5
Analysis	Review of detected events, including categorization and impact of events.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5
Mitigation	Activities that limit the expansion of the event, mitigate the event and stop the event.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5
Improvements	Organization reviews the response plan and improves it based on lessons learned during an event.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5

Annex A examines each of the categories and breaks them down into possible outcomes and activities (sub-categories), demonstrating how to leverage existing ISO and IEC standards to better support the implementation of relevant activities.

6.7 Recover

The Recover function develops and implements appropriate activities to maintain plans for resilience and to restore any capabilities or services that were impaired due to a cybersecurity event.

Within the Recovery function, the categories that can be included are:

Table 5 — Recover categories

Category	Description	References
Recovery planning	Plan for how to recover from an event and the next steps after an event.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.4.3.4
Communications	Processes and procedures for communicating the timely information to relevant parties.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.4.3.4
Improvements	Organization takes the lessons learned during an event and feeds it back into the process and procedures.	ISO/IEC 27002:2013, Clause 16 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.4.3.4

Annex A examines each of the categories and breaks them down into possible outcomes and activities (sub-categories), demonstrating how to leverage existing ISO and IEC standards to better support the implementation of relevant activities.

Annex A
(informative)

sub-categories

A.1 General

As described above in Clause 5, effective approaches to cyber risk management are flexible and outcome-focused, articulated in terms of desired security outcomes rather than dictating how outcomes should be achieved. However, both outcome-focused and more prescriptive guidance or controls have valuable functions in cyber risk management; while objectives are likely to remain consistent, controls should be constantly revised to reflect organizational and industry learnings, changing threat models, and new security techniques or capabilities. Baseline cybersecurity measures should articulate desired outcomes, such as functions and categories, and should remain applicable. Such baselines can reference more prescriptive guidance, such as sub-category activities and associated standards, that can be updated by governments and industry as they assess rapidly changing technology and threat landscape.

In the context of functions and categories, this annex describes a set of sub-category activities and lists associated standards, demonstrating how a cybersecurity framework can utilize existing information security standards.

A.2 Identify sub-categories

A.2.1 Business Environment

Table A.1 describes the activities under the Business Environment category, along with standards that can support the understanding and implementation of these activities.

Table A.1 — Identify function: Business Environment sub-categories

Description of sub-category	Standards mapping
The organization's role in the supply chain is identified and communicated	ISO/IEC 27002:2013, 15.1.3, 15.2.1 ISO/IEC 27036-1 ISO/IEC 20243:2015, Clause 4
The organization's place in critical infrastructure and its industry sector is identified and communicated	ISO/IEC 27001:2013, 4.1. IEC 62443-2-1:2010, 4.2.2
Priorities for organizational mission, objectives, and activities are established and communicated	ISO/IEC 27002:2013, Clause 6 IEC 62443-2-1:2010, 4.2.2, 4.2.3.6
Dependencies and critical functions for delivery of critical services are established	ISO/IEC 27002:2013, 11.2.2 IEC 62443-2-1:2010, 4.2.3.3 ISO/IEC 27019:2017, 9.2.2, 9.2.3, 10.11.1 ISO/IEC 20243:2015, Clause 4
Resilience requirements to support delivery of critical services are established	ISO/IEC 27002:2013, 11.1.4, 17.1.1 ISO/IEC 27019:2017, 10.12.1

A.2.2 Risk Assessment

Table A.2 describes the activities under the Risk Assessment category, along with standards that can support the understanding and implementation of these activities.

Table A.2 — Identify function: Risk Assessment sub-categories

Description of sub-category	Standards mapping
Asset vulnerabilities are identified and documented	ISO/IEC 27002:2013, 12.6.1, 18.2.3 ISO/IEC 30111 ISO/IEC 29147 IEC 62443-2-1:2010, 4.2.3, 4.2.3.7, 4.2.3.9, 4.2.3.12 ISO/IEC 27019:2017, 7.1.1, 7.1.2 ISO/IEC 20243:2015, Clause 4
Threat and vulnerability information is received from information sharing forums and sources	ISO/IEC 27002:2013, 6.1.4 ISO/IEC 30111 IEC 62443-2-1:2010, 4.2.3, 4.2.3.9, 4.2.3.12 ISO/IEC 20243:2015, Clause 4
Internal and external threats are identified and documented	ISO/IEC 27001:2013, 6.1.2 IEC 62443-2-1:2010, 4.2.3, 4.2.3.9, 4.2.3.12 ISO/IEC 20243:2015, Clause 4
Potential business impacts and likelihoods are identified	ISO/IEC 27001:2013, 6.1.2 IEC 62443-2-1:2010, 4.2.3, 4.2.3.9, 4.2.3.12
Threats, vulnerabilities, likelihoods, and impacts are used to determine risk	ISO/IEC 27002:2013, 12.6.1 ISO/IEC 20243:2015, Clause 4
Risk responses are identified and prioritized	ISO/IEC 27001:2013, 6.1.3

A.2.3 Risk Management Strategy

Table A.3 describes the activities under the Risk Management Strategy category, along with standards that can support the understanding and implementation of these activities.

Table A.3 — Identify function: Risk Management strategy sub-categories

Description of sub-category	Standards mapping
Risk management processes are established, managed, and agreed to by organizational stakeholders	ISO/IEC 27001:2013, 6.1.3, 8.3,9.3 IEC 62443-2-1:2010, 4.3.4.2 ISO/IEC 20243:2015, Clause 4
Organizational risk tolerance is determined and clearly expressed	ISO/IEC 27001:2013, 6.1.3, 8.3 IEC 62443-2-1:2010, 4.3.2.6.5
The organization's determination of risk tolerance is informed by its role in critical infrastructure and sector specific risk analysis	ISO/IEC 27001:2013, 6.1.3, 8.3

A.2.4 Governance

Table A.4 describes the activities under the Governance category, along with standards that can support the understanding and implementation of these activities.

Table A.4 — Identify function: Governance sub-categories

Description of sub-category	Standards mapping
Information security policy for the organization is established	ISO/IEC 27002:2013, 5.1.1 IEC 62443-2-1:2010, 4.3.2.6
Information security roles & responsibilities are coordinated and aligned with internal roles and external partners	ISO/IEC 27002:2013, 6.1.1, 7.2.1 IEC 62443-2-1:2010, 4.3.2.3.3 ISO/IEC 20243:2015, Clause 4
Legal and regulatory requirements regarding cybersecurity, including privacy and civil liberties obligations, are understood and managed	ISO/IEC 27002:2013, 18.1 IEC 62443-2-1:2010, 4.4.3.7
Governance and risk management processes address cybersecurity risks	ISO/IEC 27001:2013, Clause 6 IEC 62443-2-1:2010, 4.2.3 ISO/IEC 20243:2015, Clause 4

A.2.5 Asset Management

The category of Asset Management covers any data, personnel, devices, systems or facilities that are used or managed by the organization. Asset management covers the physical inventory of devices and systems, inventory of software platforms and applications in an organization and the mapping of the data flows. There are controls described in ISO/IEC 27001:2013, Annex A that can assist with knowing if the activity has been completed and guidance in ISO/IEC 27002 for implementation of those controls. Some of the sub-categories and standards that already exist to help with those sub-categories are identified in Table A.5.

Table A.5 — Identify function: Asset Management sub-categories

Description of sub-category	Standards mapping
Physical devices and systems within the organization are inventoried	ISO/IEC 27002:2013, 8.1.1, 8.1.2 IEC 62443-2-1:2010, 4.2.3.4 ISO/IEC 27019:2017, 9.2.1
Software platforms and applications within the organization are inventoried	ISO/IEC 27002:2013, 8.1.1, 8.1.2 IEC 62443-2-1:2010, 4.2.3.4
Organizational communication and data flows are mapped	ISO/IEC 27002:2013, 13.2.1 IEC 62443-2-1:2010, 4.2.3.4
External information systems are catalogued	ISO/IEC 27002:2013, 11.2.6, 8.2.1
Resources (e.g. hardware, devices, data, and software) are prioritized based on their classification, criticality, and business value	ISO/IEC 27002:2013, 11.2.6, 8.2.1

A.3 Protect categories

A.3.1 Access Control

Table A.6 describes the activities under the Access Control category, along with standards that can support the understanding and implementation of these activities.

Table A.6 — Protect function: Access Control sub-categories

Description of sub-category	Standards mapping
Identities and credentials are managed for authorized devices and users	ISO/IEC 27002:2013, 9.2.1, 9.2.2, 9.2.4, 9.2.5, 9.2.6, 9.3.1, 9.4.2, 9.4.3 IEC 62443-2-1:2010, 4.3.3.5.1 ISO/IEC 27019:2017, 11.1.1, 11.3.1, 11.5.2
Physical access and remote access is managed and protected	ISO/IEC 27002:2013, 11.1.1, 11.1.2, 6.2.2, 13.1.1 IEC 62443-2-1:2010, 4.3.3.3.2, 4.3.3.3.8, 4.3.3.6.6
Manage access permissions use the least principle and separation of duties	ISO/IEC 27002:2013, 6.1.2, 9.1.2, 9.2.3, 9.4.1, 9.4.4 IEC 62443-2-1:2010, 4.3.3.7.3 ISO/IEC 27019:2017, 8.1.1
Network integrity is protected, including network segregation as appropriate	ISO/IEC 27002:2013, 13.1.1, 13.1.3 ISO/IEC 27033-2 ISO/IEC 27033-3 IEC 62443-2-1:2010, 4.3.3.4 ISO/IEC 27019:2017, 10.6.3, 11.4.5, 11.4.8

A.3.2 Awareness and Training

Table A.7 describes the activities under the Awareness and Training category, along with standards that can support the understanding and implementation of these activities.

Table A.7 — Protect function: Awareness and Training sub-categories

Description of sub-category	Standards mapping
All users are informed and trained	ISO/IEC 27002:2013, 7.2.2 IEC 62443-2-1:2010, 4.3.2.4.2
Roles and responsibilities of senior executives, privileged users, stakeholders, personnel (physical and information security) and third party stakeholders (e.g. suppliers, customers, partners) are understood	ISO/IEC 27002:2013, 7.2.1, 7.2.2, 6.1.1, 8.2.1 ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.3.2.4.2, 4.3.2.4.3

A.3.3 Data Security

Table A.8 describes the activities under the Data Security category, along with standards that can support the understanding and implementation of these activities.

Table A.8 — Protect function: Data Security sub-categories

Description of sub-category	Standards mapping
Data at rest is protected	ISO/IEC 27002:2013, 8.2.3 ISO/IEC 27033-2 ISO/IEC 27040
Data-in-transit is protected	ISO/IEC 27002:2013, 8.2.3, 13.1.1, 13.2.1, 13.2.3, 14.1.2, 14.1.3 ISO/IEC 27033-2 ISO/IEC 27033-5
Assets are formally managed throughout removal, transfers and disposition	ISO/IEC 27002:2013, 8.2.3, 8.3.1, 8.3.2, 8.3.3, 11.2.7 IEC 62443-2-1:2010, 4.3.3.3.9, 4.3.4.4.1
Appropriate capacity planning to ensure availability	ISO/IEC 27002:2013, 12.1.3, 12.3.1 ISO/IEC 19086-1
Data leakage protection	ISO/IEC 27002:2013, 6.1.2, 7.1.1, 7.1.2, 7.3.1, 8.2.2, 8.2.3, 9.1.1, 9.1.2, 9.2.3, 9.4.1, 9.4.4, 9.4.5, 13.1.3, 13.2.1, 13.2.3, 13.2.4, 14.1.2, 14.1.3
Integrity checking mechanisms are used to verify software, firmware, and information integrity	ISO/IEC 27002:2013, 12.2.1, 12.5.1, 14.1.2, 14.1.3 ISO/IEC 20243:2015, Clause 4
The development and testing environment(s) are separate from the production environment	ISO/IEC 27002:2013, 12.1.4 ISO/IEC 27019:2017, 10.1.4

A.3.4 Information Protection Processes and procedures

Table A.9 describes the activities under the Information Protection Processes and procedures category, along with standards that can support the understanding and implementation of these activities.

Table A.9 — Protect function: Information Protection Processes and procedures sub-categories

Description of sub-category	Standards mapping
Baseline configurations of systems are created and maintained	ISO/IEC 27002:2013, 12.1.2, 12.5.1, 12.6.2, 14.2.2, 14.2.3, 14.2.4 IEC 62443-2-1:2010, 4.3.4.3.2, 4.3.4.3.3 ISO/IEC 27019:2017, 12.1.1 ISO/IEC 20243:2015, Clause 4
A system development life cycle to manage systems is implemented	ISO/IEC 27002:2013, 6.1.5, 14.1.1, 14.2.1, 14.2.5 ISO/IEC 27034 (all parts) IEC 62443-2-1:2010, 4.3.4.3.3 ISO/IEC 20243:2015, Clause 4
Change control process in place	ISO/IEC 27002:2013, 12.1.2, 12.5.1 IEC 62443-2-1:2010, 4.3.4.3.2, 4.3.4.3.3 ISO/IEC 20243:2015, Clause 4
Backups are conducted, maintained and tested	ISO/IEC 27002:2013, 12.3.1 IEC 62443-2-1:2010, 4.3.4.3.9

Table A.9 *(continued)*

Description of sub-category	Standards mapping
Physical operating environment meets policy and regulations for organizational assets	ISO/IEC 27002:2013, 11.1.4, 11.2.1, 11.2.2, 11.2.3 IEC 62443-2-1:2010, 4.3.3.3.1, 4.3.3.3.2, 4.3.3.3.3, 4.3.3.3.5, 4.3.3.3.6 ISO/IEC 27019:2017, 9.1.1, 9.1.2, 9.2.3, 9.1.7, 9.1.8, 9.1.9
Data destruction follows appropriate policy	ISO/IEC 27002:2013 8.2.3, 8.3.1, 8.3.2, 11.2.7 ISO/IEC 19086-1 IEC 62443-2-1:2010, 4.3.4.4.4
Protection processes are continuously improved	ISO/IEC 27001:2013, Clauses 9 and 10 IEC 62443-2-1:2010, 4.4.3
Communication of effectiveness of protection technologies is shared with appropriate parties	ISO/IEC 27001:2013, 7.4 ISO/IEC 27002:2013, 16.1.6
Response and recovery plans are in place, managed and tested	ISO/IEC 27002:2013, 16.1.1, 17.1.1, 17.1.2 ISO/IEC 27031 ISO/IEC 27035-1 ISO/IEC 27035-2 IEC 62443-2-1:2010, 4.3.2.5.7, 4.3.4.5.11 ISO/IEC 27019:2017 14.1.1
Vulnerability management	ISO/IEC 27002:2013, 12.6.1, 18.2.2 ISO/IEC 20243:2015, Clause 4 ISO/IEC 30111

A.3.5 Maintenance

Table A.10 describes the activities under the Maintenance category, along with standards that can support the understanding and implementation of these activities.

Table A.10 — Protect function: Maintenance sub-categories

Description of sub-category	Standards mapping
Organizational assets are maintained and repaired following approved processes and tools	ISO/IEC 27002:2013, 11.1.2, 11.2.4 ISO/IEC 20243:2015, Clause 4 IEC 62443-2-1:2010, 4.3.3.3.7
Remote maintenance is performed following approved processes and protected from unauthorized accesses.	ISO/IEC 27002:2013, 11.2.4, 15.1.1, 15.2.1 IEC 62443-2-1:2010, 4.3.3.6.5, 4.3.3.6.6, 4.3.3.6.7, 4.4.4.6.8 ISO/IEC 20243:2015, Clause 4

A.3.6 Protective Technology

Table A.11 describes the activities under the Protective Technology category, along with standards that can support the understanding and implementation of these activities.

Table A.11 — Protect function: Protection Technologies sub-categories

Description of sub-category	Standards mapping
Audit/log records are determined, documented, implemented, and reviewed in accordance with policy	ISO/IEC 27002:2013, 12.4.1, 12.4.2, 12.4.3, 12.4.4, 12.7.1 IEC 62443-2-1:2010, 4.3.3.3.9, 4.3.3.5.8, 4.3.4.4.7, 4.4.2.1, 4.4.2.4 ISO/IEC 27019:2017, 10.10.1
Removable media follows appropriate policy	ISO/IEC 27002:2013, 8.2.2, 8.3.1, 8.3.3 ISO/IEC 27040
Principle of least functionality is applied to access to systems and assets	ISO/IEC 27002:2013, 9.1.2 IEC 62443-2-1:2010, 4.3.3.5
Communications and control networks are protected	ISO/IEC 27002:2013, 13.1.1, 13.2.1 ISO/IEC 27033-2 ISO/IEC 27019:2017, 10.6.3

A.4 Detect categories

A.4.1 Anomalies and Events

Table A.12 describes the activities under the Anomalies and Events category, along with standards that can support the understanding and implementation of these activities.

Table A.12 — Detect function: Anomalies and Events sub-categories

Description of sub-category	Standards mapping
Baseline of network operations and data flows is established	ISO/IEC 27033 (all parts) IEC 62443-2-1:2010, 4.4.3.3
Detected events are analysed to understand attack targets and methods	ISO/IEC 27002:2013, 16.1.1, 16.1.4 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5.6, 4.3.4.5.7, 4.3.4.5.8
Event data is aggregated and correlated from multiple sources and sensors	ISO/IEC 27035 (all parts)
Determination of impact of event	ISO/IEC 27035 (all parts)
Alert thresholds are established	ISO/IEC 2035 (all parts) IEC 62443-2-1:2010, 4.2.3.10

A.4.2 Security Continuous Monitoring

Table A.13 describes the activities under the Security Continuous Monitoring category, along with standards that can support the understanding and implementation of these activities.

Table A.13 — Detect function: Security Continuous Monitoring sub-categories

Description of sub-category	Standards mapping
Monitoring network, physical environment, personnel, and service provider for potential events	ISO/IEC 27002:2013, 12.4.1, 14.2.7, 15.2.1 IEC 62443-2-1:2010, 4.3.3.3.8 ISO/IEC 20243:2015, Clause 4
Malicious code is detected	ISO/IEC 27002:2013, 12.2.1 IEC 62443-2-1:2010, 4.3.4.3.8 ISO/IEC 27019:2017, 10.4.1 ISO/IEC 20243:2015, Clause 4
Unauthorized mobile code is detected	ISO/IEC 27002:2013, 12.5.1
Monitoring for unauthorized personnel, connections, devices, and software is performed	ISO/IEC 27002:2013, 12.4.1, 14.2.7, 15.2.1 IEC 62443-2-1:2010, 4.3.3.3.8 ISO/IEC 20243:2015, Clause 4
External service provider activity is monitored to detect potential cybersecurity events	ISO/IEC 27036 (all parts)
Vulnerability scans are performed	ISO/IEC 27002:2013, 14.2.9

A.4.3 Detection Processes

Table A.14 describes the activities under the Detection Processes category, along with standards that can support the understanding and implementation of these activities.

Table A.14 — Detect function: Detection Processes sub-categories

Description of sub-category	Standards mapping
Roles and responsibilities for detection are well defined to ensure accountability	ISO/IEC 27002:2013, 6.1.1 IEC 62443-2-1:2010, 4.4.3.1 ISO/IEC 27019:2017, 8.1.1
Detection activities comply with all applicable requirements	ISO/IEC 27002:2013, 18.1.4 IEC 62443-2-1:2010, 4.4.3.2
Detection processes are tested	ISO/IEC 27002:2013, 14.2.8 IEC 62443-2-1:2010, 4.4.3.2
Event detection information is communicated to appropriate parties	ISO/IEC 27002:2013, 16.1.2 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5.9
Detection processes are continuously improved	ISO/IEC 27002:2013, 16.1.6 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.4.3.4

A.5 Respond categories

A.5.1 Response Planning

Table A.15 describes the activities under the Response Planning category, along with standards that can support the understanding and implementation of these activities.

Table A.15 — Respond function: Response Planning sub-categories

Description of sub-category	Standards mapping
Response plan is executed during or after an event	ISO/IEC 27002:2013, 16.1.5 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5.1

A.5.2 Communications

Table A.16 describes the activities under the Communications category, along with standards that can support the understanding and implementation of these activities.

Table A.16 — Respond function: Communications sub-categories

Description of sub-category	Standards mapping
Personnel know their roles and order of operations when a response is needed	ISO/IEC 27001:2013, 7.4 ISO/IEC 27002:2013, 6.1.1, 16.1.1 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5.2, 4.3.4.5.3, 4.3.4.5.4 ISO/IEC 27019:2017, 6.1.6, 8.1.1
Events are reported consistent with established criteria	ISO/IEC 27001:2013, 7.4 ISO/IEC 27002:2013, 6.1.3, 16.1.2 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5.5
Information is shared consistent with response plans	ISO/IEC 27001:2013, 7.4 ISO/IEC 27002:2013, 16.1.2 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5.2
Coordination with stakeholders occurs consistent with response plans	ISO/IEC 27001:2013, 7.4 ISO/IEC 27002:2013, 6.1.4, 16.1.5 ISO/IEC 27033-2 ISO/IEC 27035 (all parts) IEC 62443-2-1:2010, 4.3.4.5.5 ISO/IEC 27019:2017, 6.1.7
Voluntary information sharing occurs with external stakeholders to achieve broader cybersecurity situation awareness	ISO/IEC 27001:2013, 7.4

A.5.3 Analysis

Table A.17 describes the activities under the Analysis category, along with standards that can support the understanding and implementation of these activities.

Table A.17 — Respond function: Analysis sub-categories

Description of sub-category	Standards mapping
Notifications from detection systems are investigated	ISO/IEC 27002:2013, 12.4.1, 12.4.3, 16.1.5 ISO/IEC 27039 IEC 62443-2-1:2010, 4.3.4.5.6, 4.3.4.5.7, 4.3.4.5.8
The impact of the incident is understood	ISO/IEC 27002:2013, 16.1.6 ISO/IEC 27035-2 IEC 62443-2-1:2010, 4.3.4.5.6, 4.3.4.5.7, 4.3.4.5.8
Forensics are performed	ISO/IEC 27002:2013, 16.1.7
Incidents are categorized consistent with response plans	ISO/IEC 27002:2013, 16.1.4 IEC 62443-2-1:2010, 4.3.4.5.6

A.5.4 Mitigation

Table A.18 describes the activities under the Mitigation category, along with standards that can support the understanding and implementation of these activities.

Table A.18 — Respond function: Mitigation sub-categories

Description of sub-category	Standards mapping
Incidents are contained and mitigated	ISO/IEC 27002:2013, 12.2.1, 16.1.5 ISO/IEC 27035-1 ISO/IEC 27035-2 IEC 62443-2-1:2010, 4.3.4.5.6
Newly identified vulnerabilities are mitigated or documented as accepted	ISO/IEC 27002:2013, 12.6.1 ISO/IEC 30111

A.5.5 Improvements

Table A.19 describes the activities under the Improvements category, along with standards that can support the understanding and implementation of these activities.

Table A.19 — Respond function: Improvements sub-categories

Description of sub-category	Standards mapping
Response plans incorporate lessons learned	ISO/IEC 27001:2013, Clause 10 ISO/IEC 27002:2013, 16.1.5, 16.1.6
Response strategies are updated	ISO/IEC 27001:2013, Clause 10 ISO/IEC 27002:2013, 16.1.6

A.6 Recover Categories

A.6.1 Recovery Planning

Table A.20 describes the activities under the Recovery Planning category, along with standards that can support the understanding and implementation of these activities.