Pub K

PUBLIC CONTRACTS

Annual Review 2022 Cybersecurity and Information Technology Supplementary Materials

Table of Contents

Federal Register
Vol. 84, No. 96
Friday, May 17, 2019

Presidential Documents

Title 3—

The President

Executive Order 13873 of May 15, 2019

Securing the Information and Communications Technology and Services Supply Chain

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the International Emergency Economic Powers Act (50 U.S.C. 1701 *et seq.*) (IEEPA), the National Emergencies Act (50 U.S.C. 1601 *et seq.*), and section 301 of title 3, United States Code,

I, DONALD J. TRUMP, President of the United States of America, find that foreign adversaries are increasingly creating and exploiting vulnerabilities in information and communications technology and services, which store and communicate vast amounts of sensitive information, facilitate the digital economy, and support critical infrastructure and vital emergency services, in order to commit malicious cyber-enabled actions, including economic and industrial espionage against the United States and its people. I further find that the unrestricted acquisition or use in the United States of information and communications technology or services designed, developed, manufactured, or supplied by persons owned by, controlled by, or subject to the jurisdiction or direction of foreign adversaries augments the ability of foreign adversaries to create and exploit vulnerabilities in information and communications technology or services, with potentially catastrophic effects, and thereby constitutes an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States. This threat exists both in the case of individual acquisitions or uses of such technology or services, and when acquisitions or uses of such technologies are considered as a class. Although maintaining an open investment climate in information and communications technology, and in the United States economy more generally, is important for the overall growth and prosperity of the United States, such openness must be balanced by the need to protect our country against critical national security threats. To deal with this threat, additional steps are required to protect the security, integrity, and reliability of information and communications technology and services provided and used in the United States. In light of these findings, I hereby declare a national emergency with respect to this threat.

Accordingly, it is hereby ordered as follows:

Section 1. *Implementation.* (a) The following actions are prohibited: any acquisition, importation, transfer, installation, dealing in, or use of any information and communications technology or service (transaction) by any person, or with respect to any property, subject to the jurisdiction of the United States, where the transaction involves any property in which any foreign country or a national thereof has any interest (including through an interest in a contract for the provision of the technology or service), where the transaction was initiated, is pending, or will be completed after the date of this order, and where the Secretary of Commerce (Secretary), in consultation with the Secretary of the Treasury, the Secretary of State, the Secretary of Defense, the Attorney General, the Secretary of Homeland Security, the United States Trade Representative, the Director of National Intelligence, the Administrator of General Services, the Chairman of the Federal Communications Commission, and, as appropriate, the heads of other executive departments and agencies (agencies), has determined that:

(i) the transaction involves information and communications technology or services designed, developed, manufactured, or supplied, by persons owned by, controlled by, or subject to the jurisdiction or direction of a foreign adversary; and

(ii) the transaction:

(A) poses an undue risk of sabotage to or subversion of the design, integrity, manufacturing, production, distribution, installation, operation, or maintenance of information and communications technology or services in the United States;

(B) poses an undue risk of catastrophic effects on the security or resiliency of United States critical infrastructure or the digital economy of the United States; or

(C) otherwise poses an unacceptable risk to the national security of the United States or the security and safety of United States persons.

(b) The Secretary, in consultation with the heads of other agencies as appropriate, may at the Secretary's discretion design or negotiate measures to mitigate concerns identified under section 1(a) of this order. Such measures may serve as a precondition to the approval of a transaction or of a class of transactions that would otherwise be prohibited pursuant to this order.

(c) The prohibitions in subsection (a) of this section apply except to the extent provided by statutes, or in regulations, orders, directives, or licenses that may be issued pursuant to this order, and notwithstanding any contract entered into or any license or permit granted prior to the effective date of this order.

Sec. 2. *Authorities*. (a) The Secretary, in consultation with, or upon referral of a particular transaction from, the heads of other agencies as appropriate, is hereby authorized to take such actions, including directing the timing and manner of the cessation of transactions prohibited pursuant to section 1 of this order, adopting appropriate rules and regulations, and employing all other powers granted to the President by IEEPA, as may be necessary to implement this order. All agencies of the United States Government are directed to take all appropriate measures within their authority to carry out the provisions of this order.

(b) Rules and regulations issued pursuant to this order may, among other things, determine that particular countries or persons are foreign adversaries for the purposes of this order; identify persons owned by, controlled by, or subject to the jurisdiction or direction of foreign adversaries for the purposes of this order; identify particular technologies or countries with respect to which transactions involving information and communications technology or services warrant particular scrutiny under the provisions of this order; establish procedures to license transactions otherwise prohibited pursuant to this order; establish criteria, consistent with section 1 of this order, by which particular technologies or particular participants in the market for information and communications technology or services may be recognized as categorically included in or as categorically excluded from the prohibitions established by this order; and identify a mechanism and relevant factors for the negotiation of agreements to mitigate concerns raised in connection with subsection 1(a) of this order. Within 150 days of the date of this order, the Secretary, in consultation with the Secretary of the Treasury, Secretary of State, the Secretary of Defense, the Attorney General, the Secretary of Homeland Security, the United States Trade Representative, the Director of National Intelligence, the Administrator of General Services, the Chairman of the Federal Communications Commission and, as appropriate, the heads of other agencies, shall publish rules or regulations implementing the authorities delegated to the Secretary by this order.

(c) The Secretary may, consistent with applicable law, redelegate any of the authorities conferred on the Secretary pursuant to this section within the Department of Commerce.

Sec. 3. *Definitions*. For purposes of this order:

(a) the term "entity" means a partnership, association, trust, joint venture, corporation, group, subgroup, or other organization;

(b) the term "foreign adversary" means any foreign government or foreign non-government person engaged in a long-term pattern or serious instances of conduct significantly adverse to the national security of the United States or security and safety of United States persons;

(c) the term "information and communications technology or services" means any hardware, software, or other product or service primarily intended to fulfill or enable the function of information or data processing, storage, retrieval, or communication by electronic means, including transmission, storage, and display;

(d) the term "person" means an individual or entity; and

(e) the term "United States person" means any United States citizen, permanent resident alien, entity organized under the laws of the United States or any jurisdiction within the United States (including foreign branches), or any person in the United States.

Sec. 4. Recurring and Final Reports to the Congress. The Secretary, in consultation with the Secretary of State, is hereby authorized to submit recurring and final reports to the Congress on the national emergency declared in this order, consistent with section 401(c) of the NEA (50 U.S.C. 1641(c)) and section 204(c) of IEEPA (50 U.S.C. 1703(c)).

Sec. 5. *Assessments and Reports.* (a) The Director of National Intelligence shall continue to assess threats to the United States and its people from information and communications technology or services designed, developed, manufactured, or supplied by persons owned by, controlled by, or subject to the jurisdiction or direction of a foreign adversary. The Director of National Intelligence shall produce periodic written assessments of these threats in consultation with the heads of relevant agencies, and shall provide these assessments to the President, the Secretary for the Secretary's use in connection with his responsibilities pursuant to this order, and the heads of other agencies as appropriate. An initial assessment shall be completed within 40 days of the date of this order, and further assessments shall be completed at least annually, and shall include analysis of:

(i) threats enabled by information and communications technologies or services designed, developed, manufactured, or supplied by persons owned by, controlled by, or subject to the jurisdiction or direction of a foreign adversary; and

(ii) threats to the United States Government, United States critical infrastructure, and United States entities from information and communications technologies or services designed, developed, manufactured, or supplied by persons owned by, controlled by, or subject to the influence of a foreign adversary.

(b) The Secretary of Homeland Security shall continue to assess and identify entities, hardware, software, and services that present vulnerabilities in the United States and that pose the greatest potential consequences to the national security of the United States. The Secretary of Homeland Security, in coordination with sector-specific agencies and coordinating councils as appropriate, shall produce a written assessment within 80 days of the date of this order, and annually thereafter. This assessment shall include an evaluation of hardware, software, or services that are relied upon by multiple information and communications technology or service providers, including the communication services relied upon by critical infrastructure entities identified pursuant to section 9 of Executive Order 13636 of February 12, 2013 (Improving Critical Infrastructure Cybersecurity).

(c) Within 1 year of the date of this order, and annually thereafter, the Secretary, in consultation as appropriate with the Secretary of the Treasury, the Secretary of Homeland Security, Secretary of State, the Secretary of Defense, the Attorney General, the United States Trade Representative, the

Director of National Intelligence, and the Chairman of the Federal Communications Commission, shall assess and report to the President whether the actions taken by the Secretary pursuant to this order are sufficient and continue to be necessary to mitigate the risks identified in, and pursuant to, this order.

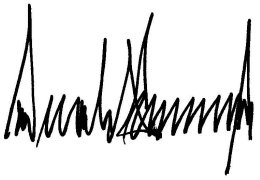
Sec. 6. *General Provisions.* (a) Nothing in this order shall be construed to impair or otherwise affect:

(i) the authority granted by law to an executive department or agency, or the head thereof; or

(ii) the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, or legislative proposals.

(b) This order shall be implemented consistent with applicable law and subject to the availability of appropriations.

(c) This order is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.



THE WHITE HOUSE,
May 15, 2019.

[FR Doc. 2019–10538
Filed 5–16–19; 11:15 am]
Billing code 3295–F9–P

Federal Register
Vol. 86, No. 93
Monday, May 17, 2021

Presidential Documents

Title 3—

The President

Executive Order 14028 of May 12, 2021

Improving the Nation's Cybersecurity

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Section 1. *Policy*. The United States faces persistent and increasingly sophisticated malicious cyber campaigns that threaten the public sector, the private sector, and ultimately the American people's security and privacy. The Federal Government must improve its efforts to identify, deter, protect against, detect, and respond to these actions and actors. The Federal Government must also carefully examine what occurred during any major cyber incident and apply lessons learned. But cybersecurity requires more than government action. Protecting our Nation from malicious cyber actors requires the Federal Government to partner with the private sector. The private sector must adapt to the continuously changing threat environment, ensure its products are built and operate securely, and partner with the Federal Government to foster a more secure cyberspace. In the end, the trust we place in our digital infrastructure should be proportional to how trustworthy and transparent that infrastructure is, and to the consequences we will incur if that trust is misplaced.

Incremental improvements will not give us the security we need; instead, the Federal Government needs to make bold changes and significant investments in order to defend the vital institutions that underpin the American way of life. The Federal Government must bring to bear the full scope of its authorities and resources to protect and secure its computer systems, whether they are cloud-based, on-premises, or hybrid. The scope of protection and security must include systems that process data (information technology (IT)) and those that run the vital machinery that ensures our safety (operational technology (OT)).

It is the policy of my Administration that the prevention, detection, assessment, and remediation of cyber incidents is a top priority and essential to national and economic security. The Federal Government must lead by example. All Federal Information Systems should meet or exceed the standards and requirements for cybersecurity set forth in and issued pursuant to this order.

Sec. 2. *Removing Barriers to Sharing Threat Information*. (a) The Federal Government contracts with IT and OT service providers to conduct an array of day-to-day functions on Federal Information Systems. These service providers, including cloud service providers, have unique access to and insight into cyber threat and incident information on Federal Information Systems. At the same time, current contract terms or restrictions may limit the sharing of such threat or incident information with executive departments and agencies (agencies) that are responsible for investigating or remediating cyber incidents, such as the Cybersecurity and Infrastructure Security Agency (CISA), the Federal Bureau of Investigation (FBI), and other elements of the Intelligence Community (IC). Removing these contractual barriers and increasing the sharing of information about such threats, incidents, and risks are necessary steps to accelerating incident deterrence, prevention, and response efforts and to enabling more effective defense of agencies' systems and of information collected, processed, and maintained by or for the Federal Government.

(b) Within 60 days of the date of this order, the Director of the Office of Management and Budget (OMB), in consultation with the Secretary of Defense, the Attorney General, the Secretary of Homeland Security, and the Director of National Intelligence, shall review the Federal Acquisition Regulation (FAR) and the Defense Federal Acquisition Regulation Supplement contract requirements and language for contracting with IT and OT service providers and recommend updates to such requirements and language to the FAR Council and other appropriate agencies. The recommendations shall include descriptions of contractors to be covered by the proposed contract language.

(c) The recommended contract language and requirements described in subsection (b) of this section shall be designed to ensure that:

(i) service providers collect and preserve data, information, and reporting relevant to cybersecurity event prevention, detection, response, and investigation on all information systems over which they have control, including systems operated on behalf of agencies, consistent with agencies' requirements;

(ii) service providers share such data, information, and reporting, as they relate to cyber incidents or potential incidents relevant to any agency with which they have contracted, directly with such agency and any other agency that the Director of OMB, in consultation with the Secretary of Defense, the Attorney General, the Secretary of Homeland Security, and the Director of National Intelligence, deems appropriate, consistent with applicable privacy laws, regulations, and policies;

(iii) service providers collaborate with Federal cybersecurity or investigative agencies in their investigations of and responses to incidents or potential incidents on Federal Information Systems, including by implementing technical capabilities, such as monitoring networks for threats in collaboration with agencies they support, as needed; and

(iv) service providers share cyber threat and incident information with agencies, doing so, where possible, in industry-recognized formats for incident response and remediation.

(d) Within 90 days of receipt of the recommendations described in subsection (b) of this section, the FAR Council shall review the proposed contract language and conditions and, as appropriate, shall publish for public comment proposed updates to the FAR.

(e) Within 120 days of the date of this order, the Secretary of Homeland Security and the Director of OMB shall take appropriate steps to ensure to the greatest extent possible that service providers share data with agencies, CISA, and the FBI as may be necessary for the Federal Government to respond to cyber threats, incidents, and risks.

(f) It is the policy of the Federal Government that:

(i) information and communications technology (ICT) service providers entering into contracts with agencies must promptly report to such agencies when they discover a cyber incident involving a software product or service provided to such agencies or involving a support system for a software product or service provided to such agencies;

(ii) ICT service providers must also directly report to CISA whenever they report under subsection (f)(i) of this section to Federal Civilian Executive Branch (FCEB) Agencies, and CISA must centrally collect and manage such information; and

(iii) reports pertaining to National Security Systems, as defined in section 10(h) of this order, must be received and managed by the appropriate agency as to be determined under subsection (g)(i)(E) of this section.

(g) To implement the policy set forth in subsection (f) of this section:

(i) Within 45 days of the date of this order, the Secretary of Homeland Security, in consultation with the Secretary of Defense acting through the Director of the National Security Agency (NSA), the Attorney General,

and the Director of OMB, shall recommend to the FAR Council contract language that identifies:

(A) the nature of cyber incidents that require reporting;

(B) the types of information regarding cyber incidents that require reporting to facilitate effective cyber incident response and remediation;

(C) appropriate and effective protections for privacy and civil liberties;

(D) the time periods within which contractors must report cyber incidents based on a graduated scale of severity, with reporting on the most severe cyber incidents not to exceed 3 days after initial detection;

(E) National Security Systems reporting requirements; and

(F) the type of contractors and associated service providers to be covered by the proposed contract language.

(ii) Within 90 days of receipt of the recommendations described in subsection (g)(i) of this section, the FAR Council shall review the recommendations and publish for public comment proposed updates to the FAR.

(iii) Within 90 days of the date of this order, the Secretary of Defense acting through the Director of the NSA, the Attorney General, the Secretary of Homeland Security, and the Director of National Intelligence shall jointly develop procedures for ensuring that cyber incident reports are promptly and appropriately shared among agencies.

(h) Current cybersecurity requirements for unclassified system contracts are largely implemented through agency-specific policies and regulations, including cloud-service cybersecurity requirements. Standardizing common cybersecurity contractual requirements across agencies will streamline and improve compliance for vendors and the Federal Government.

(i) Within 60 days of the date of this order, the Secretary of Homeland Security acting through the Director of CISA, in consultation with the Secretary of Defense acting through the Director of the NSA, the Director of OMB, and the Administrator of General Services, shall review agency-specific cybersecurity requirements that currently exist as a matter of law, policy, or contract and recommend to the FAR Council standardized contract language for appropriate cybersecurity requirements. Such recommendations shall include consideration of the scope of contractors and associated service providers to be covered by the proposed contract language.

(j) Within 60 days of receiving the recommended contract language developed pursuant to subsection (i) of this section, the FAR Council shall review the recommended contract language and publish for public comment proposed updates to the FAR.

(k) Following any updates to the FAR made by the FAR Council after the public comment period described in subsection (j) of this section, agencies shall update their agency-specific cybersecurity requirements to remove any requirements that are duplicative of such FAR updates.

(l) The Director of OMB shall incorporate into the annual budget process a cost analysis of all recommendations developed under this section.

Sec. 3. *Modernizing Federal Government Cybersecurity.* (a) To keep pace with today's dynamic and increasingly sophisticated cyber threat environment, the Federal Government must take decisive steps to modernize its approach to cybersecurity, including by increasing the Federal Government's visibility into threats, while protecting privacy and civil liberties. The Federal Government must adopt security best practices; advance toward Zero Trust Architecture; accelerate movement to secure cloud services, including Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS); centralize and streamline access to cybersecurity data to drive analytics for identifying and managing cybersecurity risks; and invest in both technology and personnel to match these modernization goals.

(b) Within 60 days of the date of this order, the head of each agency shall:

(i) update existing agency plans to prioritize resources for the adoption and use of cloud technology as outlined in relevant OMB guidance;

(ii) develop a plan to implement Zero Trust Architecture, which shall incorporate, as appropriate, the migration steps that the National Institute of Standards and Technology (NIST) within the Department of Commerce has outlined in standards and guidance, describe any such steps that have already been completed, identify activities that will have the most immediate security impact, and include a schedule to implement them; and

(iii) provide a report to the Director of OMB and the Assistant to the President and National Security Advisor (APNSA) discussing the plans required pursuant to subsection (b)(i) and (ii) of this section.

(c) As agencies continue to use cloud technology, they shall do so in a coordinated, deliberate way that allows the Federal Government to prevent, detect, assess, and remediate cyber incidents. To facilitate this approach, the migration to cloud technology shall adopt Zero Trust Architecture, as practicable. The CISA shall modernize its current cybersecurity programs, services, and capabilities to be fully functional with cloud-computing environments with Zero Trust Architecture. The Secretary of Homeland Security acting through the Director of CISA, in consultation with the Administrator of General Services acting through the Federal Risk and Authorization Management Program (FedRAMP) within the General Services Administration, shall develop security principles governing Cloud Service Providers (CSPs) for incorporation into agency modernization efforts. To facilitate this work:

(i) Within 90 days of the date of this order, the Director of OMB, in consultation with the Secretary of Homeland Security acting through the Director of CISA, and the Administrator of General Services acting through FedRAMP, shall develop a Federal cloud-security strategy and provide guidance to agencies accordingly. Such guidance shall seek to ensure that risks to the FCEB from using cloud-based services are broadly understood and effectively addressed, and that FCEB Agencies move closer to Zero Trust Architecture.

(ii) Within 90 days of the date of this order, the Secretary of Homeland Security acting through the Director of CISA, in consultation with the Director of OMB and the Administrator of General Services acting through FedRAMP, shall develop and issue, for the FCEB, cloud-security technical reference architecture documentation that illustrates recommended approaches to cloud migration and data protection for agency data collection and reporting.

(iii) Within 60 days of the date of this order, the Secretary of Homeland Security acting through the Director of CISA shall develop and issue, for FCEB Agencies, a cloud-service governance framework. That framework shall identify a range of services and protections available to agencies based on incident severity. That framework shall also identify data and processing activities associated with those services and protections.

(iv) Within 90 days of the date of this order, the heads of FCEB Agencies, in consultation with the Secretary of Homeland Security acting through the Director of CISA, shall evaluate the types and sensitivity of their respective agency's unclassified data, and shall provide to the Secretary of Homeland Security through the Director of CISA and to the Director of OMB a report based on such evaluation. The evaluation shall prioritize identification of the unclassified data considered by the agency to be the most sensitive and under the greatest threat, and appropriate processing and storage solutions for those data.

(d) Within 180 days of the date of this order, agencies shall adopt multi-factor authentication and encryption for data at rest and in transit, to the maximum extent consistent with Federal records laws and other applicable laws. To that end:

(i) Heads of FCEB Agencies shall provide reports to the Secretary of Homeland Security through the Director of CISA, the Director of OMB,

and the APNSA on their respective agency's progress in adopting multi-factor authentication and encryption of data at rest and in transit. Such agencies shall provide such reports every 60 days after the date of this order until the agency has fully adopted, agency-wide, multi-factor authentication and data encryption.

(ii) Based on identified gaps in agency implementation, CISA shall take all appropriate steps to maximize adoption by FCEB Agencies of technologies and processes to implement multifactor authentication and encryption for data at rest and in transit.

(iii) Heads of FCEB Agencies that are unable to fully adopt multi-factor authentication and data encryption within 180 days of the date of this order shall, at the end of the 180-day period, provide a written rationale to the Secretary of Homeland Security through the Director of CISA, the Director of OMB, and the APNSA.

(e) Within 90 days of the date of this order, the Secretary of Homeland Security acting through the Director of CISA, in consultation with the Attorney General, the Director of the FBI, and the Administrator of General Services acting through the Director of FedRAMP, shall establish a framework to collaborate on cybersecurity and incident response activities related to FCEB cloud technology, in order to ensure effective information sharing among agencies and between agencies and CSPs.

(f) Within 60 days of the date of this order, the Administrator of General Services, in consultation with the Director of OMB and the heads of other agencies as the Administrator of General Services deems appropriate, shall begin modernizing FedRAMP by:

(i) establishing a training program to ensure agencies are effectively trained and equipped to manage FedRAMP requests, and providing access to training materials, including videos-on-demand;

(ii) improving communication with CSPs through automation and standardization of messages at each stage of authorization. These communications may include status updates, requirements to complete a vendor's current stage, next steps, and points of contact for questions;

(iii) incorporating automation throughout the lifecycle of FedRAMP, including assessment, authorization, continuous monitoring, and compliance;

(iv) digitizing and streamlining documentation that vendors are required to complete, including through online accessibility and pre-populated forms; and

(v) identifying relevant compliance frameworks, mapping those frameworks onto requirements in the FedRAMP authorization process, and allowing those frameworks to be used as a substitute for the relevant portion of the authorization process, as appropriate.

Sec. 4. *Enhancing Software Supply Chain Security*. (a) The security of software used by the Federal Government is vital to the Federal Government's ability to perform its critical functions. The development of commercial software often lacks transparency, sufficient focus on the ability of the software to resist attack, and adequate controls to prevent tampering by malicious actors. There is a pressing need to implement more rigorous and predictable mechanisms for ensuring that products function securely, and as intended. The security and integrity of "critical software"—software that performs functions critical to trust (such as affording or requiring elevated system privileges or direct access to networking and computing resources)—is a particular concern. Accordingly, the Federal Government must take action to rapidly improve the security and integrity of the software supply chain, with a priority on addressing critical software.

(b) Within 30 days of the date of this order, the Secretary of Commerce acting through the Director of NIST shall solicit input from the Federal Government, private sector, academia, and other appropriate actors to identify existing or develop new standards, tools, and best practices for complying with the standards, procedures, or criteria in subsection (e) of this section.

The guidelines shall include criteria that can be used to evaluate software security, include criteria to evaluate the security practices of the developers and suppliers themselves, and identify innovative tools or methods to demonstrate conformance with secure practices.

(c) Within 180 days of the date of this order, the Director of NIST shall publish preliminary guidelines, based on the consultations described in subsection (b) of this section and drawing on existing documents as practicable, for enhancing software supply chain security and meeting the requirements of this section.

(d) Within 360 days of the date of this order, the Director of NIST shall publish additional guidelines that include procedures for periodic review and updating of the guidelines described in subsection (c) of this section.

(e) Within 90 days of publication of the preliminary guidelines pursuant to subsection (c) of this section, the Secretary of Commerce acting through the Director of NIST, in consultation with the heads of such agencies as the Director of NIST deems appropriate, shall issue guidance identifying practices that enhance the security of the software supply chain. Such guidance may incorporate the guidelines published pursuant to subsections (c) and (i) of this section. Such guidance shall include standards, procedures, or criteria regarding:

(i) secure software development environments, including such actions as:

(A) using administratively separate build environments;

(B) auditing trust relationships;

(C) establishing multi-factor, risk-based authentication and conditional access across the enterprise;

(D) documenting and minimizing dependencies on enterprise products that are part of the environments used to develop, build, and edit software;

(E) employing encryption for data; and

(F) monitoring operations and alerts and responding to attempted and actual cyber incidents;

(ii) generating and, when requested by a purchaser, providing artifacts that demonstrate conformance to the processes set forth in subsection (e)(i) of this section;

(iii) employing automated tools, or comparable processes, to maintain trusted source code supply chains, thereby ensuring the integrity of the code;

(iv) employing automated tools, or comparable processes, that check for known and potential vulnerabilities and remediate them, which shall operate regularly, or at a minimum prior to product, version, or update release;

(v) providing, when requested by a purchaser, artifacts of the execution of the tools and processes described in subsection (e)(iii) and (iv) of this section, and making publicly available summary information on completion of these actions, to include a summary description of the risks assessed and mitigated;

(vi) maintaining accurate and up-to-date data, provenance (*i.e.,* origin) of software code or components, and controls on internal and third-party software components, tools, and services present in software development processes, and performing audits and enforcement of these controls on a recurring basis;

(vii) providing a purchaser a Software Bill of Materials (SBOM) for each product directly or by publishing it on a public website;

(viii) participating in a vulnerability disclosure program that includes a reporting and disclosure process;

(ix) attesting to conformity with secure software development practices; and

(x) ensuring and attesting, to the extent practicable, to the integrity and provenance of open source software used within any portion of a product.

(f) Within 60 days of the date of this order, the Secretary of Commerce, in coordination with the Assistant Secretary for Communications and Information and the Administrator of the National Telecommunications and Information Administration, shall publish minimum elements for an SBOM.

(g) Within 45 days of the date of this order, the Secretary of Commerce, acting through the Director of NIST, in consultation with the Secretary of Defense acting through the Director of the NSA, the Secretary of Homeland Security acting through the Director of CISA, the Director of OMB, and the Director of National Intelligence, shall publish a definition of the term "critical software" for inclusion in the guidance issued pursuant to subsection (e) of this section. That definition shall reflect the level of privilege or access required to function, integration and dependencies with other software, direct access to networking and computing resources, performance of a function critical to trust, and potential for harm if compromised.

(h) Within 30 days of the publication of the definition required by subsection (g) of this section, the Secretary of Homeland Security acting through the Director of CISA, in consultation with the Secretary of Commerce acting through the Director of NIST, shall identify and make available to agencies a list of categories of software and software products in use or in the acquisition process meeting the definition of critical software issued pursuant to subsection (g) of this section.

(i) Within 60 days of the date of this order, the Secretary of Commerce acting through the Director of NIST, in consultation with the Secretary of Homeland Security acting through the Director of CISA and with the Director of OMB, shall publish guidance outlining security measures for critical software as defined in subsection (g) of this section, including applying practices of least privilege, network segmentation, and proper configuration.

(j) Within 30 days of the issuance of the guidance described in subsection (i) of this section, the Director of OMB acting through the Administrator of the Office of Electronic Government within OMB shall take appropriate steps to require that agencies comply with such guidance.

(k) Within 30 days of issuance of the guidance described in subsection (e) of this section, the Director of OMB acting through the Administrator of the Office of Electronic Government within OMB shall take appropriate steps to require that agencies comply with such guidelines with respect to software procured after the date of this order.

(l) Agencies may request an extension for complying with any requirements issued pursuant to subsection (k) of this section. Any such request shall be considered by the Director of OMB on a case-by-case basis, and only if accompanied by a plan for meeting the underlying requirements. The Director of OMB shall on a quarterly basis provide a report to the APNSA identifying and explaining all extensions granted.

(m) Agencies may request a waiver as to any requirements issued pursuant to subsection (k) of this section. Waivers shall be considered by the Director of OMB, in consultation with the APNSA, on a case-by-case basis, and shall be granted only in exceptional circumstances and for limited duration, and only if there is an accompanying plan for mitigating any potential risks.

(n) Within 1 year of the date of this order, the Secretary of Homeland Security, in consultation with the Secretary of Defense, the Attorney General, the Director of OMB, and the Administrator of the Office of Electronic Government within OMB, shall recommend to the FAR Council contract language requiring suppliers of software available for purchase by agencies to comply with, and attest to complying with, any requirements issued pursuant to subsections (g) through (k) of this section.

(o) After receiving the recommendations described in subsection (n) of this section, the FAR Council shall review the recommendations and, as appropriate and consistent with applicable law, amend the FAR.

(p) Following the issuance of any final rule amending the FAR as described in subsection (o) of this section, agencies shall, as appropriate and consistent with applicable law, remove software products that do not meet the requirements of the amended FAR from all indefinite delivery indefinite quantity contracts; Federal Supply Schedules; Federal Government-wide Acquisition Contracts; Blanket Purchase Agreements; and Multiple Award Contracts.

(q) The Director of OMB, acting through the Administrator of the Office of Electronic Government within OMB, shall require agencies employing software developed and procured prior to the date of this order (legacy software) either to comply with any requirements issued pursuant to subsection (k) of this section or to provide a plan outlining actions to remediate or meet those requirements, and shall further require agencies seeking renewals of software contracts, including legacy software, to comply with any requirements issued pursuant to subsection (k) of this section, unless an extension or waiver is granted in accordance with subsection (l) or (m) of this section.

(r) Within 60 days of the date of this order, the Secretary of Commerce acting through the Director of NIST, in consultation with the Secretary of Defense acting through the Director of the NSA, shall publish guidelines recommending minimum standards for vendors' testing of their software source code, including identifying recommended types of manual or automated testing (such as code review tools, static and dynamic analysis, software composition tools, and penetration testing).

(s) The Secretary of Commerce acting through the Director of NIST, in coordination with representatives of other agencies as the Director of NIST deems appropriate, shall initiate pilot programs informed by existing consumer product labeling programs to educate the public on the security capabilities of internet-of-Things (IoT) devices and software development practices, and shall consider ways to incentivize manufacturers and developers to participate in these programs.

(t) Within 270 days of the date of this order, the Secretary of Commerce acting through the Director of NIST, in coordination with the Chair of the Federal Trade Commission (FTC) and representatives of other agencies as the Director of NIST deems appropriate, shall identify IoT cybersecurity criteria for a consumer labeling program, and shall consider whether such a consumer labeling program may be operated in conjunction with or modeled after any similar existing government programs consistent with applicable law. The criteria shall reflect increasingly comprehensive levels of testing and assessment that a product may have undergone, and shall use or be compatible with existing labeling schemes that manufacturers use to inform consumers about the security of their products. The Director of NIST shall examine all relevant information, labeling, and incentive programs and employ best practices. This review shall focus on ease of use for consumers and a determination of what measures can be taken to maximize manufacturer participation.

(u) Within 270 days of the date of this order, the Secretary of Commerce acting through the Director of NIST, in coordination with the Chair of the FTC and representatives from other agencies as the Director of NIST deems appropriate, shall identify secure software development practices or criteria for a consumer software labeling program, and shall consider whether such a consumer software labeling program may be operated in conjunction with or modeled after any similar existing government programs, consistent with applicable law. The criteria shall reflect a baseline level of secure practices, and if practicable, shall reflect increasingly comprehensive levels of testing and assessment that a product may have undergone. The Director

of NIST shall examine all relevant information, labeling, and incentive programs, employ best practices, and identify, modify, or develop a recommended label or, if practicable, a tiered software security rating system. This review shall focus on ease of use for consumers and a determination of what measures can be taken to maximize participation.

(v) These pilot programs shall be conducted in a manner consistent with OMB Circular A–119 and NIST Special Publication 2000–02 (Conformity Assessment Considerations for Federal Agencies).

(w) Within 1 year of the date of this order, the Director of NIST shall conduct a review of the pilot programs, consult with the private sector and relevant agencies to assess the effectiveness of the programs, determine what improvements can be made going forward, and submit a summary report to the APNSA.

(x) Within 1 year of the date of this order, the Secretary of Commerce, in consultation with the heads of other agencies as the Secretary of Commerce deems appropriate, shall provide to the President, through the APNSA, a report that reviews the progress made under this section and outlines additional steps needed to secure the software supply chain.

Sec. 5. *Establishing a Cyber Safety Review Board.* (a) The Secretary of Homeland Security, in consultation with the Attorney General, shall establish the Cyber Safety Review Board (Board), pursuant to section 871 of the Homeland Security Act of 2002 (6 U.S.C. 451).

(b) The Board shall review and assess, with respect to significant cyber incidents (as defined under Presidential Policy Directive 41 of July 26, 2016 (United States Cyber Incident Coordination) (PPD–41)) affecting FCEB Information Systems or non-Federal systems, threat activity, vulnerabilities, mitigation activities, and agency responses.

(c) The Secretary of Homeland Security shall convene the Board following a significant cyber incident triggering the establishment of a Cyber Unified Coordination Group (UCG) as provided by section V(B)(2) of PPD–41; at any time as directed by the President acting through the APNSA; or at any time the Secretary of Homeland Security deems necessary.

(d) The Board's initial review shall relate to the cyber activities that prompted the establishment of a UCG in December 2020, and the Board shall, within 90 days of the Board's establishment, provide recommendations to the Secretary of Homeland Security for improving cybersecurity and incident response practices, as outlined in subsection (i) of this section.

(e) The Board's membership shall include Federal officials and representatives from private-sector entities. The Board shall comprise representatives of the Department of Defense, the Department of Justice, CISA, the NSA, and the FBI, as well as representatives from appropriate private-sector cybersecurity or software suppliers as determined by the Secretary of Homeland Security. A representative from OMB shall participate in Board activities when an incident under review involves FCEB Information Systems, as determined by the Secretary of Homeland Security. The Secretary of Homeland Security may invite the participation of others on a case-by-case basis depending on the nature of the incident under review.

(f) The Secretary of Homeland Security shall biennially designate a Chair and Deputy Chair of the Board from among the members of the Board, to include one Federal and one private-sector member.

(g) The Board shall protect sensitive law enforcement, operational, business, and other confidential information that has been shared with it, consistent with applicable law.

(h) The Secretary of Homeland Security shall provide to the President through the APNSA any advice, information, or recommendations of the Board for improving cybersecurity and incident response practices and policy upon completion of its review of an applicable incident.

(i) Within 30 days of completion of the initial review described in subsection (d) of this section, the Secretary of Homeland Security shall provide to the President through the APNSA the recommendations of the Board based on the initial review. These recommendations shall describe:

(i) identified gaps in, and options for, the Board's composition or authorities;

(ii) the Board's proposed mission, scope, and responsibilities;

(iii) membership eligibility criteria for private-sector representatives;

(iv) Board governance structure including interaction with the executive branch and the Executive Office of the President;

(v) thresholds and criteria for the types of cyber incidents to be evaluated;

(vi) sources of information that should be made available to the Board, consistent with applicable law and policy;

(vii) an approach for protecting the information provided to the Board and securing the cooperation of affected United States individuals and entities for the purpose of the Board's review of incidents; and

(viii) administrative and budgetary considerations required for operation of the Board.

(j) The Secretary of Homeland Security, in consultation with the Attorney General and the APNSA, shall review the recommendations provided to the President through the APNSA pursuant to subsection (i) of this section and take steps to implement them as appropriate.

(k) Unless otherwise directed by the President, the Secretary of Homeland Security shall extend the life of the Board every 2 years as the Secretary of Homeland Security deems appropriate, pursuant to section 871 of the Homeland Security Act of 2002.

Sec. 6. *Standardizing the Federal Government's Playbook for Responding to Cybersecurity Vulnerabilities and Incidents.* (a) The cybersecurity vulnerability and incident response procedures currently used to identify, remediate, and recover from vulnerabilities and incidents affecting their systems vary across agencies, hindering the ability of lead agencies to analyze vulnerabilities and incidents more comprehensively across agencies. Standardized response processes ensure a more coordinated and centralized cataloging of incidents and tracking of agencies' progress toward successful responses.

(b) Within 120 days of the date of this order, the Secretary of Homeland Security acting through the Director of CISA, in consultation with the Director of OMB, the Federal Chief Information Officers Council, and the Federal Chief Information Security Council, and in coordination with the Secretary of Defense acting through the Director of the NSA, the Attorney General, and the Director of National Intelligence, shall develop a standard set of operational procedures (playbook) to be used in planning and conducting a cybersecurity vulnerability and incident response activity respecting FCEB Information Systems. The playbook shall:

(i) incorporate all appropriate NIST standards;

(ii) be used by FCEB Agencies; and

(iii) articulate progress and completion through all phases of an incident response, while allowing flexibility so it may be used in support of various response activities.

(c) The Director of OMB shall issue guidance on agency use of the playbook.

(d) Agencies with cybersecurity vulnerability or incident response procedures that deviate from the playbook may use such procedures only after consulting with the Director of OMB and the APNSA and demonstrating that these procedures meet or exceed the standards proposed in the playbook.

(e) The Director of CISA, in consultation with the Director of the NSA, shall review and update the playbook annually, and provide information to the Director of OMB for incorporation in guidance updates.

(f) To ensure comprehensiveness of incident response activities and build confidence that unauthorized cyber actors no longer have access to FCEB Information Systems, the playbook shall establish, consistent with applicable law, a requirement that the Director of CISA review and validate FCEB Agencies' incident response and remediation results upon an agency's completion of its incident response. The Director of CISA may recommend use of another agency or a third-party incident response team as appropriate.

(g) To ensure a common understanding of cyber incidents and the cybersecurity status of an agency, the playbook shall define key terms and use such terms consistently with any statutory definitions of those terms, to the extent practicable, thereby providing a shared lexicon among agencies using the playbook.

Sec. 7. *Improving Detection of Cybersecurity Vulnerabilities and Incidents on Federal Government Networks.* (a) The Federal Government shall employ all appropriate resources and authorities to maximize the early detection of cybersecurity vulnerabilities and incidents on its networks. This approach shall include increasing the Federal Government's visibility into and detection of cybersecurity vulnerabilities and threats to agency networks in order to bolster the Federal Government's cybersecurity efforts.

(b) FCEB Agencies shall deploy an Endpoint Detection and Response (EDR) initiative to support proactive detection of cybersecurity incidents within Federal Government infrastructure, active cyber hunting, containment and remediation, and incident response.

(c) Within 30 days of the date of this order, the Secretary of Homeland Security acting through the Director of CISA shall provide to the Director of OMB recommendations on options for implementing an EDR initiative, centrally located to support host-level visibility, attribution, and response regarding FCEB Information Systems.

(d) Within 90 days of receiving the recommendations described in subsection (c) of this section, the Director of OMB, in consultation with Secretary of Homeland Security, shall issue requirements for FCEB Agencies to adopt Federal Government-wide EDR approaches. Those requirements shall support a capability of the Secretary of Homeland Secretary, acting through the Director of CISA, to engage in cyber hunt, detection, and response activities.

(e) The Director of OMB shall work with the Secretary of Homeland Security and agency heads to ensure that agencies have adequate resources to comply with the requirements issued pursuant to subsection (d) of this section.

(f) Defending FCEB Information Systems requires that the Secretary of Homeland Security acting through the Director of CISA have access to agency data that are relevant to a threat and vulnerability analysis, as well as for assessment and threat-hunting purposes. Within 75 days of the date of this order, agencies shall establish or update Memoranda of Agreement (MOA) with CISA for the Continuous Diagnostics and Mitigation Program to ensure object level data, as defined in the MOA, are available and accessible to CISA, consistent with applicable law.

(g) Within 45 days of the date of this order, the Director of the NSA as the National Manager for National Security Systems (National Manager) shall recommend to the Secretary of Defense, the Director of National Intelligence, and the Committee on National Security Systems (CNSS) appropriate actions for improving detection of cyber incidents affecting National Security Systems, to the extent permitted by applicable law, including recommendations concerning EDR approaches and whether such measures should be operated by agencies or through a centralized service of common concern provided by the National Manager.

(h) Within 90 days of the date of this order, the Secretary of Defense, the Director of National Intelligence, and the CNSS shall review the recommendations submitted under subsection (g) of this section and, as appropriate, establish policies that effectuate those recommendations, consistent with applicable law.

(i) Within 90 days of the date of this order, the Director of CISA shall provide to the Director of OMB and the APNSA a report describing how authorities granted under section 1705 of Public Law 116–283, to conduct threat-hunting activities on FCEB networks without prior authorization from agencies, are being implemented. This report shall also recommend procedures to ensure that mission-critical systems are not disrupted, procedures for notifying system owners of vulnerable government systems, and the range of techniques that can be used during testing of FCEB Information Systems. The Director of CISA shall provide quarterly reports to the APNSA and the Director of OMB regarding actions taken under section 1705 of Public Law 116–283.

(j) To ensure alignment between Department of Defense Information Network (DODIN) directives and FCEB Information Systems directives, the Secretary of Defense and the Secretary of Homeland Security, in consultation with the Director of OMB, shall:

(i) within 60 days of the date of this order, establish procedures for the Department of Defense and the Department of Homeland Security to immediately share with each other Department of Defense Incident Response Orders or Department of Homeland Security Emergency Directives and Binding Operational Directives applying to their respective information networks;

(ii) evaluate whether to adopt any guidance contained in an Order or Directive issued by the other Department, consistent with regulations concerning sharing of classified information; and

(iii) within 7 days of receiving notice of an Order or Directive issued pursuant to the procedures established under subsection (j)(i) of this section, notify the APNSA and Administrator of the Office of Electronic Government within OMB of the evaluation described in subsection (j)(ii) of this section, including a determination whether to adopt guidance issued by the other Department, the rationale for that determination, and a timeline for application of the directive, if applicable.

Sec. 8. *Improving the Federal Government's Investigative and Remediation Capabilities.* (a) Information from network and system logs on Federal Information Systems (for both on-premises systems and connections hosted by third parties, such as CSPs) is invaluable for both investigation and remediation purposes. It is essential that agencies and their IT service providers collect and maintain such data and, when necessary to address a cyber incident on FCEB Information Systems, provide them upon request to the Secretary of Homeland Security through the Director of CISA and to the FBI, consistent with applicable law.

(b) Within 14 days of the date of this order, the Secretary of Homeland Security, in consultation with the Attorney General and the Administrator of the Office of Electronic Government within OMB, shall provide to the Director of OMB recommendations on requirements for logging events and retaining other relevant data within an agency's systems and networks. Such recommendations shall include the types of logs to be maintained, the time periods to retain the logs and other relevant data, the time periods for agencies to enable recommended logging and security requirements, and how to protect logs. Logs shall be protected by cryptographic methods to ensure integrity once collected and periodically verified against the hashes throughout their retention. Data shall be retained in a manner consistent with all applicable privacy laws and regulations. Such recommendations shall also be considered by the FAR Council when promulgating rules pursuant to section 2 of this order.

(c) Within 90 days of receiving the recommendations described in subsection (b) of this section, the Director of OMB, in consultation with the Secretary of Commerce and the Secretary of Homeland Security, shall formulate policies for agencies to establish requirements for logging, log retention, and log management, which shall ensure centralized access and visibility for the highest level security operations center of each agency.

(d) The Director of OMB shall work with agency heads to ensure that agencies have adequate resources to comply with the requirements identified in subsection (c) of this section.

(e) To address cyber risks or incidents, including potential cyber risks or incidents, the proposed recommendations issued pursuant to subsection (b) of this section shall include requirements to ensure that, upon request, agencies provide logs to the Secretary of Homeland Security through the Director of CISA and to the FBI, consistent with applicable law. These requirements should be designed to permit agencies to share log information, as needed and appropriate, with other Federal agencies for cyber risks or incidents.

Sec. 9. *National Security Systems.* (a) Within 60 days of the date of this order, the Secretary of Defense acting through the National Manager, in coordination with the Director of National Intelligence and the CNSS, and in consultation with the APNSA, shall adopt National Security Systems requirements that are equivalent to or exceed the cybersecurity requirements set forth in this order that are otherwise not applicable to National Security Systems. Such requirements may provide for exceptions in circumstances necessitated by unique mission needs. Such requirements shall be codified in a National Security Memorandum (NSM). Until such time as that NSM is issued, programs, standards, or requirements established pursuant to this order shall not apply with respect to National Security Systems.

(b) Nothing in this order shall alter the authority of the National Manager with respect to National Security Systems as defined in National Security Directive 42 of July 5, 1990 (National Policy for the Security of National Security Telecommunications and Information Systems) (NSD–42). The FCEB network shall continue to be within the authority of the Secretary of Homeland Security acting through the Director of CISA.

Sec. 10. *Definitions.* For purposes of this order:

(a) the term "agency" has the meaning ascribed to it under 44 U.S.C. 3502.

(b) the term "auditing trust relationship" means an agreed-upon relationship between two or more system elements that is governed by criteria for secure interaction, behavior, and outcomes relative to the protection of assets.

(c) the term "cyber incident" has the meaning ascribed to an "incident" under 44 U.S.C. 3552(b)(2).

(d) the term "Federal Civilian Executive Branch Agencies" or "FCEB Agencies" includes all agencies except for the Department of Defense and agencies in the Intelligence Community.

(e) the term "Federal Civilian Executive Branch Information Systems" or "FCEB Information Systems" means those information systems operated by Federal Civilian Executive Branch Agencies, but excludes National Security Systems.

(f) the term "Federal Information Systems" means an information system used or operated by an agency or by a contractor of an agency or by another organization on behalf of an agency, including FCEB Information Systems and National Security Systems.

(g) the term "Intelligence Community" or "IC" has the meaning ascribed to it under 50 U.S.C. 3003(4).

(h) the term "National Security Systems" means information systems as defined in 44 U.S.C. 3552(b)(6), 3553(e)(2), and 3553(e)(3).

(i) the term "logs" means records of the events occurring within an organization's systems and networks. Logs are composed of log entries, and each entry contains information related to a specific event that has occurred within a system or network.

(j) the term "Software Bill of Materials" or "SBOM" means a formal record containing the details and supply chain relationships of various components used in building software. Software developers and vendors often create products by assembling existing open source and commercial software components. The SBOM enumerates these components in a product. It is analogous to a list of ingredients on food packaging. An SBOM is useful to those who develop or manufacture software, those who select or purchase software, and those who operate software. Developers often use available open source and third-party software components to create a product; an SBOM allows the builder to make sure those components are up to date and to respond quickly to new vulnerabilities. Buyers can use an SBOM to perform vulnerability or license analysis, both of which can be used to evaluate risk in a product. Those who operate software can use SBOMs to quickly and easily determine whether they are at potential risk of a newly discovered vulnerability. A widely used, machine-readable SBOM format allows for greater benefits through automation and tool integration. The SBOMs gain greater value when collectively stored in a repository that can be easily queried by other applications and systems. Understanding the supply chain of software, obtaining an SBOM, and using it to analyze known vulnerabilities are crucial in managing risk.

(k) the term "Zero Trust Architecture" means a security model, a set of system design principles, and a coordinated cybersecurity and system management strategy based on an acknowledgement that threats exist both inside and outside traditional network boundaries. The Zero Trust security model eliminates implicit trust in any one element, node, or service and instead requires continuous verification of the operational picture via real-time information from multiple sources to determine access and other system responses. In essence, a Zero Trust Architecture allows users full access but only to the bare minimum they need to perform their jobs. If a device is compromised, zero trust can ensure that the damage is contained. The Zero Trust Architecture security model assumes that a breach is inevitable or has likely already occurred, so it constantly limits access to only what is needed and looks for anomalous or malicious activity. Zero Trust Architecture embeds comprehensive security monitoring; granular risk-based access controls; and system security automation in a coordinated manner throughout all aspects of the infrastructure in order to focus on protecting data in real-time within a dynamic threat environment. This data-centric security model allows the concept of least-privileged access to be applied for every access decision, where the answers to the questions of who, what, when, where, and how are critical for appropriately allowing or denying access to resources based on the combination of sever.

Sec. 11. *General Provisions.* (a) Upon the appointment of the National Cyber Director (NCD) and the establishment of the related Office within the Executive Office of the President, pursuant to section 1752 of Public Law 116–283, portions of this order may be modified to enable the NCD to fully execute its duties and responsibilities.

(b) Nothing in this order shall be construed to impair or otherwise affect:

(i) the authority granted by law to an executive department or agency, or the head thereof; or

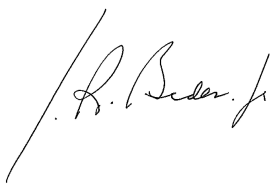
(ii) the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, or legislative proposals.

(c) This order shall be implemented in a manner consistent with applicable law and subject to the availability of appropriations.

(d) This order is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any

party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

(e) Nothing in this order confers authority to interfere with or to direct a criminal or national security investigation, arrest, search, seizure, or disruption operation or to alter a legal restriction that requires an agency to protect information learned in the course of a criminal or national security investigation.



THE WHITE HOUSE,
May 12, 2021.

[FR Doc. 2021–10460
Filed 5–14–21; 8:45 am]
Billing code 3295–F1–P

52.204-21 Basic Safeguarding of Covered Contractor Information Systems.

As prescribed in 4.1903 , insert the following clause:

Basic Safeguarding of Covered Contractor Information Systems (Nov 2021)

(a) *Definitions*. As used in this clause—

Covered contractor information system means an information system that is owned or operated by a contractor that processes, stores, or transmits Federal contract information.

Federal contract information means information, not intended for public release, that is provided by or generated for the Government under a contract to develop or deliver a product or service to the Government, but not including information provided by the Government to the public (such as on public websites) or simple transactional information, such as necessary to process payments.

Information means any communication or representation of knowledge such as facts, data, or opinions, in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audiovisual (Committee on National Security Systems Instruction (CNSSI) 4009).

Information system means a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information (44 U.S.C. 3502).

Safeguarding means measures or controls that are prescribed to protect information systems.

(b) Safeguarding requirements and procedures.

(1) The Contractor shall apply the following basic safeguarding requirements and procedures to protect covered contractor information systems. Requirements and procedures for basic safeguarding of covered contractor information systems shall include, at a minimum, the following security controls:

(i) Limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems).

(ii) Limit information system access to the types of transactions and functions that authorized users are permitted to execute.

(iii) Verify and control/limit connections to and use of external information systems.

(iv) Control information posted or processed on publicly accessible information systems.

(v) Identify information system users, processes acting on behalf of users, or devices.

(vi) Authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to organizational information systems.

(vii) Sanitize or destroy information system media containing Federal Contract Information before disposal or release for reuse.

(viii) Limit physical access to organizational information systems, equipment, and the respective operating environments to authorized individuals.

(ix) Escort visitors and monitor visitor activity; maintain audit logs of physical access; and

control and manage physical access devices.

(x) Monitor, control, and protect organizational communications (*i.e.*, information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems.

(xi) Implement subnetworks for publicly accessible system components that are physically or logically separated from internal networks.

(xii) Identify, report, and correct information and information system flaws in a timely manner.

(xiii) Provide protection from malicious code at appropriate locations within organizational information systems.

(xiv) Update malicious code protection mechanisms when new releases are available.

(xv) Perform periodic scans of the information system and real-time scans of files from external sources as files are downloaded, opened, or executed.

(2) *Other requirements.* This clause does not relieve the Contractor of any other specific safeguarding requirements specified by Federal agencies and departments relating to covered contractor information systems generally or other Federal safeguarding requirements for controlled unclassified information (CUI) as established by Executive Order 13556.

(c) *Subcontracts.* The Contractor shall include the substance of this clause, including this paragraph (c), in subcontracts under this contract (including subcontracts for the acquisition of commercial products or commercial services, other than commercially available off-the-shelf items), in which the subcontractor may have Federal contract information residing in or transiting through its information system.

(End of clause)

Parent topic: 52.204 [Reserved]

52.224-1 Privacy Act Notification.

As prescribed in 24.104 , insert the following clause in solicitations and contracts, when the design, development, or operation of a system of records on individuals is required to accomplish an agency function:

Privacy Act Notification (Apr 1984)

The Contractor will be required to design, develop, or operate a system of records on individuals, to accomplish an agency function subject to the Privacy Act of1974, Public Law93-579, December 31,1974 (5 U.S.C.552a) and applicable agency regulations. Violation of the Act may involve the imposition of criminal penalties.

(End of clause)

Parent topic: 52.224 [Reserved]

52.224-2 Privacy Act.

As prescribed in 24.104 , insert the following clause in solicitations and contracts, when the design, development, or operation of a system of records on individuals is required to accomplish an agency function:

Privacy Act (Apr 1984)

(a) The Contractor agrees to-

(1) Comply with the Privacy Act of1974 (the Act) and the agency rules and regulations issued under the Act in the design, development, or operation of any system of records on individuals to accomplish an agency function when the contract specifically identifies-

(i) The systems of records; and

(ii) The design, development, or operation work that the contractor is to perform;

(2) Include the Privacy Act notification contained in this contract in every solicitation and resulting subcontract and in every subcontract awarded without a solicitation, when the work statement in the proposed subcontract requires the redesign, development, or operation of a system of records on individuals that is subject to the Act; and

(3) Include this clause, including this paragraph (3), in all subcontracts awarded under this contract which requires the design, development, or operation of such a system of records.

(b) In the event of violations of the Act, a civil action may be brought against the agency involved when the violation concerns the design, development, or operation of a system of records on individuals to accomplish an agency function, and criminal penalties may be imposed upon the officers or employees of the agency when the violation concerns the operation of a system of records on individuals to accomplish an agency function. For purposes of the Act, when the contract is for the operation of a system of records on individuals to accomplish an agency function, the Contractor is considered to be an employee of the agency.

(c)

(1) "Operation of a system of records," as used in this clause, means performance of any of the activities associated with maintaining the system of records, including the collection, use, and dissemination of records.

(2) "Record," as used in this clause, means any item, collection, or grouping of information about an individual that is maintained by an agency, including, but not limited to, education, financial transactions, medical history, and criminal or employment history and that contains the person’s name, or the identifying number, symbol, or other identifying particular assigned to the individual, such as a fingerprint or voiceprint or a photograph.

(3) "System of records on individuals," as used in this clause, means a group of any records under the control of any agency from which information is retrieved by the name of the individual or by some identifying number, symbol, or other identifying particular assigned to the individual.

(End of clause)

Parent topic: 52.224 [Reserved]

52.224-3 Privacy Training.

As prescribed in 24.302 , insert the following clause:

Privacy Training (Jan 2017)

(a) *Definition*. As used in this clause, "personally identifiable information" means information that can be used to distinguish or trace an individual's identity, either alone or when combined with other information that is linked or linkable to a specific individual. (See Office of Management and Budget (OMB) Circular A-130, Managing Federal Information as a Strategic Resource).

(b) The Contractor shall ensure that initial privacy training, and annual privacy training thereafter, is completed by contractor employees who-

(1) Have access to a system of records;

(2) Create, collect, use, process, store, maintain, disseminate, disclose, dispose, or otherwise handle personally identifiable information on behalf of an agency; or

(3) Design, develop, maintain, or operate a system of records (see also FAR subpart 24.3 and 39.105).

(c)

(1) "Privacy training shall address the key elements necessary for ensuring the safeguarding of personally identifiable information or a system of records. The training shall be role-based, provide foundational as well as more advanced levels of training, and have measures in place to test the knowledge level of users. At a minimum, the privacy training shall cover-

(i) The provisions of the Privacy Act of 1974 (5 U.S.C. 552a), including penalties for violations of the Act;

(ii) The appropriate handling and safeguarding of personally identifiable information;

(iii) The authorized and official use of a system of records or any other personally identifiable information;

(iv) The restriction on the use of unauthorized equipment to create, collect, use, process, store, maintain, disseminate, disclose, dispose or otherwise access personally identifiable information;

(v) The prohibition against the unauthorized use of a system of records or unauthorized disclosure, access, handling, or use of personally identifiable information; and

(vi) The procedures to be followed in the event of a suspected or confirmed breach of a system of records or the unauthorized disclosure, access, handling, or use of personally identifiable information (see OMB guidance for Preparing for and Responding to a Breach of Personally Identifiable Information).

(2) Completion of an agency-developed or agency-conducted training course shall be deemed to satisfy these elements.

(d) The Contractor shall maintain and, upon request, provide documentation of completion of privacy training to the Contracting Officer.

(e) The Contractor shall not allow any employee access to a system of records, or permit any employee to create, collect, use, process, store, maintain, disseminate, disclose, dispose or otherwise handle personally identifiable information, or to design, develop, maintain, or operate a system of records unless the employee has completed privacy training, as required by this clause.

(f) The substance of this clause, including this paragraph (f), shall be included in all subcontracts under this contract, when subcontractor employees will-

(1) Have access to a system of records;

(2) Create, collect, use, process, store, maintain, disseminate, disclose, dispose, or otherwise handle personally identifiable information; or

(3) Design, develop, maintain, or operate a system of records.

(End of clause)

Alternate I (Jan 2017). As prescribed in 24.302(b), if the agency specifies that only its agency-provided training is acceptable, substitute the following paragraph (c) for paragraph (c) of the basic clause:

(c) The contracting agency will provide initial privacy training, and annual privacy training thereafter, to Contractor employees for the duration of this contract.

Parent topic: 52.224 [Reserved]

Draft (2nd) NIST Special Publication 800-161 Revision 1

Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations

Jon Boyens
Angela Smith
Nadya Bartol
Kris Winkler
Alex Holbrook
Matthew Fallon

This publication is available free of charge from:
https://doi.org/10.6028/NIST.SP.800-161r1-draft2

National Institute of Standards and Technology
U.S. Department of Commerce

Draft (2nd) NIST Special Publication 800-161 Revision 1

Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations

Jon Boyens
Angela Smith
Computer Security Division
Information Technology Laboratory

Nadya Bartol
Kris Winkler
Alex Holbrook
Matthew Fallon
Boston Consulting Group

This publication is available free of charge from:
https://doi.org/10.6028/NIST.SP.800-161r1-draft2

October 2021

U.S. Department of Commerce
Gina M. Raimondo, Secretary

National Institute of Standards and Technology
James K. Olthoff, Performing the Non-Exclusive Functions and Duties of the Under Secretary of Commerce for Standards and Technology & Director, National Institute of Standards and Technology

Authority

This publication has been developed by NIST in accordance with its statutory responsibilities under the Federal Information Security Modernization Act (FISMA) of 2014, 44 U.S.C. § 3551 *et seq.*, Public Law (P.L.) 113-283. NIST is responsible for developing information security standards and guidelines, including minimum requirements for federal information systems, but such standards and guidelines shall not apply to national security systems without the express approval of appropriate federal officials exercising policy authority over such systems. This guideline is consistent with the requirements of the Office of Management and Budget (OMB) Circular A-130.

Nothing in this publication should be taken to contradict the standards and guidelines made mandatory and binding on federal agencies by the Secretary of Commerce under statutory authority. Nor should these guidelines be interpreted as altering or superseding the existing authorities of the Secretary of Commerce, Director of the OMB, or any other federal official. This publication may be used by nongovernmental organizations on a voluntary basis and is not subject to copyright in the United States. Attribution would, however, be appreciated by NIST.

National Institute of Standards and Technology Special Publication 800-161 Revision 1
Natl. Inst. Stand. Technol. Spec. Publ. 800-161 Rev. 1, 338 pages (October 2021)
CODEN: NSPUE2

This publication is available free of charge from:
https://doi.org/10.6028/NIST.SP.800-161r1-draft2

Public comment period: *October 28, 2021* through *December 10, ~~3,~~ 2021*

National Institute of Standards and Technology
Attn: Computer Security Division, Information Technology Laboratory
100 Bureau Drive (Mail Stop 8930) Gaithersburg, MD 20899-8930
Email: scrm-nist@nist.gov

All comments are subject to release under the Freedom of Information Act (FOIA).

96 **Reports on Computer Systems Technology**

97 The Information Technology Laboratory (ITL) at the National Institute of Standards and
98 Technology (NIST) promotes the U.S. economy and public welfare by providing technical
99 leadership for the Nation's measurement and standards infrastructure. ITL develops tests, test
100 methods, reference data, proof of concept implementations, and technical analyses to advance the
101 development and productive use of information technology. ITL's responsibilities include the
102 development of management, administrative, technical, and physical standards and guidelines for
103 the cost-effective security and privacy of other than national security-related information in federal
104 information systems. The Special Publication 800-series reports on ITL's research, guidelines, and
105 outreach efforts in information system security, and its collaborative activities with industry,
106 government, and academic organizations.
107

108 **Abstract**

109 Organizations are concerned about the risks associated with products and services that may
110 contain potentially malicious functionality, are counterfeit, or are vulnerable due to poor
111 manufacturing and development practices within the supply chain. These risks are associated
112 with an enterprise's decreased visibility into, and understanding of, how the technology they
113 acquire is developed, integrated, and deployed, as well as the processes, procedures, and
114 practices used to ensure the security, resilience, reliability, safety, integrity, and quality of the
115 products and services.
116
117 This publication provides guidance to organizations on identifying, assessing, and mitigating
118 cybersecurity risk in the supply chain at all levels of their organizations. The publication
119 integrates cybersecurity supply chain risk management (C-SCRM) into risk management
120 activities by applying a multi-level, C-SCRM-specific approach, including guidance on
121 development of C-SCRM strategy implementation plans, C-SCRM policies, C-SCRM plans, and
122 C-SCRM risk assessments for products and services.

123 **Keywords**

124 C-SCRM; cybersecurity supply chain risk management; acquire; information and
125 communication technology; supply chain; cybersecurity supply chain; supply chain assurance;
126 supply chain risk; supply chain risk assessment; supply chain security; risk management;
127 supplier.
128
129

Acknowledgements

The authors, Jon Boyens, National Institute of Standards and Technology (NIST), Angela Smith (NIST), Nadya Bartol, Boston Consulting Group (BCG), Kris Winkler (BCG), Alex Holbrook (BCG), and Matthew Fallon (BCG) would like to acknowledge and thank Alexander Nelson (NIST), Murugiah Souppaya (NIST), Paul Black (NIST), Victoria Pillitteri (NIST), Kevin Stine (NIST), Paul Black (NIST), Stephen Quinn (NIST), Nahla Ivy (NIST), Matthew Barrett (Cyber ESI), Greg Witte, (Huntington Ingalls), R.K. Gardner (New World Technology Partners), David A. Wheeler (Linux Foundation), Karen Scarfone (Scarfone Cybersecurity), Natalie Lehr-Lopez (ODNI/NCSC), Halley Farrell (BCG), and the original authors of the NIST SP 800-161, Celia Paulsen (NIST), Rama Moorthy (Hatha Systems), and Stephanie Shankles (U.S. Department of Veterans Affairs) for their contributions to the original NIST SP 800-161. The authors would also like to thank the C-SCRM community, which has provided the authors invaluable insight and diverse perspectives to managing the supply chain, especially the Departments and Agencies who provided us with their experience and documentation on NIST SP 800-161 implementation since its release in 2015 as well as the public and private members of the Enduring Security Framework who collaborated to provide input into Appendix F.

Note to Reviewers

Revision 1 of this foundational NIST publication represents a multi-year effort to incorporate the requisite next-generation C-SCRM controls to accomplish the above objectives. It includes the changes necessary to make the SP increasingly modular based, and expand alignment to [NIST 800-37], *Risk Management Framework for Information Systems and Organizations: A System Life Cycle Approach for Security and Privacy* as well as NIST [800-39], *Managing Information Security Risk: Organization, Mission, and Information System View*. Changes also focus on making implementation guidance more accessible to various, often diverse, audiences, including acquirers, suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers as well as increasing enablement through the inclusion of C-SCRM Strategy & Implementation Plan, C-SCRM Policy, C-SCRM Plan, and Cybersecurity Supply Chain Risk Assessment Templates.

Questions to reviewers:

- Does the revised structure of the document with added Audience Profiles fill the need to account for different audiences who may read the document?
- Within Appendix G C-SCRM Activities in the Risk Management Process – Does the discussion of materiality in the Criticality Analysis section sufficiently address the topic as an issue or key aspect to many organizations?
- Does the EO Appendix strike the right level of guidance given NIST's directive to publish "*preliminary guidelines, based on the consultations described in subsection (b) of this section and drawing on existing documents as practicable, for enhancing software supply chain security and meeting the requirements of this section*"?

Major changes include:

- Added Figure 3-1, *C-SCRM Metrics Development Process*

- Updated Risk Appetite & Tolerance Figure G-4 and moved to Appendix G: *C-SCRM Activities in the Risk Management Process*

Additional major changes per section / appendix include:

Section 1, Introduction

- Added Section 1.3: *Audience Profiles and Document Use Guidance*
- Added discussion of the terms "enterprise" vs. "organization" and the use of terms in the context of SP 800-161
- Added discussion of the concept of tailoring C-SCRM to Section 1.1: *Purpose*
- Revised Section 1.4: *Background* along with Fig. 1-1: *Dimensions of C-SCRM*

Section 2, Integration of C-SCRM into Enterprise-wide Risk Management

- Added *Section 2.1, The Business Case for C-SCRM* (previously in Section 1 in 1st Public Draft)
- Added *Cybersecurity Risks in Supply Chains* (previously in Section 1 in 1st Public Draft)
- Revised and streamlined discussion of Multi-level Risk Management

Section 3, (NEW) Critical success factors

- Section 3.4, *C-SCRM Key Practices* (previously in Section 1 of 1st public draft)
  - Added foundational, sustaining, and enabling practices to guide organizations effort to adopt C-SCRM practices described in this document
- Added Section 3.5.1, *Measuring C-SCRM Through Performance Measures*, offering guidance on the development of C-SCRM metrics (NEW to 2nd Public Draft)

Appendix A – C-SCRM Controls

- C-SCRM Controls – (previously section 4 in 1st Public Draft)
- Added discussion of EO related topics (e.g., SBOM into NIST SP 800-53 Rev. 5 controls supplemental guidance

Appendix B – C-SCRM Control Summary

Appendix C – Risk Response Framework

- Added Scenario 6

Appendix D – C-SCRM Templates

- Added references to Executive Order 14028

Appendix E – FASCSA (NEW)

- Augments NIST SP 800-161, Revision 1 and provides additional guidance to specific federal agencies related to FASCSA

Appendix F – Response to Executive Order 14028's Call to Publish Preliminary Guidelines for Enhancing Software Supply Chain Security (NEW)

- Added NIST response to Section 4(c) of Executive Order 14028's directive to establish preliminary guidelines for enhancing software supply chain security

Appendix G – C-SCRM ACTIVITIES IN THE RISK MANAGEMENT PROCESS

Appendix H – Glossary

- Updated glossary based on comments received on Initial Public Draft

Appendix I – Acronyms

Appendix J – References

- Moved *Relationship to Other Programs and Publications* from Section 1
- Moved *Section 1.7 Implementing C-SCRM* in the context of SP 800-37 Rev. 2 from Section 1
- Moved *METHODOLOGY FOR BUILDING C-SCRM GUIDANCE USING SP 800-39, SP 800-37 REVISION 2, AND NIST SP 800-53 REVISION 5* from Section 1

Your feedback on this draft publication is important to us. We appreciate each contribution from our reviewers. The insightful comments from both the public and private sectors, nationally and internationally, continue to help shape the final publication to ensure it meets the needs and expectations of our customers. NIST anticipates publishing the final version no later than April 2022. These dates are subject to change.

- JON BOYENS, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Call for Patent Claims

This public review includes a call for information on essential patent claims, (claims whose use would be required for compliance with the guidance or requirements in this Information Technology Laboratory (ITL) draft publication). Such guidance and/or requirements may be directly stated in this ITL Publication or by reference to another publication. This call also includes disclosure, where known, of the existence of pending U.S. or foreign patent applications relating to this ITL draft publication and of any relevant unexpired U.S. or foreign patents.

ITL may require from the patent holder, or a party authorized to make assurances on its behalf, in written or electronic form, either:

a) assurance in the form of a general disclaimer to the effect that such party does not hold and does not currently intend holding any essential patent claim(s); or

b) assurance that a license to such essential patent claim(s) will be made available to applicants desiring to utilize the license for the purpose of complying with the guidance or requirements in this ITL draft publication either:

   i. under reasonable terms and conditions that are demonstrably free of any unfair discrimination; or
   ii. without compensation and under reasonable terms and conditions that are demonstrably free of any unfair discrimination.

Such assurance shall indicate that the patent holder (or third party authorized to make assurances on its behalf) will include in any documents transferring ownership of patents subject to the assurance, provisions sufficient to ensure that the commitments in the assurance are binding on the transferee, and that the transferee will similarly include appropriate provisions in the event of future transfers with the goal of binding each successor-in-interest.

The assurance shall also indicate that it is intended to be binding on successors-in-interest regardless of whether such provisions are included in the relevant transfer documents.

Such statements should be addressed to: scrm-nist@nist.gov

Table of Contents

412
413

List of Figures

List of Tables

472

1. INTRODUCTION

Information, communications, and operational technology (ICT/OT) rely on a complex, globally distributed and interconnected supply chain ecosystem that is extensive, comprised of geographically diverse routes, and consists of multiple levels of outsourcing. This ecosystem is composed of public and private sector entities (e.g., acquirers, suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers)[1] and technology, law, policy, procedures, and practices that interact to conduct research and development, design, manufacture, acquire, deliver, integrate, operate, maintain, dispose of, and otherwise utilize or manage ICT/OT products and services. This ecosystem has evolved to provide a set of highly refined, cost-effective, and reusable solutions. Public and private sector entities have rapidly adopted this ecosystem of solutions options and increased their reliance on commercially available products, system integrator support for custom-built systems, and external service providers. This, in turn, has resulted in increased complexity, diversity, and scale of these entities.

In this document, the term ***supply chain*** refers to the linked set of resources and processes between and among multiple levels of an enterprise, each of which is an acquirer that begins with the sourcing of products and services and extends through the product and service life cycle.

Given the definition of supply chain, a ***cybersecurity risk in supply chains*** is the potential for harm or compromise resulting from the cybersecurity risk posed by suppliers, their supply chains, and their products or services. Cybersecurity risk in the supply chain arise from threats that exploit vulnerabilities or exposures within products and services traversing the supply chain as well as threats exploiting vulnerabilities or exposures within the supply chain itself.

Note for the purposes of NIST publications SCRM and C-SCRM refer to the same concept. This is because NIST is addressing only the cybersecurity aspects of SCRM. Other organizations may employ a different definition of SCRM outside the scope of this publication. This publication does not address many of the non-cybersecurity aspects of SCRM. Also, note that ICT SCRM is a term no longer being utilized for the purposes of this publication.

Technology solutions provided through the supply chain present significant benefits including low cost, interoperability, rapid innovation, product feature variety sourced across a landscape of competing vendors. These solutions, whether proprietary, government-developed, or open source, can meet the needs of a global base of public and private sector customers. However, the same globalization, enterprise interdependency, and reliance on supplied products and services that allows for such benefits can also increase the risk of a threat event that can directly or indirectly affect the supply chain. Cybersecurity risk in the supply chain is often undetected and arise in a manner resulting in risks to both the acquirer and the end-user. For example, deployed software is typically COTS software components, which in turn include smaller COTS components at multiple tiers. Deployed software updates often fail to update the smaller COTS components with known vulnerabilities—even when those vulnerabilities are exploitable in the

[1] See definitions suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers in Appendix F, Glossary.

larger deployed software. Software users may be unable to detect the smaller known-vulnerable components in larger COTS software (e.g., due to complete lack of SBOMs).

Currently, enterprises and many private sector suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers use varied and insufficiently standardized practices, which make it difficult to consistently measure and manage cybersecurity risk in the supply chain across different enterprises.

In this document, the practices and controls described for Cybersecurity Supply Chain Risk Management (C-SCRM) apply to both information technology (IT) and OT environments, and is inclusive of IoT. Similar to IT environments relying on ICT products and services, OT environments rely on OT and ICT products and services, which create a cyber risk from ICT/OT products, services, suppliers, and their supply chains. Enterprises should include OT-related suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers within the scope of their C-SCRM activities.

When engaging with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, agencies should carefully consider the breadth of the Federal government's footprint and the high likelihood that individual agencies may enforce varying and conflicting C-SCRM requirements. Overcoming this complexity requires interagency coordination and partnerships. The passage of the Federal Acquisition Supply Chain Security Act (FASCSA) of 2018 aimed to address this concern by creating a government-wide approach to the problem of supply chain security in federal acquisitions by establishing the Federal Acquisition Security Council (FASC). The FASC therefore serves as a focal point of coordination and information sharing and a harmonized approach to acquisition security that addresses C-SCRM in acquisition processes and procurements across the federal enterprise. In addition, the law incorporated SCRM into FISMA by requiring reporting on progress and effectiveness of the agency's supply chain risk management consistent with guidance issued by the Office of Management and Budget and the Council.

Note that this publication uses the term "enterprise" to describe Level 1 of the risk management hierarchy. In practice, an organization is defined as an entity of any size, complexity, or positioning within a larger enterprise structure (e.g., a federal agency or company). An enterprise is an organization by this definition, but it exists at the top level of the hierarchy where individual senior leaders have unique risk management responsibilities [NISTIR 8286]. Several organizations may comprise an enterprise. In these cases, an enterprise may have multiple Level 1s with stakeholders and activities defined at both the enterprise and the organization levels. Level 1 activities conducted at the enterprise level should inform those activities completed within the subordinate organizations. Enterprises and organizations tailor the C-SCRM practices described in this publication as applicable and appropriate based on their own unique enterprise structure. There are cases in this publication in which the term "organization" is inherited from a referenced source (e.g., other NIST Publication, regulatory language). Refer to NISTIR 8286 *Integrating Cybersecurity and Enterprise Risk Management (ERM)* for further guidance on this topic.

1.1. Purpose

Cybersecurity Supply Chain Risk Management (C-SCRM) is a systematic process for managing exposures to cybersecurity risks, threats, and vulnerabilities throughout the supply chain and developing appropriate response strategies presented by the supplier, the supplied products, services, and the supply chain. The purpose of this publication is to provide guidance to enterprises on how to identify, assess, select, and implement risk management processes and mitigating controls across the enterprise to help manage cybersecurity risk in the supply chain.

The C-SCRM guidance provided in this document is not one-size-fits-all. Instead, the guidance throughout this publication should be adopted and tailored to the unique size, resources, and risk circumstances of each enterprise. Enterprises adopting this guidance may vary in state of progress toward implementing and adopting C-SCRM practices internally. To that end, this publication describes key practices observed in enterprises, and offers a general prioritization of C-SCRM practices (i.e., Foundational, Sustaining, Enabling), for enterprises to consider as they implement and mature C-SCRM. However, this publication does not offer a specific roadmap for enterprises to follow in order to reach various states of capability.

The processes and controls identified in this document can be modified or augmented with enterprise-specific requirements from policies, guidelines, response strategies, and other sources. This publication empowers enterprises to develop C-SCRM strategies tailored to their specific mission/business needs, threats, and operational environments.

1.2. Target Audience

C-SCRM is an enterprise-wide activity that should be directed under the overall enterprise and/or enterprise governance, regardless of the specific enterprise structure.

This publication is intended to serve a diverse audience involved in C-SCRM, including:

- Individuals with system, information security, privacy, or risk management and oversight responsibilities, including authorizing officials (AOs), chief information officers, senior information security officers, and senior officials for privacy;
- Individuals with system development responsibilities, including mission or business owners, program managers, system engineers, system security engineers, privacy engineers, hardware and software developers, system integrators, and acquisition or procurement officials;
- Individuals with acquisition and procurement-related responsibilities, including acquisition officials and contracting officers;
- Individuals with logistical or disposition-related responsibilities, including program managers, procurement officials, system integrators, and property managers;
- Individuals with security and privacy implementation and operations responsibilities, including mission or business owners, system owners, information owners or stewards, system administrators, continuity planners, and system security or privacy officers;

- Individuals with security and privacy assessment and monitoring responsibilities, including auditors, Inspectors General, system evaluators, control assessors, independent verifiers and validators, and analysts; and
- Commercial entities, including industry partners, that produce component products and systems, create security and privacy technologies, or provide services or capabilities that support information security or privacy.

1.3. Audience Profiles and Document Use Guidance

Given the wide audience of this publication, several reader profiles have been defined to point readers to the sections of the document which most closely pertain to their use case. Some readers will belong to multiple profiles and therefore should consider reading all applicable sections. Any reader accountable for the implementation of a C-SCRM capability or function within their enterprise, regardless of role, should consider the entire document applicable to their use case.

1.3.1. Enterprise Risk Management and C-SCRM Owners and Operators

These readers are those responsible for enterprise risk management and cybersecurity supply chain risk management within the enterprise. These readers may help develop C-SCRM policies and standards, perform assessments of cybersecurity risk in supply chains, and serve as subject matter experts to the rest of the enterprise. The entire document is relevant to and recommended for readers fitting this profile.

1.3.2. Enterprise, Agency, Mission and Business Process Owners and Operators

These readers are the personnel responsible for the activities that create and/or manage risk within the enterprise. These personnel may also own the risk as part of their duties within the mission or business process. These personnel may have responsibilities for managing cybersecurity risk in the supply chain across the enterprise. These readers may seek general knowledge and guidance on Cybersecurity Supply Chain Risk Management. Recommended reading includes:

- Section 1: Introduction
- Section 2: Integration of C-SCRM into Enterprise-wide Risk Management
- Section 3.3: C-SCRM Awareness and Training
- Section 3.4: C-SCRM Key Practices
- Section 3.6: Dedicated Resources
- Appendix A: C-SCRM Security Controls
- Appendix B: C-SCRM Control Summary

1.3.3. Acquisition and Procurement Owners and Operators

These readers are those with C-SCRM responsibilities as part of their role in the procurement or acquisition function of an enterprise. Acquisition personnel may execute C-SCRM activities as a

part of their general responsibilities in the acquisition and procurement life cycle. These personnel will collaborate closely with the enterprise's C-SCRM personnel to execute C-SCRM activities with acquisition and procurement. Recommended reading includes:

- Section 1: Introduction
- Section 2.1: The Business Case for C-SCRM
- Section 2.2: Cybersecurity Risk in Supply Chains
- Section 3.1: C-SCRM in Acquisition
- Section 3.3: C-SCRM Awareness and Training
- Appendix A: C-SCRM Security Controls
    - These readers should pay special attention to requisite controls for supplier contracts and include in agreements with both primary and sub-tier contractor parties

1.3.4. Information Security, Privacy, or Cybersecurity operators

These readers are those with responsibility for protecting the confidentiality, integrity, and availability of the enterprise's critical processes and information systems. As part of those responsibilities, these readers may find themselves directly or indirectly involved with conducting Cybersecurity Supply Chain Risk Assessments and/or the selection and implementation of C-SCRM controls. In smaller enterprises, these personnel may bear the responsibility of implementing C-SCRM in their enterprise, and as such should refer to section 1.3.1 for guidance. Recommended reading includes:

- Section 1: Introduction
- Section 2.1: The Business Case for C-SCRM
- Section 2.2: Cybersecurity Risk in Supply Chains
- Section 3.2: Supply Chain Information Sharing
- Section 3.4: C-SCRM Key Practices
- Appendix A: C-SCRM Security Controls
- Appendix B: C-SCRM Control Summary
- Appendix C: Risk Exposure Framework
- Appendix D: C-SCRM Activities in the Risk Management Process

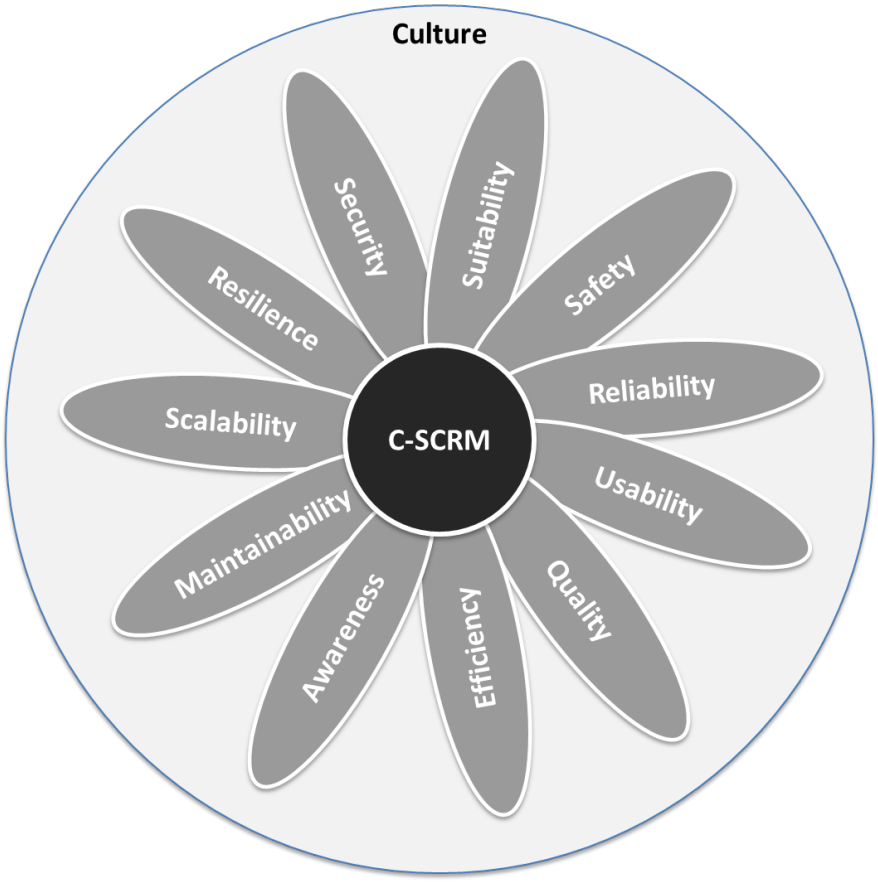
1.3.5. Systems development, system engineering, and system implementation personnel

These readers are those with responsibilities for executing activities within an information system's SDLC. As part of their SDLC responsibilities, these readers will be responsible for the execution of operational-level C-SCRM activities. Specifically, these personnel may be concerned with implementing C-SCRM controls to manage cybersecurity risk that arises from products and services provided through the supply chain within the scope of their information system(s). Recommended reading includes:

- Section 1: Introduction
- Section 2.1: The Business Case for C-SCRM
- Section 2.2: Cybersecurity Risk in Supply Chains
- Section 2.3.3: Level 3 - Operational
- Appendix A: C-SCRM Security Controls
- Appendix B: C-SCRM Control Summary
- Appendix C: Risk Exposure Framework
- Appendix D: C-SCRM Activities in the Risk Management Process

1.4. Background

C-SCRM encompasses activities spanning the entire system development life cycle, (SDLC), including research and development, design, manufacturing, acquisition, delivery, integration, operations and maintenance, disposal, and overall management of an enterprise's products and services. Many enterprises already perform certain C-SCRM related-activities as a part of these SDLC functions. Addressing cybersecurity risk in the supply chain within the SDLC is a factor that determines the success of C-SCRM. C-SCRM is the organized and purposeful management of cybersecurity risk in the supply chain. C-SCRM requires enterprise recognition and awareness and lies at the intersection of security, suitability, safety, reliability, usability, quality, efficiency, maintainability, scalability, and resilience as depicted in Figure 1-1. These dimensions are layers of consideration for enterprises as they approach C-SCRM and should be considered the outputs of effective C-SCRM.



715 **Fig. 1-1: Dimensions of C-SCRM**

716 • Culture is the set of shared values, practices, goals, and attitudes of the organization that
717 set the stage for successful C-SCRM;
718 • Awareness is focused on a learning process that sets the stage for training by changing
719 individual and enterprise attitudes to realize the importance of C-SCRM and the adverse
720 consequences of its failure;[2]
721 • Security provides the confidentiality, integrity, and availability of information that (a)
722 describes the supply chain (e.g., information about the paths of products and services,
723 both logical and physical), or (b) traverses the supply chain (e.g., intellectual property
724 contained in products and services), as well as information about the parties participating
725 in the supply chain (anyone who touches a product or service throughout its life cycle);
726 • Suitability is focused on the supply chain as well as the provided products and services
727 being right and appropriate for the enterprise and its purpose;
728 • Safety is focused on ensuring the product or service are free from conditions that can
729 cause death, injury, occupational illness, damage to or loss of equipment or property, or
730 damage to the environment; [3]
731 • Reliability is focused on the ability of a product or service to function as defined for a
732 specified period of time in a predictable manner;[4]

[2] NIST SP 800-16
[3] NIST SP 800-160 Vol.2
[4] NIST SP 800-160 Vol.2

- Usability is focused on the extent to which a product or services can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use;[5]
- Quality is focused on meeting or exceeding performance, technical, and functional specifications while ensuring vulnerabilities are mitigated that may limit the intended function of a component or delivery of a service, lead to component or service failure, or provide opportunities for exploitation;
- Efficiency is focused on the timeliness of the intended result delivered by a product or service;
- Maintainability is focused on the ease of a product or service to accommodate change and improvements based on past experience in support of expanding future derived benefits;
- Scalability is the capacity of a product or service to handle increased growth and demand;
- Resilience is focused on ensuring a product, service, or the supply chain supports the enterprise's ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.

1.4.1. Enterprise's Supply Chain

Contemporary enterprises run complex information systems and networks to support their missions. These information systems and networks are composed of ICT/OT[6] products and components made available by *suppliers, developers, and system integrators*. Enterprises also acquire and deploy an array of services, that include but are not limited to:

- Custom software for information systems built to be deployed within the enterprise, made available by *developers;*
- Operations, maintenance, and disposal support for information systems and networks within and outside of the enterprise's boundaries,[7] made available by *system integrators or other ICT/OT-related service providers;* and
- External services to support the enterprise's operations that are positioned both inside and outside of the authorization boundaries, made available by *external system service providers*.

These services may span the entire SDLC for an information system or service and may be:

- Performed by the staff employed by the enterprise, developer, system integrator, or external system service provider;

[5] NIST SP 800-63-3

[6] NIST SP 800-37 Rev. 2 defines Operational Technology as:
Programmable systems or devices that interact with the physical environment (or manage devices that interact with the physical environment). These systems/devices detect or cause a direct change through the monitoring and/or control of devices, processes, and events. Examples include industrial control systems, building management systems, fire control systems, and physical access control mechanisms.

[7] For federal information systems, this is the Authorization Boundary, defined in NIST SP 800-53 Rev. 5 as:
All components of an information system to be authorized for operation by an authorizing official. This excludes separately authorized systems to which the information system is connected.

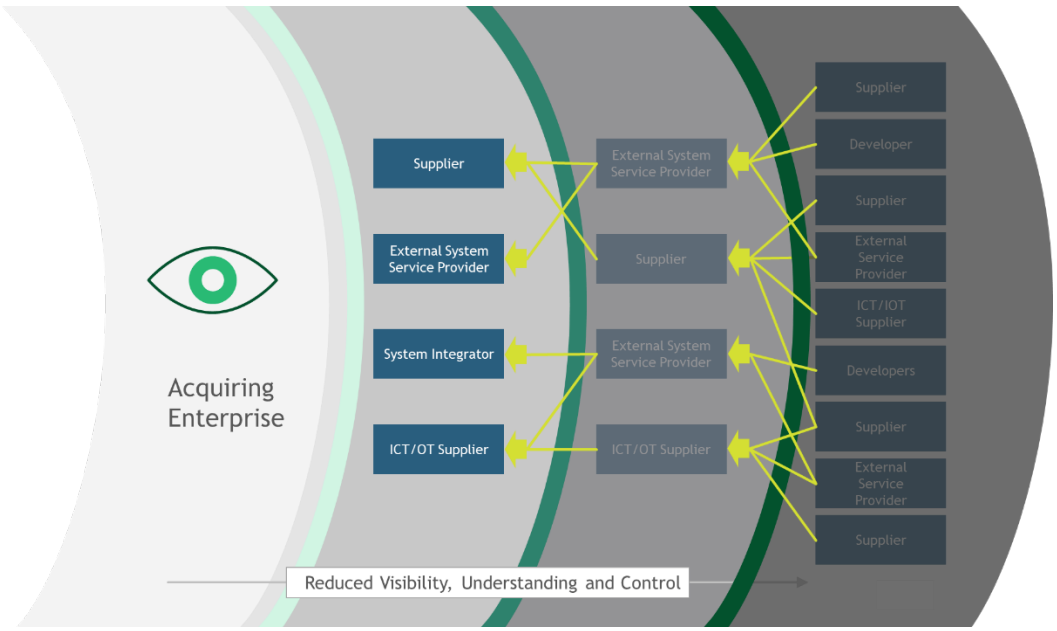
- Physically hosted by the enterprise or by the developer, system integrator, or external system service provider;
- Supported or comprised of development environments, logistics/delivery environments that transport information systems and components, or applicable system and communications interfaces;
- Proprietary, open source, or commercial off-the-shelf (COTS) hardware and software.

The responsibility and accountability for the services and associated activities performed by different parties within this ecosystem are usually defined by agreement documents between the enterprise and suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

1.4.2. Supplier Relationships within Enterprises

Enterprises depend on the supply chain to provide a variety of products and services enabling the enterprise to achieve its strategic and operational objectives. Identifying cybersecurity risk in supply chains is complicated by the information asymmetry that exists between acquiring enterprises and their suppliers and service providers. Acquirers often lack visibility and understanding of how acquired technology is developed, integrated, and deployed, and how services they acquire are delivered. Cybersecurity risk in the supply chain also arises as a result of the inadequacy or absence of processes, procedures, and practices used to ensure the security, safety, integrity, quality, reliability, trustworthiness or authenticity of a technology product, service, or source of the products and services. The level of cybersecurity risk in the supply chain to which an enterprise is exposed depends largely on the relationship between the products and services provided and the criticality of the missions, business processes, and systems they support. Enterprises have a variety of relationships with their suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Figure 1-3 depicts how these diverse relationships affect an enterprise's visibility and control of the supply chain.

801



803 **Fig. 1-2: An Enterprise's Visibility, Understanding, and Control of its Supply Chain**

804 Some supply chain relationships are tightly intermingled, such as the development by a system
805 integrator of a complex information system operating within the federal agency's authorization
806 boundary, or the management of federal agency information systems and resources by an
807 external service provider. These relationships are usually guided by an agreement, (e.g.,
808 contract), that establishes detailed functional, technical, and security requirements and may
809 provide for custom development or significant customization of products and services. For these
810 relationships, system integrators and external service providers are likely able to work with the
811 enterprise to implement such processes and controls, (listed within this document), which are
812 deemed appropriate based on the results of a criticality and risk assessment and cost/benefit
813 analysis. This may include floating requirements upstream in the supply chain to ensure higher
814 confidence in the satisfaction of necessary assurance objectives. The decision to extend such
815 requirements must be balanced with an appreciation of what is feasible and cost-effective. The
816 degree to which system integrators and external service providers are expected to implement C-
817 SCRM processes and controls should be weighed against the risks to the enterprise posed by not
818 adhering to those additional requirements. Often, working directly with the system integrators
819 and external service providers to proactively identify appropriate mitigation processes and
820 controls will help create a more cost-effective strategy.
821
822 Procuring ICT/OT products directly from suppliers establishes a direct relationship between
823 those suppliers and the acquirers. This relationship is also usually guided by an agreement
824 between the acquirer and the supplier. However, commercial ICT/OT developed by suppliers are
825 typically designed for general purposes for a global market and are not typically tailored to an
826 individual customer's specific operational or threat environments. Enterprises should perform
827 due diligence research regarding their specific C-SCRM requirements to determine if an IT

828 solution is "fit for purpose[8]," includes requisite security features and capabilities, will meet
829 quality and resiliency expectations, and requires support by the supplier for the product—or
830 product components—over its life cycle.
831
832 An assessment of the findings of an acquirer's research about a product—which may include
833 engaging in a dialog directly with suppliers whenever possible—will help acquirers understand
834 the characteristics and capabilities of existing ICT/OT products and services, set expectations
835 and requirements for suppliers, and identify C-SCRM needs not yet satisfied by the market. It
836 can also help identify emerging solutions that may at least partially support the acquirer's needs.
837 Overall, such research and engagement with a supplier will allow the acquirer to better articulate
838 their requirements to align with and drive market offerings and make risk-based decisions about
839 product purchases, configurations, and usages within their environment.
840
841 **Managing Cost and Resources**
842
843 Balancing cybersecurity risk in supply chains with the costs and benefits of C-SCRM controls
844 should be a key component of the acquirer's overall approach to C-SCRM.
845
846 Enterprises should be aware that implementing C-SCRM controls necessitates additional
847 financial and human resources. Requiring a greater level of testing, documentation, or security
848 features from suppliers, developers, system integrators, external system service providers, and
849 other ICT/OT-related service providers may increase the price of a product or service which may
850 result in increased cost to the acquirer. This is especially true for those products and services
851 developed for general-purpose applications and not tailored to the specific enterprise security or
852 C-SCRM requirements. When deciding whether to require and implement C-SCRM controls,
853 acquirers should consider both the costs of implementing these controls and the risks of not
854 implementing them.
855
856
857 To mitigate cost, and when appropriate, acquirers should allow suppliers, developers, system
858 integrators, external system service providers, and other ICT/OT-related service providers the
859 opportunity to reuse applicable existing data and documentation that may provide evidence to
860 support C-SCRM, e.g., existing standards.
861
862
863 ## 1.5. Relationship to Other Publications and Publication Summary
864
865 This publication builds on the concepts promoted within other NIST publications and tailors
866 those concepts for use within Cybersecurity Supply Chain Risk Management. As a result of this
867 relationship, this publication inherits many of the concepts and looks to those other NIST
868 publications to continue to advance the base frameworks, concepts, and methodologies. Those
869 NIST publications include:

[8] "Fit for purpose" is a term used informally to describe a process, configuration item, IT service, etc., capable of meeting its objectives or service levels. Being fit-for-purpose requires suitable design, implementation, control, and maintenance. (Adapted from Information Technology Infrastructure Library (ITIL) Service Strategy [ITIL Service Strategy].)

- **NIST Cybersecurity Framework (CSF) Version 1.1:** voluntary guidance, based on existing standards, guidelines, and practices for organizations to better manage and reduce cybersecurity risk. In addition to helping organizations manage and reduce risks, it was designed to foster risk and cybersecurity management communications amongst both internal and external organizational stakeholders;
- **FIPS 199, *Standards for Security Categorization of Federal Information and Information Systems*:** a standard for categorizing federal information and information systems according to an agency's level of concern for confidentiality, integrity, and availability and the potential impact on agency assets and operations should their information and information systems be compromised through unauthorized access, use, disclosure, disruption, modification, or destruction;
- **NIST SP 800-30, Revision 1, *Guide for Conducting Risk Assessments*:** guidance for conducting risk assessments of federal information systems and organizations, amplifying the guidance in Special Publication 800-39. Risk assessments, carried out at all three tiers in the risk management hierarchy, are part of an overall risk management process—providing senior leaders/executives with the information needed to determine appropriate courses of action in response to identified risks;
- **NIST SP 800-37, Revision 2, *Risk Management Framework for Information Systems and Organizations: A System Life Cycle Approach for Security and Privacy*:** describes the Risk Management Framework (RMF) and provides guidelines for applying the RMF to information systems and organizations. The RMF provides a disciplined, structured, and flexible process for managing security and privacy risk that includes information security categorization; control selection, implementation, and assessment; system and common control authorizations; and continuous monitoring;
- **NIST SP 800-39, *Managing Information Security Risk: Organization, Mission, and Information System View*:** provides guidance for an integrated, organization-wide program for managing information security risk to organizational operations (i.e., mission, functions, image, and reputation), organizational assets, individuals, other organizations, and the Nation resulting from the operation and use of federal information systems;
- **NIST SP 800-53 Revision 5, *Security and Privacy Controls for Information Systems and Organizations*:** provides a catalog of security and privacy controls for information systems and organizations to protect organizational operations and assets, individuals, other organizations, and the Nation from a diverse set of threats and risks, including hostile attacks, human errors, natural disasters, structural failures, foreign intelligence entities, and privacy risks;
- **NIST SP 800-53B Revision 5, *Control Baselines for Information Systems and Organizations*:** provides security and privacy control baselines for the Federal Government. There are three security control baselines (one for each system impact level—low-impact, moderate-impact, and high-impact), as well as a privacy baseline that is applied to systems irrespective of impact level;
- **NIST SP 800-160 Vol. 1, *Systems Security Engineering*:** addresses the engineering-driven perspective and actions necessary to develop more defensible and survivable

914 systems, inclusive of the machine, physical, and human components comprising the
915 systems, capabilities and services delivered by those systems;
916 • **NIST SP 800-160 Vol. 2, *Developing Cyber Resilient Systems: A Systems Security**
917 ***Engineering Approach*:** a handbook for achieving the identified cyber resiliency
918 outcomes based on a systems engineering perspective on system life cycle processes in
919 conjunction with risk management processes, allowing the experience and expertise of
920 the organization to help determine what is correct for its purpose;
921 • **NIST SP 800-181 Revision 1, *National Initiative for Cybersecurity Education (NICE)**
922 ***Cybersecurity Workforce Framework*:** a fundamental reference for describing and
923 sharing information about cybersecurity work. It expresses that work as Task statements
924 and describes Knowledge and Skill statements that provide a foundation for learners
925 including students, job seekers, and employees;
926 • **NISTIR 7622, *Notional Supply Chain Risk Management Practices for Federal**
927 ***Information Systems*:** provides a wide array of practices that, when implemented,
928 will help mitigate supply chain risk to federal information systems. It seeks to equip
929 federal departments and agencies with a notional set of repeatable and commercially
930 reasonable supply chain assurance methods and practices that offer a means to obtain an
931 understanding of, and visibility throughout, the supply chain;
932 • **NISTIR 8179, *Criticality Analysis Process Model: Prioritizing Systems and**
933 ***Components*:** helps organizations identify those systems and components that are most
934 vital, and which may need additional security or other protections;
935 • **NISTIR 8276, *Key Practices in Cyber Supply Chain Risk Management: Observations**
936 ***from Industry*:** provides the ever-increasing community of digital businesses a set of Key
937 Practices that any organization can use to manage cybersecurity risks associated with
938 their supply chains. The Key Practices presented in this document can be used to
939 implement a robust C-SCRM function at an organization of any size, scope, and
940 complexity. These practices combine the information contained in existing C-SCRM
941 government and industry resources with the information gathered during the 2015 and
942 2019 NIST research initiatives; and
943

- **NISTIR 8286, *Identifying and Estimating Cybersecurity Risk for Enterprise Risk Management (ERM)*:** helps individual organizations within an enterprise improve their cybersecurity risk information, which they provide as inputs to their enterprise's ERM processes through communications and risk information sharing.

This publication also draws upon concepts and work from other regulations, government reports, standards, guidelines, and best practices. A full list of those references can be found in the *Appendix H: References* section of this document.

Key Takeaways

The Supply Chain. ICT/OT relies on a globally distributed, interconnected supply chain ecosystem that consists of public and private sector entities (e.g., acquirers, suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers).

Supply Chain Products and Services. Products and services that enterprises rely on the supply chain for include, but are not limited to, provision of systems and system components, custom software, operational support services, hosting systems and services, and performing system support roles.

Supply Chain Benefits and Risks. This ecosystem offers benefits including low cost, interoperability, rapid innovation, product feature variety and ability to choose between competing vendors, but the same mechanisms that provide those benefits also introduce a variety of cybersecurity risk in supply chains such as a supplier disruption that causes a reduction in service levels and leads to dissatisfaction from the enterprise's customer base.

Cybersecurity Supply Chain Risk Management (C-SCRM). C-SCRM, as is described in this document, is a systematic process which aims to help enterprises manage cybersecurity risk in the supply chain. Enterprises should identify, adopt, and tailor practices described in this document to best suit their unique strategic, operational, and risk context.

Scope of C-SCRM. C-SCRM encompasses a wide array of stakeholder groups that include, but are not limited to, information security and privacy, system developers and implementers, acquisition, and procurement, as well as legal and HR. C-SCRM covers activities that span the entire system development life cycle (SDLC), from initiation to sunset and disposal. In addition, C-SCRM risks should be aggregated and contextualized as part of enterprise risk management processes to ensure the enterprise understands its total risk exposure of its critical operations to different risk types (e.g., financial risk, strategic risk).

2. INTEGRATION OF C-SCRM INTO ENTERPRISE-WIDE RISK MANAGEMENT

C-SCRM should be integrated into enterprise-wide risk management processes described in [NIST SP 800-39] and depicted in Figure 2-1. This process includes the following continuous and iterative steps:

(i) Frame risk. Establish the context for risk-based decisions and the current state of the enterprise's information and communications technology and services, and the associated supply chain;

(ii) Assess risk. Review and interpret criticality, threat, vulnerability, likelihood[9], impact, and related information;

(iii) Respond to risk. Select, tailor, and implement mitigation controls based upon risk assessment findings; and

(iv) Monitor risk exposure and effectiveness in mitigating risk, on an ongoing basis, including tracking changes to an information system or supply chain, using effective enterprise communications and a feedback loop for continuous improvement.

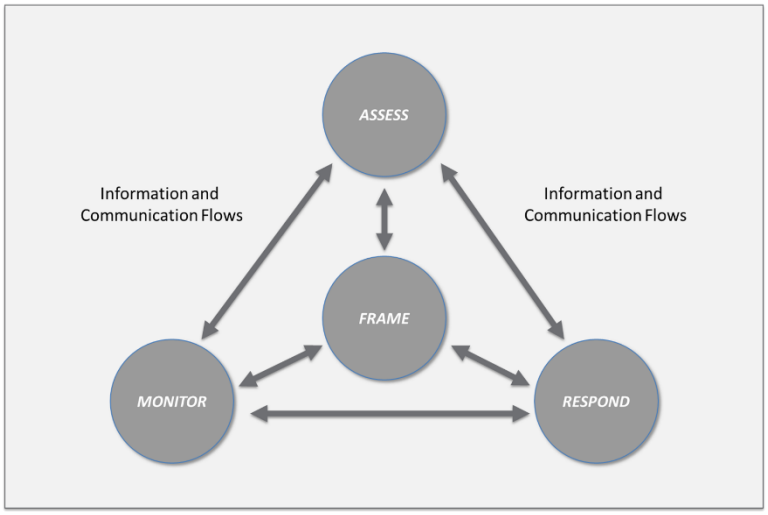


Fig. 2-1: Risk Management Process

Managing cybersecurity risk in the supply chain is a complex undertaking that requires cultural transformation and a coordinated, multidisciplinary approach across an enterprise. Effective cybersecurity supply chain risk management (C-SCRM) requires engagement from stakeholders inside the enterprise (e.g., departments, processes) as well as outside the enterprise (e.g., suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers) to actively collaborate, communicate, and take actions to secure favorable C-SCRM outcomes. Successful cybersecurity supply chain risk management requires enterprises to purposefully pursue a cultural shift to raise the state of awareness across the enterprise of the potential business ramifications of cybersecurity risk in the supply chain.

[9] In mathematics, likelihood and probability are fundamental different concepts but the difference between the two is considered outside the scope of this publication. For C-SCRM purposes likelihood is defined as the probability of a threat exploiting a vulnerability within a given timeframe.

Enterprises should aim to infuse perspectives from multiple disciplines and processes (e.g., information security, procurement, enterprise risk management, engineering, software development, IT, legal, HR, etc.) into their approaches to managing cybersecurity risk in the supply chain. Enterprises may define explicit roles to bridge and integrate these processes as a part of an enterprise's broader risk management activities. This orchestrated approach is an integral part of an enterprise's effort to identify C-SCRM priorities, develop solutions, and incorporate C-SCRM into overall risk management decisions. Enterprises should perform C-SCRM activities as a part of the acquisition, SDLC, and broader enterprise risk management processes. Embedded C-SCRM activities involve determining the criticality of functions and their dependency on the supplied products and services, identifying, and assessing applicable risks, determining appropriate mitigating actions, documenting selected risk response actions, and monitoring performance of C-SCRM activities. As exposure to supply chain risk differs across (and sometimes within) enterprises, business and mission-specific strategies and policies should set the tone and direction for C-SCRM across the enterprise.

Organizations should ensure that tailored C-SCRM plans are designed to:

- Manage, rather than eliminate risk as risk is integral to the pursuit of value;
- Ensure that operations are able to adapt to constantly emerging or evolving threats;
- Be responsive to changes within their own organization, programs, and the supporting information systems; and
- Adjust to the rapidly evolving practices of the private sector's global ICT supply chain.

Section 2.1 describes the three-level risk management approach in terms of C-SCRM. Generally, senior leaders provide the strategic direction, mid-level leaders plan and manage programs and projects, and individuals on the front lines procure, develop, implement, and operate the products and perform the services in their supply chain. As part of a multifaceted approach, enterprises may rely on a centralized, interdisciplinary team or program management office (PMO) to lead, perform, and coordinate Level 1 and Level 2 C-SCRM processes that inform C-SCRM processes at the Level 3 operational level. Section 2.1 describes Multi-level Risk Management as it applies to C-SCRM. The foundational concepts are described in greater detail in [NIST SP 800-39].

Note that Section 2 provides an overview of the governance, organizational structure, roles and responsibilities, and high-level activities performed across the three-cybersecurity supply chain risk management levels. Appendix D provides a detailed discussion of the specific activities within the cybersecurity supply chain risk management process.

2.1. The Business Case for C-SCRM

Today, every enterprise heavily relies on digital technology to fulfill its business and mission. Digital technology is comprised of ICT/OT products and is delivered through and supported by services. C-SCRM is a critical capability that every enterprise needs to have to address cyber risks posed by the use of digital technology to support its business and mission. The depth, extent, and maturity of a C-SCRM capability for each enterprise should be based on the

uniqueness of business or mission, enterprise-specific compliance requirements, operational environment, risk appetite, and risk tolerance.

Establishing and sustaining a C-SCRM capability creates a number of significant benefits:

- An established C-SCRM program will allow agencies to know which systems on their networks are most critical;
- Reduced likelihood of supply chain compromise by a cybersecurity threat. Well-designed C-SCRM processes and controls achieve this by enhancing an enterprise's ability to effectively detect, respond, and recover from events that result in significant business disruptions, should a C-SCRM compromise occur;
- Operational and enterprise efficiencies achieved through clear structure, purpose, and alignment of C-SCRM capabilities and prioritization, consolidation, and streamlining of existing C-SCRM processes;
- Greater assurance that products acquired are of high quality, authentic, reliable, resilient, maintainable, secure, and safe;
- Greater assurance that suppliers and service providers, as well as the technology products and services they provide, are trustworthy and can be relied upon to meet their performance requirements.

Enterprises should carefully consider the potential costs of applying C-SCRM processes and controls, weighing such costs against the risk to the enterprise were they not applied. Implementing C-SCRM processes and controls will require financial and human resources, as well as tools and infrastructure investments, not only from the enterprises themselves, but also from their suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers which may also result in increased costs to the acquirer. Such costs may be realized through required staff upskilling or hiring, vendor switching, impacts on contingency planning, supplier diversity, and procurement timeline delays.

The passage of the 2018 SECURE Technology Act, formation of the Federal Acquisition Security Council (FASC), and the observations from the 2015 and 2019 Case Studies in Cyber Supply Chain Risk Management captured in the National Institute of Standards and Technology Interagency Report (NISTIR) 8276, *Key Practices in Cyber Supply Chain Risk Management*, point to a broad public and private sector consensus: C-SCRM capabilities are a critical and foundational component of any enterprise's risk posture.

2.2. Cybersecurity Risk in Supply Chains

Cybersecurity risk in the supply chain is the potential for harm or compromise that arises from the cybersecurity risks posed by suppliers, their supply chains, and their products or services. Examples of cybersecurity risk in the supply chain includes, but is not limited to:

- An organized criminal enterprise introduces counterfeit products into the market resulting in a loss of customer trust and confidence;

- Insiders working on behalf of a system integrator steal sensitive intellectual property resulting in loss of a major competitive advantage;[10]
- A proxy working on behalf of a nation-state inserts malicious software into supplier-provided product components used in systems sold to government agencies. A breach occurs and results in loss of several government contracts; and
- A system integrator working on behalf of an agency reuses vulnerable code leading to a breach of mission critical data with national security implications.

Risks such as these are realized when threats in the cybersecurity supply chain exploit existing vulnerabilities. Figure 2-3 depicts cybersecurity risk in the supply chain resulting from the likelihood that relevant threats may exploit applicable vulnerabilities and the consequential potential impact.

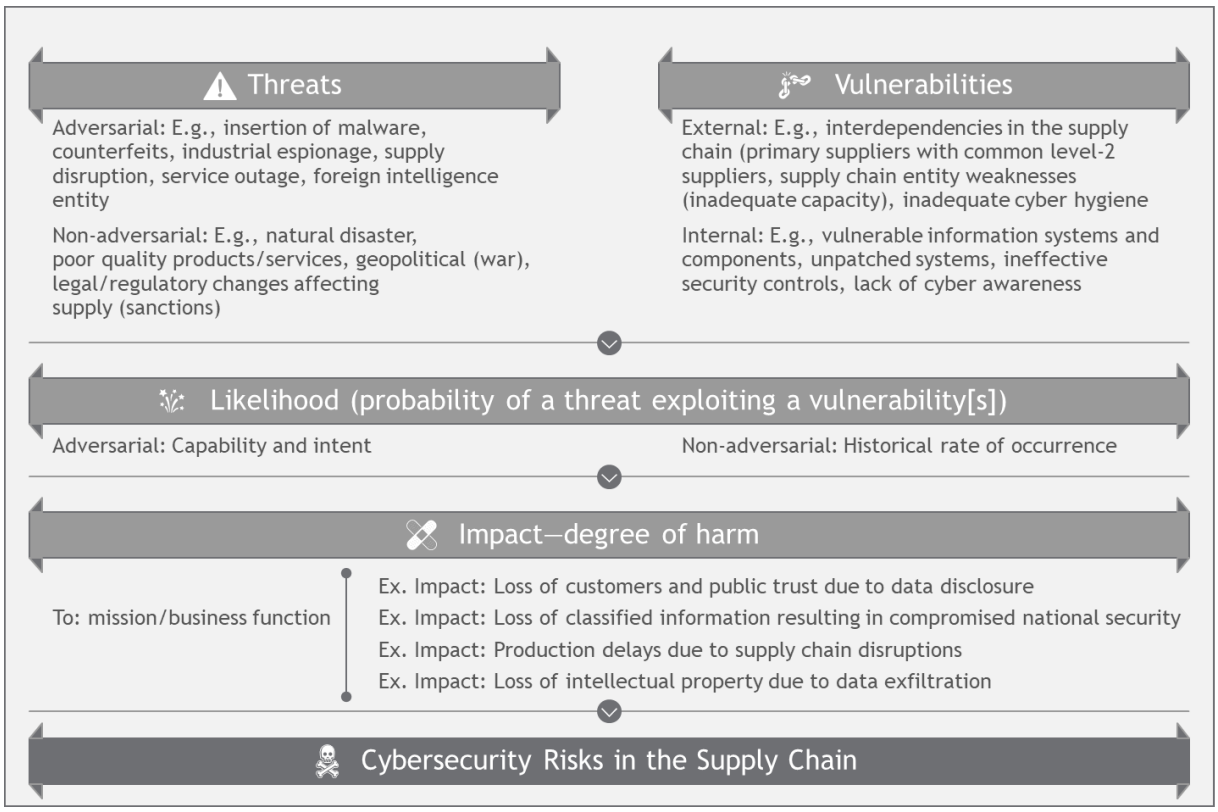


Fig. 2-2: Cybersecurity Risk in the Supply Chain

Supply chain cybersecurity vulnerabilities may lead to persistent negative impact on an enterprise's missions ranging from reduction in service levels leading to customer dissatisfaction to the theft of intellectual property or degradation of critical mission and business processes. It may, however, take years for such vulnerability to be exploited or discovered. It may also be difficult to determine whether an event was the direct result of a supply chain vulnerability.

[10] To qualify as a cybersecurity risk in the supply chain, insider threats specifically deal with instances of 3rd party insider threats and not 1st party insider threats

Vulnerabilities in the supply chain are often interconnected and may also expose enterprises to cascading cybersecurity risk in the supply chain. For example, a large-scale service outage at a major cloud services provider may cause service or production disruptions for multiple entities within an enterprise's supply chain and lead to negative effects within multiple mission and business processes.

Ownership and accountability for cybersecurity risks in the supply chain ultimately lies with the head of the organization:

- Decision-makers are informed by an organization's risk profile, risk appetite, and risk tolerance levels; processes should address when and how escalation of risk decisions needs to occur.
- Ownership should be delegated to authorizing officials within the agency based on their executive authority over organizational missions, business operations or information systems.
- Authorizing officials may further delegate responsibilities to designated officials who are responsible for the day-to-day management of risk.

2.3. Multi-level Risk Management

To integrate risk management throughout an enterprise, [NIST SP 800-39] describes three levels, depicted in Figure 2-4, that address risk from different perspectives: (i) enterprise-level; (ii) mission/business process level; and (iii) operational level. C-SCRM requires the involvement of all three levels.

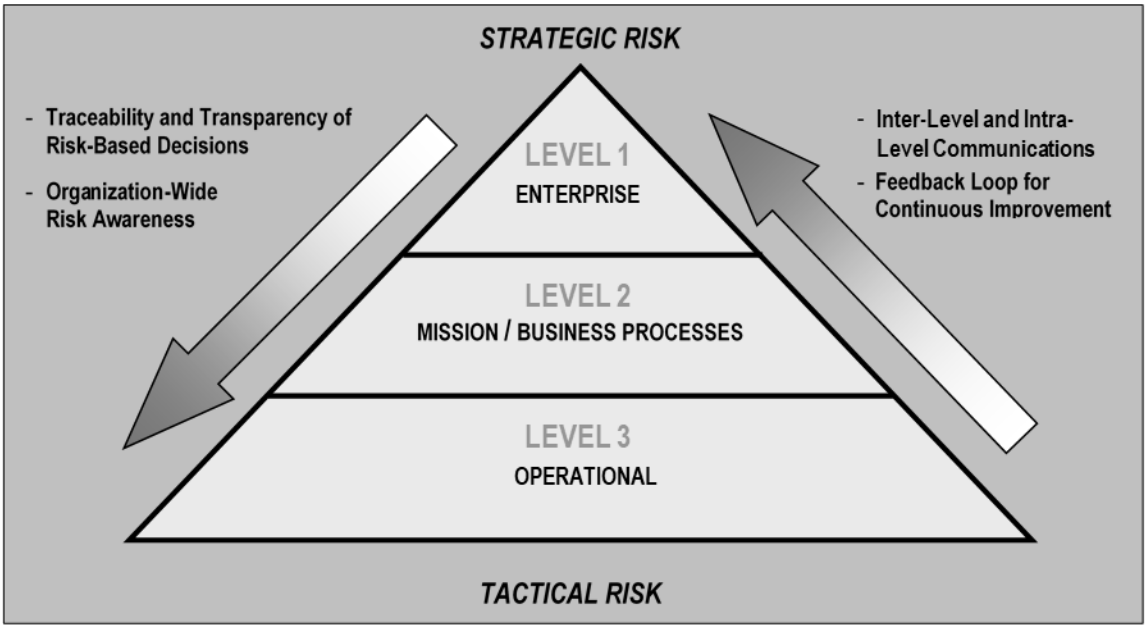


Fig. 2-3: Multileveled Enterprise-Wide Risk Management[11]

[11] Further information about the concepts depicted in Figure 2-2 can be found in [NIST SP 800-39].

In multitiered risk management, the C-SCRM process is carried out seamlessly across the three tiers with the overall objective of continuous improvement in the enterprise's risk-related activities and effective inter- and intra-tier communication among stakeholders with a vested interest in C-SCRM.

C-SCRM activities can be performed by a variety of individuals or groups within an enterprise ranging from a single individual to committees, divisions, centralized program offices, or any other enterprise structure. C-SCRM activities will be distinct for different enterprises depending on their structure, culture, mission, and many other factors. C-SCRM activities at each of three tiers/levels include the production of different high-level C-SCRM deliverables:

- At Level 1, the overall C-SCRM strategy, policy, and implementation plan set the tone, governance structure, and boundaries for how C-SCRM is managed across the enterprise and guide C-SCRM activities performed at the mission and business process levels.
- At Level 2, the Mid-Level C-SCRM strategies, policies, and implementation plans assume the context and direction set forth at the enterprise level and tailor it to the specific mission and business process.
- At Level 3, the C-SCRM plans provide the basis for determining whether an information system meets business, functional, and technical requirements and includes appropriately tailored controls. These plans are heavily influenced by the context and direction provided by Level 2.

Figure 2-5 provides an overview of the multitiered risk management structure as well as the associated strategies, policies and plans developed at each level. Refer to sections 2.3.1 through 2.3.5 for a more in-depth discussion of the specific activities at each level.

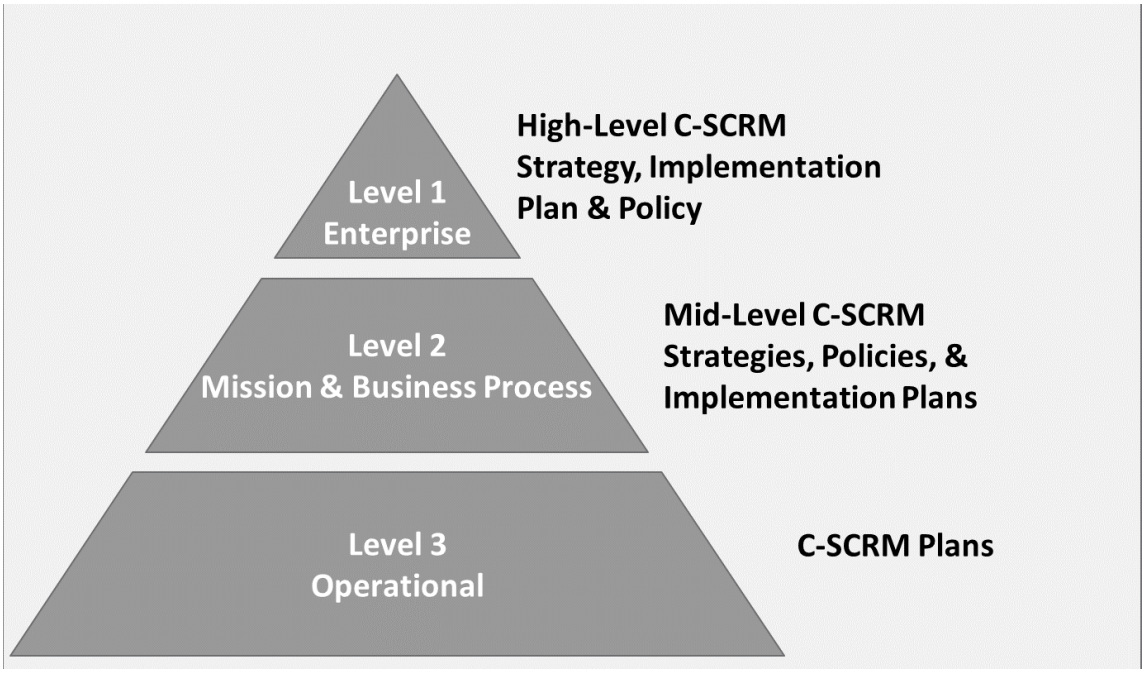


Fig. 2-4: C-SCRM Documents in Multi-level Enterprise-wide Risk Management

2.3.1. Roles and Responsibilities Across the Three Levels

Implementing C-SCRM requires enterprises to establish a coordinated team-based approach and a shared-responsibility model to effectively manage cybersecurity risk in the supply chain. Enterprises should establish and adhere to C-SCRM-related policies, develop, and follow processes (often cross-enterprise in nature), as well as employ programmatic and technical mitigation techniques. The coordinated team approach, either ad hoc or formal, enables enterprises to effectively conduct a comprehensive, multi-perspective analysis of their supply chain and to respond to risks, communicate with external partners/stakeholders, and gain broad consensus regarding appropriate resources for C-SCRM. The C-SCRM team should work together to make decisions and take actions deriving from the input and involvement of multiple perspectives and expertise. The team leverages, but does not replace, those C-SCRM responsibilities and processes that should be specifically assigned to an individual enterprise or disciplinary area. Effective implementations of C-SCRM often include the adoption of a shared-responsibility model which distributes responsibilities and accountabilities for C-SCRM related activities and risk across this diverse group of stakeholders. Examples of C-SCRM activities in which enterprises benefit from a multidisciplinary approach include but are not limited to developing a strategic sourcing strategy; incorporating C-SCRM requirements into a solicitation; and determining options about how best to mitigate an identified supply chain risk, especially one assessed to be significant.

Members of the C-SCRM team should be a diverse group of people involved in the various aspects of the enterprise's critical processes including but not limited to information security, procurement, enterprise risk management, engineering, software development, IT, legal, and HR. Collectively, to aid in C-SCRM, these individuals should have an awareness of, and provide expertise in, enterprise processes and practices specific to their discipline area, vulnerabilities, threats, and attack vectors, as well as an understanding of the technical aspects and inter-dependencies of systems or information flowing through systems. The C-SCRM team may be an extension of an enterprise's existing enterprise risk management function, grown as part of an enterprise's cybersecurity risk management function, or operate out of a different department.

The key to forming multidisciplinary C-SCRM teams is breaking down barriers between otherwise disparate functions within the enterprise. Many enterprises begin this process from the top by establishing a working group or council of senior leaders with representation from the necessary and appropriate functional areas. A charter should be established outlining the goals, objectives, authorities, meeting cadences, and responsibilities of the working group. Once this council is formed, decisions can be made on how to operationalize the interdisciplinary approach at mission and business process as well as operational levels. Often this takes the form of working groups consisting of mission and business process representatives who can meet at more regular cadences and address more operational and tactically focused C-SCRM challenges.

Table 2-1 shows a summary of C-SCRM stakeholders for each level with the specific C-SCRM activities performed within the corresponding level. These activities are either direct C-SCRM activities or have an impact on C-SCRM.

1211 **Table 2-1: Cybersecurity Supply Chain Risk Management Stakeholders[12]**

Levels	Level Name	Generic Stakeholder	Activities
1	Enterprise	Executive Leadership: CEO, CIO, COO, CFO, CISO, Chief Technology Officer (CTO), CRO etc.	• Define Enterprise C-SCRM strategy • Form governance structures and operating model • Frame risk for the enterprise and set the tone for our risk is managed (e.g., set risk appetite) • Define high-level implementation plan, policy, goals, and objectives • Make enterprise-level C-SCRM Decisions • Form a C-SCRM PMO
2	Mission/Business Process	Business Management: Program Management [PM], Research and Development [R&D], Engineering [SDLC oversight], Acquisition and Supplier Relationship Management/Cost Accounting, and other management related to reliability, safety, security, quality, C-SCRM PMO, etc.	• Develop mission and business process- specific strategy • Develop policies and procedures, guidance, and constraints • Develop C-SCRM implementation plan(s) • Tailor enterprise risk frame to the mission/ business process (e.g., set risk tolerances) • Manage risk within mission and busines processes • Form and/or collaborate with a C-SCRM PMO • Report on C-SCRM to Level 1 and act on reporting from Level 3

1212

[12] Small and Midsized Businesses may not see such a high-degree of differentiation in their C-SCRM stakeholders.

3	Operational	Systems Management: Architects, Developers, System Owners, QA/QC, Test, Contracting Personnel, C-SCRM PMO staff, control engineer and/or control system operator, etc.	• Develop C-SCRM plans • Implement C-SCRM policies and requirements • Adhere to constraints provided by Levels 1 and 2 • Tailor C-SCRM to the context of the individual system and apply it throughout the SDLC • Report on C-SCRM to Level 2

The C-SCRM process should be carried out across the three risk management levels with the overall objective of continuous improvement in the enterprise's risk-related activities and effective inter- and intra-level communication, thus integrating both strategic and tactical activities among all stakeholders with a shared interest in the mission/business success of the enterprise. Whether addressing a component, a system, a process, a mission process, or a policy, it is important to engage the relevant C-SCRM stakeholders at each level to ensure that risk management activities are as informed as possible. Figure 2-6 illustrates the relationship between key C-SCRM documents across the 3 levels.

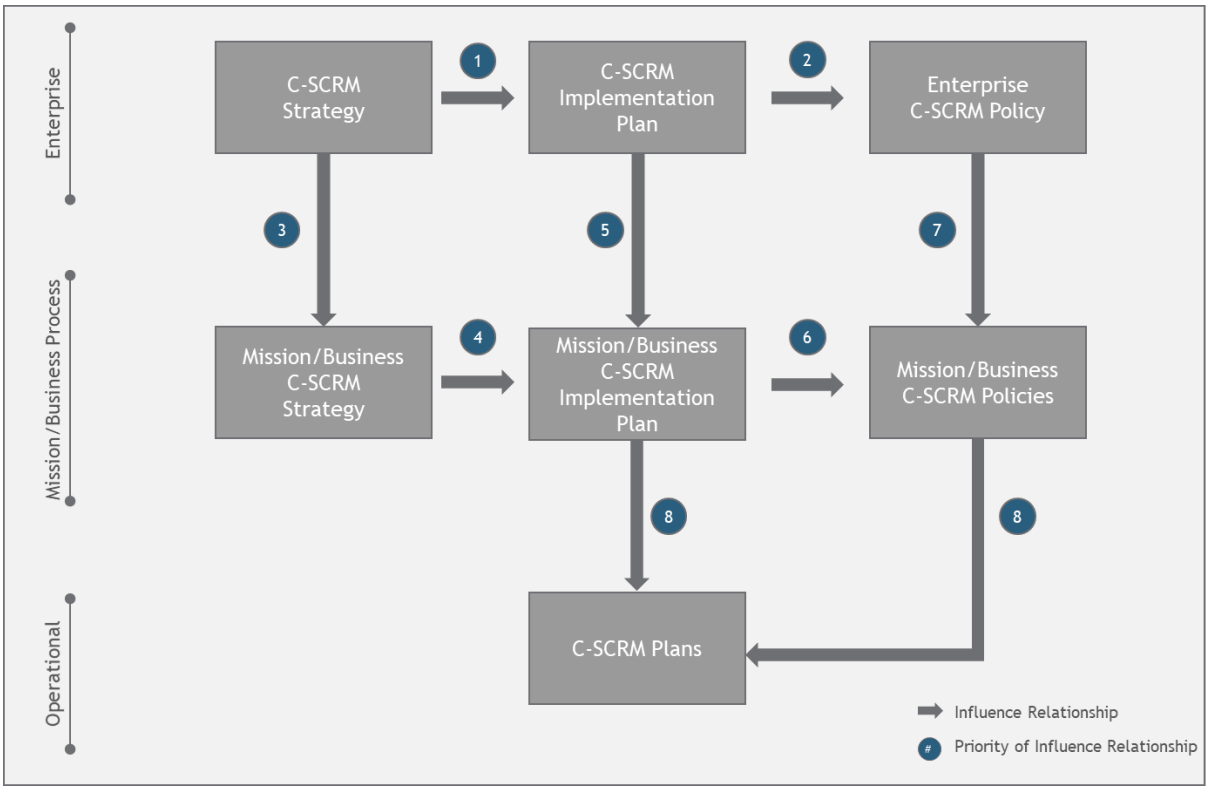


Fig. 2-5: Relationship Between C-SCRM Documents

The next few sections provide example roles and activities in each level. Because every enterprise is different, however, activities may be performed at different levels than listed and as individual enterprise context requires.

> Section 4.5 provides a number of mission/business C-SCRM controls that organizations can utilize in a tailored capacity to help guide Level 1, Level 2, and Level 3 C-SCRM activities. Note that the tailoring should be scoped to the organization's risk management needs and organizations should analyze the cost of not implementing C-SCRM policies, capabilities, and controls when evaluating alternative risk response courses of action. These costs may include but are not limited to poor quality or counterfeit products; supplier misuse of intellectual property; supplier tampering with or compromise of mission-critical information; and exposure to cyber attacks through vulnerable supplier information systems.

2.3.2. Level 1—Enterprise

Level 1 (Enterprise) sets the tone and direction for enterprise-wide C-SCRM activities by providing an overarching C-SCRM strategy, C-SCRM policy, and High-Level Implementation Plan that shapes how C-SCRM is implemented across the enterprise. Within Level-1, governance structures are formed to enable senior leaders and executives to collaborate on C-SCRM with the risk executive (function) in which leaders make C-SCRM decisions, delegate decisions to Levels 2 and 3, and prioritize enterprise-wide resource allocation for C-SCRM. Level 1 activities help to ensure that C-SCRM mitigation strategies are consistent with the strategic goals and objectives of the enterprise. Level 1 activities culminate in the C-SCRM Strategy, Policy, and High-Level Implementation Plan that shape and constrain how C-SCRM is carried out at Levels 2 and 3.

At Level 1, the risk executive functional role is responsible and accountable for serving as a common C-SCRM resource for executive leadership and authorizing officials across the enterprise. Effective C-SCRM requires the risk executive to collaborate and gather perspectives from leaders such as the chief executive officer (CEO), chief risk officer (CRO), chief information officer (CIO), chief legal officer (CLO)/general counsel, chief information security officer (CISO), and chief acquisition officer (CAO). Enterprises may form a multidisciplinary C-SCRM council which includes as members the aforementioned leaders or designated representatives from the functions they oversee (e.g., CRO /enterprise risk management). The C-SCRM council serves as a forum to collaborate on setting priorities and managing cybersecurity risk in the supply chain for the enterprise. The C-SCRM council or other C-SCRM-oriented body are responsible for setting the direction for and approving the enterprise's C-SCRM enterprise-wide strategy. The C-SCRM strategy makes explicit the enterprise's assumptions, constraints, risk tolerances, and priorities/trade-offs. These leaders are also responsible and accountable for developing and promulgating a holistic set of policies that span the enterprise's missions and business processes, guiding the establishment and maturation of a C-SCRM capability and the implementation of a cohesive set of C-SCRM activities. Leaders should establish a C-SCRM PMO or other dedicated C-SCRM-related function to drive C-SCRM activities and serve as a fulcrum for coordinated, C-SCRM-oriented services and guidance to the enterprise. Leaders should also clearly articulate lead roles at the mission and business process level responsible and

accountable for detailing action plans and being accountable for the execution of C-SCRM activities.

The C-SCRM governance structures and operational model dictate authority, responsibility, and decision-making power for C-SCRM and define *how* C-SCRM processes are accomplished within the enterprise. The best C-SCRM governance and operating model is one that meets business and functional requirements of the enterprise. For example, an enterprise facing strict budgetary constraints or stiff C-SCRM requirements may consider governance and operational models which centralize decision-making authority and rely on a C-SCRM PMO to consolidate responsibilities for resource-intensive tasks such as vendor risk assessments. In contrast, enterprises which have mission/business processes governed with a high degree of autonomy or possess highly differentiated C-SCRM requirements may opt for decentralized authority, responsibilities, and decision-making power.

In addition to defining C-SCRM governance structures and operating models, Level 1 carries out the activities necessary to frame C-SCRM for the enterprise. C-SCRM framing is the process by which the enterprise makes explicit the assumptions about cybersecurity risk in the supply chain (e.g., threats, vulnerabilities, risk impact, risk likelihood), constraints (e.g., enterprise policies, regulations, resource limitation, etc.), appetite and tolerance, and priorities and tradeoffs that guide C-SCRM decisions across the enterprise. The risk framing process provides the inputs necessary to establish the C-SCRM strategy that dictates how the enterprise plans to assess, respond to, and monitor cybersecurity risk in the supply chain across the enterprise. A high-level implementation plan should also be developed to guide execution against the enterprise's C-SCRM strategy. The risk framing process is discussed in further detail within Appendix C of this document.

Informed by the risk framing process and the C-SCRM strategy, Level 1 provides the enterprise's C-SCRM policy. The C-SCRM policy establishes the C-SCRM program's purpose, outlines the enterprise's C-SCRM responsibilities, defines and grants authority to C-SCRM roles across the enterprise, and outlines applicable C-SCRM compliance and enforcement expectations and processes. Appendix C of this document provides example templates for the C-SCRM Strategy and C-SCRM Policy.

Risk assessment activities performed at Level 1 focus on assessing, responding to, and monitoring cybersecurity risk in the supply chain to the enterprise's portfolio of operations, assets, and personnel. Level 1 risk assessments may be based on the enterprise's Level 1 Frame step (i.e., assumptions, constraints, appetite, tolerances, priorities, and tradeoffs), or may be aggregated enterprise-level assumptions based on risk assessments completed across multiple mission and business processes. For example, a Level 1 risk assessment may analyze the exposure of the enterprise's primary mission or business objective to a threat scenario affecting a specific product or service provided through the supply chain. The enterprise-level risk determination may be based on an analysis of similar other analyses conducted within several mission and business processes as well as the relative criticality of those processes to the enterprise's primary objective.

Reporting plays an important role in equipping Level 1 decision-makers with the context necessary to make informed decisions on how to manage cybersecurity risk in the supply chain. Reporting should focus on enterprise-wide trends and include coverage of the extent to which C-SCRM has been implemented across the enterprise, the effectiveness of C-SCRM, and the conditions related to cybersecurity risk in the supply chain. C-SCRM reports should highlight any conditions that require urgent leadership attention and/or action and may benefit from highlighted C-SCRM risk and performance trends over a period of time. Those responsible and accountable for C-SCRM within the enterprise should work with leaders to identify reporting requirements which include, but are not limited to frequency, scope, and format. Reporting should include metrics discussed further in Section 3.5.1.

Level 1 activities ultimately provide the overarching context and boundaries within which the enterprise's mission and business processes manage cybersecurity risk in the supply chain. Outputs from Level 1 (e.g., C-SCRM Strategy, C-SCRM Policy, Governance, and Operating Model) are further tailored and refined within Level 2 to fit the context of each mission and business process. Level 1 outputs should also be iteratively informed by—and updated as a result of—C-SCRM outputs at lower levels.

Note in complex enterprises that Tier 1 activities may be completed at an enterprise level as well as at an individual organization level. Enterprise Level 1 activities should shape and guide Organization Level 1 activities.

Additional information can be found in: SR-1, SR-3, PM-2, PM-6, PM-7, PM-9, PM-28, PM-29, PM-30, and PM-31

2.3.3. Level 2—Mission/Business Process

Level 2 addresses how the enterprise assesses, responds to, and monitors cybersecurity risk in the supply chain within mission and business processes. Level 2 activities are performed in accordance with the C-SCRM strategy, and policies provided by Level 1.[13] In this level, process-specific C-SCRM strategies, policies, and implementation plans dictate how the enterprise's C-SCRM goals and requirements are met within each mission and business process. Here, specific C-SCRM program requirements are defined and managed and include cost, schedule, performance, security, and a variety of critical non-functional requirements. These nonfunctional requirements include concepts such as reliability, dependability, safety, security, and quality.

Level 2 roles include but are not limited to representatives of each mission/business process such as program managers, research and development, and acquisitions/procurement. Level 2 C-SCRM activities address C-SCRM within the context of the enterprise's mission and business process. Mission and business process-specific strategies, policies, and procedures should be developed to tailor the C-SCRM implementation to fit the specific requirements of each mission and business process. Aligning to and further developing the high-level Enterprise Strategy and Implementation Plan, the enterprise should generate its own mission/business-level strategy and implementation plan and ensure C-SCRM execution within the constraints of its defined C-SCRM strategies, as well as awareness of and conformance to its C-SCRM policies. To facilitate the development and execution of Level 2 Strategy and Implementation plan(s), enterprises may benefit from forming a committee with representation from each mission/business process. This coordination and collaboration can help to identify cybersecurity risk in the supply chain within and across respective mission/business areas and develop an enterprise and C-SCRM architecture that lends itself to risk-aware mission and business processes. A C-SCRM PMO may also assist in the implementation of C-SCRM at Level 2 through the provision of services (e.g., policy templates, C-SCRM subject matter expert (SME) support).

Many threats *to* and *through* the supply chain are addressed at Level 2 in the management of third-party relationships with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Because C-SCRM can both directly and indirectly impact mission and processes, understanding, integrating, and coordinating C-SCRM activities at this level are critical for ensuring successful mission and business process operations. Level 2 activities focus on tailoring and applying the enterprise's C-SCRM frame to fit the specific mission and business process threats, vulnerabilities, impacts, and likelihoods. Informed by outputs from Level 1 (e.g., C-SCRM strategy), mission and business processes will adopt a C-SCRM strategy which tailors the enterprise's overall strategy to a specific mission and business process. At Level 2, the enterprise may also issue mission- and business process-specific policies which contextualize the enterprise's policy for the process.

In accordance with the C-SCRM strategy, enterprise leaders for specific mission and business processes should develop and execute a C-SCRM implementation plan. The C-SCRM implementation plan provides a more detailed roadmap for operationalizing the C-SCRM strategy(ies) within the mission and business process. Within the C-SCRM implementation

[13] For more information, see [NIST SP 800-39 Section 2.2].

plans, the mission and business process will specify C-SCRM roles and responsibilities, implementation milestones and dates, as well as processes for monitoring and reporting. Appendix D of this document provides example templates for the C-SCRM Strategy and Implementation Plan, as well as the C-SCRM Policy.

C-SCRM activities performed at Level 2 focus on assessing, responding to, and monitoring risk exposure arising from the mission and business process dependencies on suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Risk exposures to the supply chain may occur as a result of primary dependencies on the supply chain or from secondary dependencies of the process on individual information systems or other mission and business processes. For example, risk exposure may arise due to a supplier providing critical system components or services to multiple information systems on which critical processes depend. Risk may also arise from vendor-sourced products and services unrelated to information systems as well as the role these products and services play in the overall mission and business process objectives. Enterprises should consider non-traditional cybersecurity risk in the supply chain that may circumvent or escape C-SCRM processes such as open source software. Enterprises should establish policies and controls to manage risk associated with non-traditional cybersecurity risk in the supply chain.

Reporting at Level 2 plays an important role in equipping mission and business process leaders with the context necessary to manage C-SCRM within the scope of their mission and business process. Topics covered at Level 2 will reflect those covered for Level 1 but should be reshaped to focus on the specific mission and business process they correspond to. Level 2 reporting should include metrics that demonstrate the mission and business process performance in contrast to the risk appetite and risk tolerance thresholds defined at Levels 1 and 2. Similar to Level 1, reporting requirements should be defined to fit the needs of the mission and business process leaders as well as leaders at Level 1.

Outputs from Level 2 activities will have a significant impact in shaping how C-SCRM activities are carried out within Level 3. For example, risk tolerance and common control baseline decisions may be defined at Level 2, then tailored and applied within the context of individual information systems within Level 3. Level 2 outputs should also be used to iteratively influence and further refine Level 1 outputs.

Additional information can be found in: SR-1, SR-3, SR-6, PM-2, PM-6, PM-7, PM-30, PM-31, and PM-32.

2.3.4. Level 3—Operational

Level 3 is comprised of personnel responsible and accountable for operational activities, including conducting procurements and executing system-related C-SCRM activities as part of the enterprise's SDLC, which includes research and development, design, manufacturing, delivery, integration, operations and maintenance, and disposal/retirement of systems. These personnel include but are not limited to system owners, contracting officers, contracting officer representatives, architects, system engineers, information security specialists, system integrators, and developers. These personnel are responsible for developing C-SCRM plans which address

the management, implementation assurance, and monitoring of C-SCRM controls (to include those applicable to external parties, such as contractors) and the acquisition, development, and sustainment of systems across the SDLC to support mission and business processes. In enterprises where a C-SCRM PMO has been established, activities such as product risk assessments may be provided as a centralized, shared service.

Within Level 3, outputs provided by C-SCRM activities completed at Levels 1 and 2 prepare the enterprise to execute C-SCRM at the operational level in accordance with the RMF [NIST 800-37r2]. C-SCRM is applied to information systems through the development and implementation of C-SCRM plans. These plans are heavily influenced by assumptions, constraints, risk appetite and tolerance, and priorities and tradeoffs defined by Levels 1 and 2. C-SCRM plans dictate how C-SCRM activities are integrated into all systems in the SDLC: acquisition (both custom and off-the-shelf), requirements, architectural design, development, delivery, installation, integration, maintenance, and disposal/retirement. In general, C-SCRM plans are implementation-specific, and provide policy implementation, requirements, constraints, and implications for systems that support mission and business processes.

Level 3 activities focus on managing operational-level risk exposure resulting from any ICT/OT-related products and services provided through the supply chain that are in use by the enterprise or fall within the scope of the systems authorization boundary. Level 3 C-SCRM activities begin with an analysis of the likelihood and impact of potential supply chain cybersecurity threats exploiting an operational-level vulnerability (e.g., in a system or system component). Where applicable, these risk assessments should be informed by risk assessments completed in Levels 1 and 2. In response to determining risk, enterprises should evaluate alternative courses of action for reducing risk exposure (e.g., accept, avoid, mitigate, share, and/or transfer). Risk response is achieved by selecting, tailoring, implementing, and monitoring C-SCRM controls throughout the SLDC in accordance with the RMF [NIST 800-37r2]. Selected C-SCRM controls often consist of a combination of inherited common controls from Levels 1 and 2 as well as information system-specific controls.

Reporting at Level 3 should focus on the C-SCRM's implementation, efficiency, effectiveness, as well as the overall level of exposure to cybersecurity risks in the supply chain for the particular system. System-level reporting should provide system owners with tactical-level insights enabling them to make rapid adjustments and respond to risk conditions. Level 3 reporting should include metrics which demonstrate performance against the risk appetite and risk tolerance thresholds defined at Levels 1, 2 and 3.

A critical Level 3 activity is the development of the C-SCRM plan. Along with applicable security control information, the C-SCRM plan includes information on the system, its categorization, operational status, related agreements, architecture, critical system personnel, related laws, regulations and policies, and contingency plan. This plan is a living document that should be maintained and used as the reference for continuous monitoring of implemented C-SCRM controls. C-SCRM plans are intended to be referenced regularly and should be reviewed and refreshed periodically. These are not intended to be documents developed to satisfy a compliance requirement. Rather, enterprises should be able to demonstrate how they have

historically and continue to effectively employ their plans to shape, align, inform, and take C-SCRM actions and decisions across all three levels.

Information gathered as part of Level 3 C-SCRM activities should iteratively inform C-SCRM activities completed within Levels 1 and 2 to further refine C-SCRM strategies and implementation plans.

Additional information can be found in: SR-1, SR-2, SR-6, PL-2, PM-31, and PM-32.

2.3.5. C-SCRM PMO

A variety of operating models (e.g., centralized, decentralized, hybrid) are available to enterprises that facilitate C-SCRM activities across the enterprise and its missions/business processes. One such model involves concentrating and assigning responsibilities for certain C-SCRM activities to a central PMO. In this model, the C-SCRM PMO acts as a service provider to other missions/business processes. Missions/business processes are then responsible for selecting and requesting services from the C-SCRM PMO as part of their responsibilities to meet the enterprise's C-SCRM goals and objectives. There are a variety of beneficial services that a PMO may provide:

- Advisory services and subject matter expertise
- Chair for internal C-SCRM working groups, council, or other coordination bodies
- Centralized hub for tools, job aids, awareness, and training templates
- Supplier/product risk assessments
- Liaison to external stakeholders
- Information sharing management (e.g., intra department/agency as well as to/from FASC)
- Management of C-SCRM risk register
- Secretariat/staffing function for enterprise C-SCRM governance
- C-SCRM project and performance management
- C-SCRM briefings, presentations, and reporting

A C-SCRM PMO typically consists of C-SCRM SMEs who help drive the C-SCRM strategy and implementation across the enterprise and its mission and business processes. A C-SCRM PMO may include or report to a dedicated executive-level official responsible and accountable for overseeing C-SCRM activities across the enterprise. A C-SCRM PMO should consist of dedicated personnel or include matrixed representatives with responsibilities for C-SCRM from several of the enterprise's processes including but not limited to information security, procurement, risk management, engineering, software development, IT, legal, and HR. Regardless of whether a C-SCRM PMO sits at Level 1 or Level 2, it is critical that the C-SCRM PMO include cross-disciplinary representation.

The C-SCRM PMO responsibilities may include providing services to the enterprise's leaders that help set the tone for how C-SCRM is applied throughout the enterprise. The C-SCRM PMO may provide SME support to guide Level 1 stakeholders through the risk framing process which

includes establishing the enterprise appetite and tolerance for cybersecurity risk in the supply chain. In addition, accountable risk executives may delegate responsibility of drafting the enterprise's C-SCRM strategy and policy to the PMO. C-SCRM PMOs may also coordinate C-SCRM information sharing internally or with external entities. Finally, the PMO may conduct C-SCRM-focused executive-level briefings (e.g., to the risk executive function, board of directors) to help Level 1 stakeholders develop an aggregated picture of the state of cybersecurity risk in the supply chain across the enterprise.

At Level 2, C-SCRM PMO may develop C-SCRM starter kits that contain a base strategy, set of policies, procedures and guidelines which can be further customized within specific mission and business processes. This PMO may also provide SME consulting support to stakeholders within mission and business processes as they create process-specific C-SCRM strategies and develop C-SCRM implementation plans. As part of this responsibility, the C-SCRM PMO may advise on or develop C-SCRM common control baselines within the enterprise mission and business processes. The C-SCRM PMO may also perform C-SCRM risk assessments focused on suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers of both technology and non-technology related products and services.

The responsibility of a C-SCRM PMO at Levels 1 and 2 would ultimately influence C-SCRM activities at the Level 3 operational level. A C-SCRM PMO may advise teams throughout the SDLC on C-SCRM control selection, tailoring, and monitoring. Ultimately a C-SCRM PMO may be responsible for activities that produce C-SCRM outputs across the risk management levels. Centralizing C-SCRM services offers enterprises an opportunity to capitalize on specialized skill sets within a consolidated team offering high-quality C-SCRM services to the rest of the enterprise. By centralizing risk assessment services, enterprises may achieve a level of standardization not otherwise possible (e.g., in a decentralized model). Enterprises may also realize cost efficiencies in cases where PMO resources are dedicated to C-SCRM activities versus resources in decentralized models which may perform multiple roles in addition to C-SCRM responsibilities.

A C-SCRM PMO model will typically favor larger, more complex enterprises requiring standardization of C-SCRM practices across a disparate set of mission and business processes. Ultimately, enterprises should select a C-SCRM operating model that is applicable and appropriate relative to their available resources and context.

Key Takeaways

Business Case for C-SCRM. C-SCRM provides enterprises with a number of benefits which include but are not limited to an understanding of critical systems, reduced likelihood of supply chain compromise, operational and enterprise efficiencies, fewer product quality and security issues, and more reliable and trustworthy supplied services.

Cybersecurity Risk in Supply Chains. The potential for harm or compromise arising from a relationship with suppliers, their supply chains, and their supplied products or services. These adverse impacts materialize when a human or non-human threat successfully exploits a vulnerability tied to a system, product, service, or the supply chain ecosystem.

Multilevel, Multidisciplinary C-SCRM. As described in [NIST SP 800-39], multitiered risk management is the purposeful execution and continuous improvement of cybersecurity supply chain risk management activities at the enterprise (e.g., CEO, COO), mission and business process (e.g., business management, R&D), and operational (e.g., systems management) levels. Each level contains stakeholders from multiple disciplines (e.g., information security, procurement, enterprise risk management, engineering, software development, IT, legal, HR, etc.) which collectively execute and continuously improve C-SCRM

IC-SCRM PMO. A dedicated office known as a C-SCRM PMO may support the enterprise's C-SCRM activities by providing support products (e.g., policy templates) and services (e.g., vendor risk assessments) to the rest of the enterprise. A C-SCRM PMO may provide support across the three levels and sit at Level 1 or 2 depending on the enterprise.

3. CRITICAL SUCCESS FACTORS

To successfully address evolving cybersecurity risk in the supply chain, enterprises need to engage multiple internal processes and capabilities, communicate and collaborate across enterprise levels and mission areas, and ensure that all individuals within the enterprise understand their role in managing cybersecurity risk in the supply chain. Enterprises need strategies for communicating, determining how best to implement, and monitoring the effectiveness of their supply chain cybersecurity controls and practices. In addition to communicating cybersecurity supply chain risk management controls internally, enterprises should engage with peers to exchange cybersecurity supply chain risk management insights. These insights will aid enterprises in continuously evaluating how well they are doing and identify where they need to improve and how to take steps to mature their C-SCRM program. This section addresses the requisite enterprise processes and capabilities in making C-SCRM successful. While this publication has chosen to highlight these critical success factors, this represents a non-exhaustive set of factors that contribute to an enterprise's successful execution of C-SCRM. Critical success factors are fluid and will evolve over time as the environment and the enterprise's own capability advances.

3.1. C-SCRM in Acquisition

Integrating C-SCRM considerations into acquisition activities is essential to improving management of cybersecurity risk in the supply chain at every step of the procurement and contract management process. This life cycle begins with a purchaser identifying a need and includes the processes to plan for and articulate requirements, conduct research to identify and assess viable sources of supply, solicit bids, and evaluate offers to ensure conformance to C-SCRM requirements and assess C-SCRM risk associated with the bidder and the proposed product and/or service offering. After contract award, ensure the supplier satisfies the terms and conditions articulated in their contractual agreement and the products and services conform as expected and required. C-SCRM considerations need to be addressed at every step in this life cycle.

Enterprises rely heavily on commercial products and outsourced services to perform operations and fulfill their missions and business objectives. However, it is important to highlight that products and services can also be obtained outside of the procurement process, as is the case with open source software, relying on an in-house provider for shared services, or by repurposing an existing product to satisfy a new need. C-SCRM must also be addressed for these other "acquiring" processes.

In addition to addressing cybersecurity risk in the supply chain and performing C-SCRM activities during each phase of the acquisition process, enterprises should develop and execute an acquisition strategy driving reductions in their overall exposure to cybersecurity risk in supply chains. By applying such strategies, enterprises can reduce cybersecurity risk in the supply chain within specific procurement processes as well as for the overall enterprise. By adopting acquisition policies and processes integrating C-SCRM into acquisition activities, enterprises will aid, direct, and inform efforts to realize targeted risk reducing outcomes.

Additionally, adopting C-SCRM controls aligned to an industry-recognized set of standards and guidelines (e.g., NIST 800-53 Rev.5, NIST CSF), the enterprise can ensure holistic coverage of cybersecurity risk in the supply chain and corresponding C-SCRM practices. C-SCRM controls may apply to different participants of the supply chain to include the enterprise itself, prime contractors, and sub-contractors. Because enterprises heavily rely on prime contractors and their subcontractors to develop and implement ICT/OT products and services, those controls implemented within the SDLC are likely to flow down to subcontractors. Establishing C-SCRM controls applicable throughout the supply chain and the SDLC will aid the enterprise in establishing a common lexicon and set of expectations with suppliers and sub-suppliers to aid all participants in managing cybersecurity risk in the supply chain.

3.1.1. Acquisition in the C-SCRM Strategy and Implementation Plan

An enterprise's C-SCRM Strategy and Implementation Plan serve as a roadmap to guide the enterprise toward the achievement of long-term, sustainable reductions in exposure to cybersecurity risk in the supply chain. As a core part of the C-SCRM Strategy and Implementation Plan, enterprises should address how cybersecurity risk is managed throughout the acquisition process.

Cybersecurity risk in the supply chain include those arising from the supplier's enterprise, products, or services, as well as the supplier's own suppliers and supply chains. The C-SCRM PMO may be helpful in developing specific strategies and implementation plans for integrating C-SCRM considerations into acquisitions. Acquisition activities relevant to C-SCRM include but are not limited to:

- Promoting awareness and communicating C-SCRM expectations as part of supplier relationship management efforts;
- Establishing a checklist of acquisition security requirements that must be completed as part of procurement requests to ensure necessary provision and protections are in place;
- Leveraging an external shared service provider or utilize the C-SCRM PMO to provide supplier, product, and/or services assessment activities as a shared service to other internal processes including acquisition;
- Conducting due diligence to inform determinations about a bidder's responsibility and to identify and assess bidders' risk posture or risk associated with a given product or service offering;
- Obtaining open source software from vetted and approved libraries;
- Including C-SCRM criteria in source selection evaluations;
- Establishing and referencing a list of prohibited suppliers, if appropriate, per applicable regulatory and legal references; and
- Establishing and procuring from an approved products list or list of preferred or qualified suppliers who have demonstrated conformance with the enterprise's security requirements through a rigorous process defined by the enterprise or another acceptable qualified list program activity.

The C-SCRM Strategy and Implementation Plan should address the acquisition security-relevant foundational elements necessary to implement a C-SCRM program. To support the strategy,

enterprise leaders should promote the value and importance of C-SCRM within acquisitions and ensure sufficient, dedicated funding is in place for necessary activities. Doing so will help enterprises ensure responsibility for program or business processes and accountability for progress toward the attainment of results. Enterprises should also assign roles and responsibilities, some of which will be cross-enterprise in nature and team-based, while others will be specific to acquisition processes. Finally, relevant training should be provided to members of the acquisition workforce to ensure roles and responsibilities are understood and executed in alignment with leader expectations.

The enterprise's capabilities, resources, operational constraints, and existing portfolio of supplier relationships, contracts, acquired services, and products provide the baseline context necessary to lay out a strategic path both realistic and achievable. This baseline starting point also serves as a marker by which performance progress and outcomes can be tracked and assessed.

A critical first step is to ensure there is a current and accurate inventory of the enterprise's supplier relationships and contracts as well as an understanding of the products or services those suppliers provide. This information allows for a mapping of these suppliers into strategically relevant groupings as determined by the organization. For example, an assessment of these suppliers might result in groupings of multiple categories (e.g., "strategic/innovative," "mission-critical," "sustaining" or "standard/non-essential"). This segmentation facilitates further analysis and understanding of the exposure to cybersecurity risk in the supply chain throughout the enterprise and helps to focus attention and assign priority to those critical suppliers of the most strategic or operational importance to the enterprise and its mission and business processes. It is useful to identify which products and services require a higher level of confidence in risk mitigation, and can be helpful in identifying areas of risk, such as overreliance on a single source of supply. This inventory and mapping also facilitates the selection and tailoring of C-SCRM contract language and evaluation criteria.

Additional information can be found in: SA-1, SA-2, SA-4, SR-5, SR-13, and [NISTIR 8179]

3.1.2. The Role of C-SCRM in the Acquisition Process

When conducting a procurement, enterprises should designate experts from different subject matter areas to participate in the acquisition process as members of the Acquisition Team. While procurement requirements address and are tailored to satisfying a specific purpose and ensure compliance mandates are met, contextual factors such as mission criticality, the sensitivity of data, and the operational environment must also be considered to effectively address cybersecurity risk in supply chains.

This contextual basis sets the stage for the Acquisition Team to be able to effectively gauge their tolerance for risk as it pertains to a specific procurement requirement and determine which of the [NIST SP 800-161 Rev 1] and [NIST SP 800-53 Rev 5] controls are relevant and necessary to consider for specific acquisitions. The program office or requiring official should consult with information security personnel to complete this control selection process and work with their procurement official to incorporate these controls into requirements documents and contracts. Security is a critical factor in procurement decisions.

Acquisition policies and processes need to incorporate C-SCRM considerations into each step of the procurement and contract management life cycle management process (i.e., plan procurement, define/develop requirements, perform market analysis, complete procurement, ensure compliance, monitor performance and for changes that affect C-SCRM risk status) as described in [NISTIR 7622]. This includes ensuring cybersecurity risk in the supply chain is addressed when making ICT/OT-related charge card purchases.

During the 'plan procurement' step, the need for and the criticality of the good or service to be procured needs to be identified, along with a description of the factors that are driving the determination of the need and level of criticality as this informs how much risk may be tolerated, who should be involved in the planning and the development of the specific requirements that will need to be satisfied. This activity is typically led by the acquirer mission/business process owner or a designee in collaboration with the procurement official or contracting officer representative

During the planning phase , the enterprise should develop and define requirements to address cybersecurity risk in the supply chain, in addition to specifying performance, schedule, and cost objectives. This process is typically initiated by the acquirer mission/business process owner or a designee in collaboration with the procurement official and other members of the C-SCRM team.

With requirements defined, enterprises will typically complete a market analysis for potential suppliers. Market research and analysis activities will explore the availability of potential or pre-qualified sources of supply. This step is typically initiated by the acquirer mission and business process owner or a designated representative. Enterprises should use this phase to conduct more robust due diligence research on potential suppliers and/or products in order to generate a supplier risk profile. As part of due diligence, the enterprise may consider the market concentration for the sought-after product or service as a means of identifying interdependencies within the supply chain. The enterprise may also use a request for information (RFIs), sources sought notice (SSNs), and/or due diligence questionnaires for the initial screening and collection of evidence from potential suppliers. Enterprises should not treat the initial C-SCRM due diligence risk assessment as exhaustive. Results of this research can also be helpful in shaping the sourcing approach and refining requirements.

Finally, the enterprise will complete the procurement step by releasing a statement of work (SOW), performance work statement (PWS), or statement of objective (SOO) for the release of a request for proposal (RFP) or request for quotes (RFQ). As part of selection, any bidders responding to the RFP or RFQ should be evaluated against relevant, critical C-SCRM criteria. The RFP review process should also include any procurement-specific supplier risk assessment. The assessment criteria will be heavily informed by the defined C-SCRM requirements and include coverage over but not limited to information about the enterprise, its security processes, and its security track record. The response review process involves multiple C-SCRM stakeholders including procurement, the mission and business process owner, as well as appropriate information system owners and technical experts. Prior to purchase enterprises should identify and assess product or system components' quality, vulnerability(ies), authenticity and other relevant cybersecurity-supply chain risk factors and complete this risk assessment prior to deployment,

Once the contract is executed, the enterprise should monitor for change that alters its exposure to cybersecurity risk in the supply chain. Change that alters exposure to cybersecurity risk in the supply chain may include but is not limited to internal enterprise or system changes, supplier operational or structural changes, product updates, as well as geopolitical or environmental changes. An enterprise should continuously apply lessons learned collected during the acquisition process to enhance its ability to assess, respond to and monitor cybersecurity risk in the supply chain.

Table 3-1 shows a summary of where C-SCRM assessments may take place within the various steps of the procurement process.

Table 3-1: C-SCRM in the Procurement Process

Procurement Process	Service Risk Assessment	Supplier Risk Assessment	Product Risk Assessment
Plan Procurement	Service Risk Assessment Criticality of Needed Service Other Context (functions performed; access to systems/data, etc.) Fit for Purpose	Fit for Purpose	Criticality of Needed Product Other Context (Operating Environment, Data, Users, etc.) Fit for Purpose
Define/Develop Requirements	Identify relevant C-SCRM controls/ requirements	Identify relevant C-SCRM controls/ /requirements	Identify relevant C-SCRM controls/ requirements
Perform Market Analysis		Initial Risk Assessment (e.g., Due-Diligence Questionnaires)	Research product options and risk factors
Solicit Bids/ Complete Procurement		Complete Risk Assessment	Pre-Deployment Risk Assessment
Operate & Maintain	Continuous Risk Monitoring	Continuous Risk Monitoring	Continuous Risk Monitoring

In addition to process activities, there are many useful acquisition security-enhancing tools and techniques available, including obscuring the system end use or system component, using blind or filtered buys, requiring tamper-evident packaging, or using trusted or controlled distribution. The results from a supply chain cybersecurity risk assessment can guide and inform the strategies, tools, and methods that are most applicable to the situation. Tools and techniques may provide protections against unauthorized production, theft, tampering, insertion of counterfeits, insertion of malicious software or backdoors, and poor development practices throughout the system development life cycle.

To ensure effective and continued management of cybersecurity risk in the supply chain throughout the acquisition life cycle, contractual agreements and contract management should include:

- The satisfaction of applicable security requirements in contracts and mechanisms as a qualifying condition for award;

- Flow-down control requirements to sub-contractors, if and when applicable, including C-SCRM performance objectives, linked to the method of inspection, in a Quality Assurance Surveillance Plan or equivalent method for monitoring performance;
- Periodic revalidation of supplier adherence to security requirements to ensure continual compliance;
- Processes and protocols for communication and reporting of information about vulnerabilities, incidents, and other business disruptions, to include acceptable deviations if the business disruption is deemed serious, and baseline criteria to determine whether a disruption qualifies as serious; and
- Terms and conditions that address government, supplier, and other applicable third party(ies) roles, responsibilities, and actions for responding to identified supply chain risk(s), or risk incident(s) in order to mitigate risk exposure, minimize harm, and support timely corrective action or recovery from an incident.

There are a variety of acceptable validation and revalidation methods, such as requisite certifications, site visits, third-party assessment, or self-attestation. The type and rigor of the required methods should be commensurate to the criticality of the service or product being acquired and the corresponding assurance requirements.

Additional guidance for integrating C-SCRM into the acquisition process is provided in Appendix C that demonstrates the enhanced overlay of C-SCRM into the [NIST SP 800-39] Risk Management Process. In addition, enterprises should refer to and follow acquisition/procurement policies, regulations, and best practices that are specific to their domain (e.g., critical infrastructure sector, state government, etc.)

Additional information can be found in: SA-1, SA-2, SA-3, SA-4, SA-9, SA-19, SA-20, SA-22, SR-5, SR-6, SR-10, and SR-11

3.2. Supply Chain Information Sharing

Enterprises are continuously exposed to risk originating from their supply chains. An effective information-sharing process helps to ensure enterprises can gain access to information critical to understanding and mitigating cybersecurity risk in the supply chain, and also share relevant information to others that may benefit from or require awareness of these risks.

To aid in identifying, assessing, monitoring, and responding to cybersecurity risk in the supply chain, enterprises should build information-sharing processes and activities into their C-SCRM programs. This may include establishing information-sharing agreements with peer enterprises, as well as with business partners and suppliers. By exchanging supply chain risk information within a sharing community, enterprises can leverage the collective knowledge, experience, and capabilities of that sharing community to gain a more complete understanding of the threats the enterprise may face. Additionally, sharing of supply chain risk information allows enterprises to better detect campaigns that target specific industry sectors and institutions. However, the enterprise should be sure that information sharing occurs through formal sharing structures; for example, Information Sharing and Analysis Centers (ISACs). Informal or unmanaged information sharing can expose enterprises to potential legal risks.

Federal enterprises should establish processes to be able to effectively engage with the FASC's information-sharing agency, which is responsible for facilitating information sharing among government agencies and acting as a central, government-wide facilitator for C-SCRM information-sharing activities.

NIST SP 800-150 describes key practices for establishing and participating in supply chain risk information-sharing relationships as follows:

- Establish information-sharing goals and objectives that support business processes and security policies
- Identify existing internal sources of supply chain risk information
- Specify the scope of information-sharing activities
- Establish information sharing rules
- Join and participate in information-sharing efforts
- Actively seek to enrich indicators by providing additional context, corrections, or suggested improvements
- Use secure, automated workflows to publish, consume, analyze, and act upon supply chain risk information
- Proactively establish supply chain risk information-sharing agreements
- Protect the security and privacy of sensitive information
- Provide ongoing support for information sharing activities

As shown in Table 3-2, below, supply chain risk information describes or identifies cybersecurity supply chain relevant characteristics and risk factors associated with a product or service or source of supply. It may exist in various forms (e.g., raw data, a supply chain network map, risk assessment report, etc.) and should be accompanied with the metadata that will facilitate an assessment of a level of confidence in and credibility of the information. Enterprises should follow established processes and procedures that describe whether and when sharing or reporting of certain information is mandated or voluntary and if there are any necessary requirements with which to adhere regarding information handling, protection, and classification.

1844 **Table 3-2: Supply Chain Characteristics and Cybersecurity Risk Factors Associated with a**
1845 **Product, Service, or Source of Supply[14]**

Source of Supply, Product, or Service Characteristics	Risk Indicators, Analysis, and Findings
• Features and functionality; • Access to data and information, including system privileges; • Installation or operating environment; • Security, authenticity, and integrity of a given product or service and the associated supply and compilation chain; • The ability of the source to produce and deliver a product or service, as expected; • Foreign control of, or influence over, the source (e.g., foreign ownership, personal and professional ties between the source and any foreign entity, legal regime of any foreign country in which the source is headquartered or conducts operations); • Market alternatives to the source; and • Potential risk factors such as geo-political, legal, managerial/internal controls, financial stability, cyber incidents, personal and physical security, or any other information that would factor into an analysis of the security, safety, integrity, resilience, reliability, quality, trustworthiness, or authenticity of a product, service, or source.	• Threat information includes indicators (system artifacts or observables associated with an attack), tactics, techniques, and procedures (TTPs); • Security alerts, threat intelligence reports; • Implications to national security, homeland security, and/or national critical infrastructure and/or processes associated with the use of the product or service; • Vulnerability of federal systems, programs, or facilities; • Threat level and vulnerability level assessment/score; • Potential impact or harm caused by the possible loss, damage, or compromise of a product, material, or service to an enterprise's operations or mission and the likelihood of a potential impact or harm, or the exploitability of a system; and • Capacity to mitigate risks identified.

1846
1847
1848 ## 3.3. C-SCRM Training and Awareness
1849
1850 Numerous individuals within the enterprise contribute to the success of C-SCRM. These may
1851 include but are not limited to information security, procurement, risk management, engineering,
1852 software development, IT, legal, HR. Examples of these groups' contributions include:

[14] Supply Chain Characteristics and Cybersecurity Risk Factors Associated with a Product, Service, or Source of Supply is non-exhaustive.

- System Owners are responsible for multiple facets of C-SCRM at the operational level as part of their responsibility for the development, procurement, integration, modification, operation, maintenance, and/or final disposition of an information system;
- Human Resources defines and implements background checks and training policies which help ensure that individuals are trained in appropriate C-SCRM processes and procedures;
- Legal helps draft or review C-SCRM-specific contractual language that is included by procurement in contracts with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers;
- Acquisition/procurement defines the process for implementing supplier assurance practices embedded in the acquisition process;
- Engineering designs products and must understand existing requirements for use of open source components;
- Software developers ensure software vulnerabilities are identified and addressed as early as possible, including testing and fixing code;
- Shipping and receiving ensures that boxes containing critical components have not been tampered with en route or at the warehouse.

Everyone within an enterprise, including the end users of information systems, has a role in managing cybersecurity risk in the supply chain. The enterprise should foster an overall culture of security including C-SCRM as an integral part. The enterprise can use a variety of communication methods to foster the culture, of which traditional awareness and role-based training are only one component.

Every individual within an enterprise should receive appropriate training to enable them in understanding the importance of C-SCRM to their enterprise, their specific roles, and responsibilities, and as it relates to processes and procedures for reporting incidents. This training can be integrated into the overall cybersecurity awareness training. Enterprises should define baseline training requirements at a broad scope within Level 1, and those requirements should be tailored and refined based on the specific context within Levels 2 and 3.

Those individuals who have more significant roles in managing cybersecurity risk in the supply chain should receive tailored C-SCRM training that helps them understand the scope of their responsibilities, specific process, and procedure implementation for which they are responsible, and the actions to take in the event of an incident, disruption, or another C-SCRM-related event. The enterprises should establish specific role-based training criteria and develop role-specific C-SCRM training to address specific C-SCRM roles and responsibilities. The enterprise may also consider adding C-SCRM content into preexisting role-based training for some specific roles. Refer to the Awareness and Training controls in Section 4.5 for more detail.

Enterprises are encouraged to utilize the NIST National Initiative for Cybersecurity Education (NICE) Framework[15] as a means of forming a common lexicon on C-SCRM workforce topics. This will aid enterprises in developing training linked to role-specific C-SCRM responsibilities and communicating cybersecurity workforce-related topics. The NICE Framework outlines

[15] NIST Special Publication 800-181: National Initiative for Cybersecurity Education (NICE) Cybersecurity Workforce Framework

Categories, Specialty Areas, Work Roles, Knowledge, Skills, and Abilities (KSAs), and Tasks which describe cybersecurity work.

3.4. C-SCRM KEY PRACTICES

Cybersecurity Supply Chain risk management builds on existing standardized practices in multiple disciplines, as well as ever-evolving C-SCRM capabilities. Enterprises should prioritize achieving a base-level maturity in key practices prior to specifically focusing on advanced C-SCRM capabilities. Enterprises should tailor their implementation of these practices to what is applicable and appropriate given unique context, e.g., based on available resources and risk profile. Those key practices are described in NIST standards and guidelines, such as [NISTIR 8276], as well as other applicable national and international standards and best practices. They include integrating C-SCRM across the enterprise; establishing a formal program; knowing and managing critical products, services, and suppliers; understanding an enterprise's supply chain; closely collaborating with critical suppliers; including critical suppliers in resilience and improvement activities; assessing and monitoring throughout the supplier relationship; and, planning for the full life cycle.

3.4.1. Foundational Practices

Having foundational practices in place is critical to successfully and productively interacting with system integrators. Suppliers may be at varying levels themselves regarding having the standardized practices in place. The following are specific examples of the recommended multidisciplinary foundational practices that can be implemented incrementally to improve an enterprise's ability to develop and execute more advanced C-SCRM practices:

- Establish a core, dedicated multi-disciplinary C-SCRM Program Management Office and/or C-SCRM team;
- Implement a risk-management hierarchy and risk-management process (in accordance with NIST SP 800-39, *Managing Information Security Risk* [NIST SP 800-39]) including an enterprise-wide risk assessment process (in accordance with NIST SP 800-30 Revision 1, *Guide for Conducting Risk Assessments* [NIST SP 800-30 Rev. 1]);
- Establish an enterprise governance structure that integrates C-SCRM requirements and incorporates these requirements into the enterprise policies;
- Develop a process for identifying and measuring the criticality of the enterprise's suppliers, products, and services;
- Raise awareness and foster understanding of what C-SCRM is and why it is critically important;
- Develop and/or integrate C-SCRM into acquisition/procurement policies and procedures (including Federal Information Technology Acquisition Reform Act (FITARA) processes, applicable to federal agencies) and purchase card processes. Supervisors and managers should also ensure their staff aims to build cybersecurity competencies;
- Establish consistent, well-documented, repeatable processes for determining [Federal Information Processing Standards (FIPS) 199] impact levels;

- Establish and begin using supplier risk-assessment processes on a prioritized basis (inclusive of criticality analysis, threat analysis, and vulnerability analysis) after the [FIPS 199] impact level has been defined;
- Implement a quality and reliability program that includes quality assurance and quality control process and practices;
- Establish explicit collaborative and discipline-specific roles, accountabilities, structures, and processes for supply chain, cybersecurity, product security, and physical security (and other relevant) processes (e.g., Legal, Risk Executive, HR, Finance, Enterprise IT, Program Management/System Engineering, Information Security, Acquisition/Procurement, Supply Chain Logistics, etc.);
- Ensure that adequate resources are dedicated and allocated to information security and C-SCRM to ensure proper implementation of policy, guidance, and controls;
- Ensure sufficient cleared personnel, with key C-SCRM roles and responsibilities, to access and share C-SCRM-related classified information;
- Implement an appropriate and tailored set of baseline information security controls found in NIST SP 800-53 Revision 5, Security and Privacy Controls for Information Systems and Enterprises [NIST SP 800-53 Rev. 5];
- Establish internal checks and balances to ensure compliance with security and quality requirements;
- Establish a supplier management program including, for example, guidelines for purchasing directly from qualified original equipment manufacturers (OEMs)[16] or their authorized distributors and resellers;
- Implement a robust incident management program to successfully identify, respond to, and mitigate security incidents. This program should be capable of identifying the root cause of security incidents, including those originating from the cybersecurity supply chain;
- Establish internal processes to validate that suppliers and service providers actively identify and disclose vulnerabilities in their products; and
- Establish a governance capability for managing and monitoring SBOMs for embedded software vulnerabilities and risk across the enterprise.

3.4.2. Sustaining Practices

Sustaining practices should be used to enhance the efficacy of cybersecurity supply chain risk management. These practices are inclusive of and build upon foundational practices. Enterprises that have standardized and implemented the foundational practices broadly should consider these practices as next steps in advancing their cybersecurity supply chain risk management capabilities:

- Establish and collaborate with a threat-informed security program;

[16] For purposes of this publication, the term *original equipment manufacturers* are inclusive of *original component manufacturers*.

- Use confidence building mechanisms such as third-party assessment surveys, on-site visits, and formal certifications such as ISO 27001 to assess critical supplier security capabilities and practices;
- Establish formal processes and intervals for monitoring and reassessing existing supplier relationships for potential changes to their risk profile;
- Use the enterprise's understanding of its C-SCRM risk profile (or risk profiles, specific to mission/business areas) to define a risk appetite and risk tolerances to empower leaders with delegated authority across the enterprise to make C-SCRM decisions in alignment with the enterprise's mission imperatives and strategic goals and objectives;
- Use a formalized information-sharing function to engage with the FASC as well as other government agencies to enhance the enterprise's supply chain cybersecurity threat and risk insights and help ensure a coordinated and holistic government-wide approach to addressing cybersecurity risk in the supply chain that may affect a broader set of agencies or national security;
- Coordinate with the enterprise's cybersecurity program leadership to elevate top C-SCRM Risk Profile risks to the senior-most enterprise risk committee;
- Embed C-SCRM specific training into training curriculums of applicable roles across the enterprise processes involved with C-SCRM including but not limited to information security, procurement, risk management, engineering, software development, IT, legal, and HR;
- Integrate C-SCRM considerations into every aspect of the system and product life cycle, implementing consistent, well-documented, repeatable processes for systems engineering, cybersecurity practices, and acquisition;
- Integrate the enterprise's defined C-SCRM requirements into contractual language found in agreements with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers;
- Include critical suppliers in contingency planning, incident response, and disaster recovery planning and testing;
- Engage with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to improve their cybersecurity practices; and
- Define, collect, and report C-SCRM metrics to ensure risk-aware leadership, enable active management of the completeness of C-SCRM implementations, and drive efficacy of the enterprise's C-SCRM processes and practices.

3.4.3. Enhancing Practices

Enhancing practices should be applied by the enterprise with the goal of advancement toward adaptive and predictive C-SCRM capabilities. Enterprises should pursue these practices once sustaining practices have been broadly implemented and standardized across the enterprise:

- Automate C-SCRM processes where applicable and practical to drive execution consistency, efficiency, and make available the critical resources required for other critical C-SCRM activities;
- Adopt quantitative risk analyses that apply probabilistic approaches (e.g., Bayesian Analysis, Monte Carlo Methods) to reduce uncertainty about cybersecurity risk in the

supply chain, enhance enterprise leadership's ability to identify optimal risk responses, and measure response effectiveness; and

- Apply insights gained from leading C-SCRM metrics (i.e., forward-looking indicators) to shift from reactive to predictive C-SCRM strategies and plans that adapt to risk profile changes before they occur.

The guidance and controls contained in this publication are built on existing multidisciplinary practices and are intended to increase the ability of enterprises to strategically manage cybersecurity risk in the supply chain over the entire life cycle of systems, products, and services. Refer to Table 3-3 in Section 3 for a summary of C-SCRM key practices.

3.5. Capability Implementation Measurement and C-SCRM Measures

Enterprises should actively manage the efficiency and effectiveness of their C-SCRM programs through ongoing measurement of the programs themselves. Enterprises can use several methods of measuring and managing the effectiveness of their C-SCRM program:

- Using a framework, such as NIST CSF to assess their C-SCRM capabilities;
- Measuring progress of their C-SCRM initiatives towards completion;
- Measuring performance of their C-SCRM initiatives towards desired outcomes.

All methods rely on a variety of data collection, analysis, contextualization, and reporting activities. Collectively, these methods should be used to track and report out progress and results that ultimately indicate reductions in risk exposure and improvements in the enterprise's security outcomes.

C-SCRM performance management provides multiple enterprise and financial benefits. Major benefits include increasing stakeholder accountability for C-SCRM performance; improving effectiveness of C-SCRM activities; demonstrating compliance with laws, rules, and regulations; providing quantifiable inputs for resource allocation decisions; cost-avoidance associated with reduced impact from—or likelihood of experiencing—a cyber-supply chain incident.

Enterprises can use a framework such as NIST CSF Implementation Tiers to baseline their C-SCRM capabilities. Frameworks such as these provide a useful context for an enterprise to track and gauge the increasing rigor and sophistication of their C-SCRM practices. Progression against framework topics is measured using ordinal (i.e., 1-5) scales which illustrate the progression of capabilities across tiers. The following are examples of how C-SCRM capability could be gauged by applying NIST CSF Tiers:

- CSF Tier 1: The enterprise does not understand its exposure to cybersecurity risk in the supply chain or its role in the larger ecosystem. The enterprise does not collaborate with other entities or have processes in place to identify, assess and mitigate cybersecurity risk in the supply chain;
- CSF Tier 2: The enterprise understands its cybersecurity risk in the supply chain associated with products and services and its role in the larger ecosystem. The enterprise has not formalized its capabilities to manage cybersecurity risk in the supply chain

internally or its capability to engage and share information with entities in the broader ecosystem;

- CSF Tier 3: Enterprise-wide approach to managing cybersecurity risk in the supply chain is enacted via enterprise risk management policies, processes, and procedures. This likely includes a governance structure (e.g., Risk Council) that manages cybersecurity risk in the supply chain in balance with other enterprise risks. Policies, processes, and procedures are implemented consistently, as intended, and continuously monitored and reviewed. Personnel possess the knowledge and skills to perform their appointed cybersecurity supply chain risk management responsibilities. The enterprise has formal agreements in place to communicate baseline requirements to its suppliers and partners. The enterprise understands its external dependencies and collaborates with partners to share information to enable risk-based management decisions within the enterprise in response to events;
- CSF Tier 4: The enterprise actively consumes and distributes information with partners and uses real-time or near real-time information to improve cybersecurity and supply chain security before an event occurs. The enterprise leverages institutionalized knowledge of cybersecurity supply chain risk management with its external suppliers and partners as well as internally, in related functional areas and at all levels of the enterprise. The enterprise communicates proactively using formal (e.g., agreements) and informal mechanisms to develop and maintain strong relationships with its suppliers, buyers, and other partners.

Capability building begins by establishing a solid programmatic foundation that includes enabling strategies and plans, policies and guidance, investment in training and dedicated program resources. Once this foundational capability is in place, enterprises can use these progression charts to orient the strategic direction of their programs to target states of C-SCRM capability in different areas of the program. Table 3-3 provides an example C-SCRM implementation model.

2091

2092 **Table 3-3: Example C-SCRM Practice Implementation Model[17]**

Implementation Level	Associated C-SCRM Practices
Foundational	• Established C-SCRM Policies across enterprise-levels • Defined C-SCRM hierarchy • Established C-SCRM governance structure • Well-documented, consistent C-SCRM processes • Quality and reliability program • Explicit roles for C-SCRM • Adequate and dedicated C-SCRM resources • Defined C-SCRM control baseline • Established C-SCRM internal checks and balances to assure compliance • Established supplier management program • C-SCRM included in an established incident management program
Sustaining	• Use of third-party assessments, site visits, and formal certification • Defined C-SCRM risk appetite and risk tolerances • Formalized information-sharing processes (e.g., engages w/ FASC) • Formal C-SCRM training program • C-SCRM integrated into SDLC • C-SCRM integrated into contractual agreements • Suppliers participate in incident response, disaster recovery, and contingency planning • Formally defined, collected, and reported C-SCRM metrics
Enhancing	• C-SCRM process automation • Use of quantitative risk analysis • Predictive and adaptive C-SCRM strategies and processes

2093
2094

[17] For more information on C-SCRM capabilities, refer to section 1.5 C-SCRM Key Practices.

3.5.1. Measuring C-SCRM Through Performance Measures

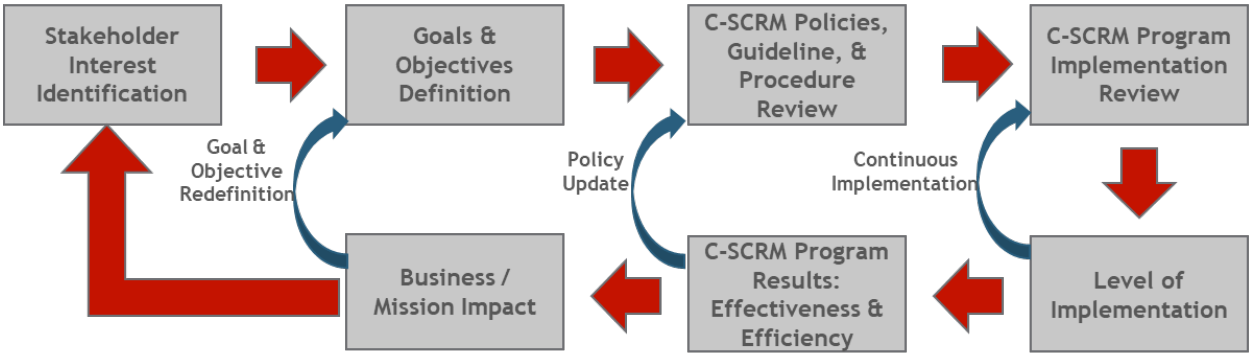


Fig. 3-1: C-SCRM Metrics Development Process

Enterprises typically rely on information security measures to facilitate decision-making as well as improve performance and accountability in their information security programs. Enterprises can achieve similar benefits within their C-SCRM programs. Figure 3-1 illustrates measuring the development process as is outlined in [NIST SP 800-55 Rev. 1], which provides guidance on the specific development, selection, and implementation of operational-level and program-level performance measures. Enterprises should consider this process for the development of C-SCRM metrics which includes:

- **Stakeholder Interest Identification**: identify the primary (e.g., CISO, CIO, CTO) and secondary C-SCRM stakeholders (e.g., COO, CFO) and define/measure requirements based on the context required for each stakeholder or stakeholder group;
- **Goals and Objectives Definition**: identify and document enterprise strategic and C-SCRM-specific performance goals and objectives. These goals may be expressed in the form of enterprise strategic plans, C-SCRM policies, requirements, laws, regulations, etc.;
- **C-SCRM Policies, Guidelines, and Procedure Review**: identify the desired C-SCRM practices, controls, and expectations outlined within these documents and used to guide/implement C-SCRM across the enterprise;
- **C-SCRM Program Implementation Review:** collect any existing data, measures, and evidence which can provide insights used to derive new measures. These may be found in C-SCRM Plans, POA&Ms, supplier assessments, etc;
- **Level of Implementation:** develop and map measures to the identified C-SCRM standards, policies, and procedures to demonstrate the program's implementation progress. These measures should be considered when rendering decisions to prioritize and invest in C-SCRM capabilities;
- **C-SCRM Program Results on Efficiency & Effectiveness:** develop and map measures of C-SCRM's efficiency and effectiveness to the identified strategy and policy objectives to gauge whether desired C-SCRM outcomes are met. These measures should be considered as part of policy refreshes; and

- **Business and Mission Impact:** development and mapping of measures to the identified enterprise strategic and C-SCRM-specific objectives to offer insight on the impact of C-SCRM (e.g., contribution to business process cost savings; reduction in national security risk). These measures should be considered a component of goal and objective refreshes.

Similar to information security measures, C-SCRM-focused measures can be attained at different levels of an enterprise. Table 3-4 provides example measurement topics across the three Risk Management levels.

Table 3-4: Example Measurement Topics Across the Risk Management Levels

Risk Management Level	Example Measurement Topics
Level 1	• Policy adoption at lower levels • Timeliness of policy adoption at lower levels • Adherence to risk appetite and tolerance thresholds • Differentiated levels of risk exposure across Level 2 • Compliance with regulatory mandates • Adherence to customer requirements
Level 2	• Effectiveness of mitigation strategies • Time allocation across C-SCRM activities • Mission/business process-level risk exposure • Degree and quality of C-SCRM requirement adoption in mission/business processes • Use of C-SCRM PMO by Level 3
Level 3	• Design effectiveness of controls • Operating effectiveness of controls • Cost efficiency of controls

Enterprises should validate identified C-SCRM goals and objectives with their targeted stakeholder groups prior to beginning an effort to develop specific measures. When developing C-SCRM measures, enterprises should focus on the stakeholder's highest priorities and target measures based on data that can be realistically sourced and gathered. Each established measure should have a specified performance target used to gauge whether goals and objectives in relation to that measure are being met. Enterprises should consider the use of measures templates to formalize each measure and serve as a source of reference for all information pertaining to that measure. Finally, enterprises should develop a formal feedback loop with stakeholders to ensure that measures are continually providing the desired insights and remain aligned with the enterprise's overall strategic objectives for C-SCRM.

3.6. Dedicated Resources

To appropriately manage cybersecurity risk in the supply chain, enterprises should dedicate funds towards this effort. Identifying resource needs and taking steps to secure adequate, recurring, and dedicated funding is an essential and important activity that needs to be built into the C-SCRM strategy and implementation planning effort and incorporated into an enterprise's budgeting, investment review, and funds management processes. Access to adequate resources is a critical, key enabler for the establishment and sustainment of a C-SCRM program capability. The continued availability of dedicated funds will allow enterprises to sustain, expand, and mature their capabilities over time.

Securing and assigning C-SCRM funding is representative of leadership's commitment to the importance of C-SCRM and its relevance to national and economic security and ensuring the protection, continuity and resilience of mission and business processes and assets.

Funding facilitates goal and action-oriented planning. Examining resource needs and allocating funding prompts a budgeting and strategic-planning process. Effective enterprises begin by defining a set of goals and objectives upon which to build a strategic roadmap laying out the path to achieve them, through the assignment and allocation of finite resources. The establishment of dedicated funding, tied to C-SCRM objectives, sets conditions for accountability of performance, and compels responsible staff to be efficient and effective and adopt a mindset of continuously seeking to improve C-SCRM capabilities and achieve security enhancing outcomes.

Obtaining new or increased funding can be a challenge as resources are often scarce and necessary for many competing purposes. The limited nature of funds forces prioritization. C-SCRM leaders need to first examine what can be accomplished within the constraints of existing resources and be able to articulate, prioritize, and defend their requests for additional resources. For new investment proposals, this requires a reconciliation of planned initiatives against the enterprise's mission/business objectives. When well-executed, a systematic planning process can tighten the alignment of C-SCRM processes to these objectives.

Many C-SCRM processes can and should be built into existing program and operational activities and may be adequately performed using available funds. However, there may be a need for an influx of one-time resources to establish an initial C-SCRM program capability. For example, this might include the need to hire new personnel with expertise in C-SCRM, acquire contractor support to aid in developing C-SCRM program guidance, or develop content for role-based C-SCRM training. There may also be insufficient resources in place to satisfy all recurring C-SCRM program needs. Existing funds may need to be reallocated towards C-SCRM efforts or new or additional funds requested. Enterprises should also seek out opportunities to leverage shared services whenever practical.

The use of shared services can optimize the use of scarce resources and concentrates capability into centers of excellence providing cost-efficient access to services, systems, or tools. Enterprises can adopt cost-sharing mechanisms across their lower-level entities that allow cost-efficient access to C-SCRM resources and capabilities. Enterprises pursuing shared-services

models for C-SCRM should also be aware of the challenges with such models. Shared services (e.g., C-SCRM PMO) are most effective when the enterprise at large relies on a fairly homogenous set of C-SCRM strategies, policies, and processes. In many instances, centralized delivery of C-SCRM services require a robust technology infrastructure. The enterprise's systems should be able to support process automation and centralized delivery in order to fully realize the benefits of a shared-services model.

Consultation with budget/finance officials is critical to understanding what options may be available and viable in the near term and outyears. These officials can also advise on how best to justify needs, and the timeframes and processes for requesting new funds. There are likely different processes to follow for securing recurring funds versus requesting one-time funding. For example, funding for a new information system to support a C-SCRM capability may involve the development of a formal business case presented to an enterprise's investment review board for approval. Breaking out resource needs into ongoing and one-time costs, as well as into cost categories that align with budget formulation, resource decision-making, and the allocation and management of available funds will also be helpful.

It is recommended that the C-SCRM PMO have the lead responsibility of coordinating with mission/business process and budget officials to build out and maintain a multi-year C-SCRM program budget that captures both recurring and non-recurring resource requirements and maps those requirements to available funding and fund sources. To understand the amount of funding required, when, and for what purpose, enterprises should identify and assess which type and level of resources (people or things), are required to implement a C-SCRM program capability and perform required C-SCRM processes on an ongoing basis. The cost associated with each of these identified resource needs would then be captured, accumulated, and reflected in a budget that includes line items for relevant cost categories, such as personnel costs, contracts, training, travel, or tools and systems. This will provide the enterprise a baseline understanding of what can be accomplished within existing resource levels and where there are gaps in need of being filled. The actual allocation of funds may be centralized in a single C-SCRM budget or may be dispersed across the enterprise and reflected in individual office or mission/business process-area budgets. Regardless of how funds are actually assigned, a centralized picture of the C-SCRM budget and funds status will provide a valuable source of information that justifies new requests, informs prioritization decisions, and adjusts expectations about certain activities and the duration in which they can be accomplished.

Ensuring that C-SCRM program funding is distinctly articulated within the enterprise's budget—with performance measures linked to the funding—will drive accountability for results. The visible dedication of funds in budget requests and performance plans and reports compels leadership attention on C-SCRM processes and accomplishment of objectives. Budgets must be requested and justified on a periodic basis. This process allows leadership and oversight officials to trace and measure the effectiveness and efficiency of allocated resources. This, in turn, serves as a driving function for program and operational C-SCRM personnel to track and manage their performance.

Key Takeaways

C-SCRM in Acquisition. Integration of C-SCRM into acquisition activities is critical to the success of any C-SCRM program. C-SCRM requirements should be embedded throughout the acquisition life cycle. The C-SCRM activities performed include but are not limited to performing risk assessments of services, suppliers, and products, identifying relevant C-SCRM controls, conducting due diligence, and continuously monitoring suppliers.

Supply Chain Information Sharing. Enterprises will gain access to information critical to understanding and mitigating cybersecurity risk in the supply chain by building information-sharing processes and activities into C-SCRM programs. Enterprises should engage with peers, business partners, suppliers, and information-sharing communities (e.g., ISACs) to gain insight into cybersecurity risk in the supply chain and learn from the experience of the community at large.

C-SCRM Awareness and Training. Enterprises should adopt enterprise-wide and role-based training regimens to educate users on the potential impact that cybersecurity risk in the supply chain can have on the business and how to adopt best practices for risk mitigation. Robust C-SCRM training is a key enabler for enterprises as they drive a shift towards a C-SCRM-aware culture.

C-SCRM Key Practices. This publication outlines several Foundational, Sustaining, and Enabling C-SCRM practices that enterprises should adopt and tailor to their unique context. Enterprises should prioritize reaching a base level of maturity in key practices before focusing on advanced C-SCRM capabilities.

Capability Implementation Measurement and C-SCRM Measures. Enterprises should actively manage the efficiency and effectiveness of their C-SCRM programs. First enterprises should adopt a C-SCRM framework and use this framework as the basis for measuring the progress their enterprise has made toward its C-SCRM objectives. Next, enterprises should create and implement quantitative performance measures and target tolerance which provide a periodic glimpse into the enterprise's progress through the lens of specific operational objectives.

Dedicated Resources. Where possible and applicable, enterprises should commit dedicated funds toward C-SCRM. Benefits of doing so include but are not limited to facilitating strategic and goal-oriented planning, driving accountability of internal stakeholders to execute and mature the C-SCRM practices of the enterprise, and the continuous monitoring of progress by enterprise leadership.

APPENDIX A: C-SCRM SECURITY CONTROLS

C-SCRM CONTROLS INTRODUCTION

NIST defines security controls as:

> *The management, operational, and technical controls (i.e., safeguards or countermeasures) prescribed for an information system to protect the confidentiality, integrity, and availability of the system and its information. [FIPS 200, FIPS 199, CNSSI No. 4009, NIST SP 800-37 Rev. 1, NIST SP 800-53 Rev. 5, NIST SP 800-53A Rev. 5]*

[NIST SP 800-53 Rev. 5] defines numerous cybersecurity supply chain-related controls within the catalog of information security controls. This section is structured as an enhanced overlay of [NIST SP 800-53 Rev. 5]. It identifies and augments C-SCRM-related controls with additional supplemental guidance and provides new controls as appropriate. The C-SCRM controls are organized into the twenty (20) control families of [NIST SP 800-53 Rev. 5]. This approach facilitates use of the security controls assessment techniques articulated in [NIST SP 800-53A Rev. 5] to assess implementation of C-SCRM controls.

The controls provided in this publication are intended for enterprises to implement internally, as well as require of their contractors and subcontractors—if and when applicable—and as articulated in a contractual agreement. As with [NIST SP 800-53 Rev. 5], the security controls and control enhancements are a starting point from which controls/enhancements may be removed, added, or specialized based on an enterprise's needs. Each control in this section is listed for its applicability to C-SCRM. Those controls from [NIST SP 800-53 Rev. 5] not listed are not considered directly applicable to C-SCRM, and thus are not included in this publication. Details and supplemental guidance for the various C-SCRM controls in this publication are contained in Section 4.5.

C-SCRM CONTROLS SUMMARY

During the Respond Step of the risk management process articulated in Section 2, enterprises select, tailor, and implement controls for mitigating cybersecurity risk in the supply chain. [NIST 800-53B] lists a set of information security controls at the [FIPS 199] high-, moderate-, and low-impact levels. This section describes how these controls help mitigate risk to information systems and components, as well as the supply chain infrastructure. The section provides twenty (20) C-SCRM control families that include relevant controls and supplemental guidance.

Figure 4-1 depicts the process used to identify, refine, and add C-SCRM supplemental guidance to the [NIST SP 800-53 Rev. 5] C-SCRM-related controls. The figure, in which Figure 1-4 is repeated, represents the following steps:

1. Selected and extracted individual controls and enhancements from [NIST SP 800-53 Rev. 5] applicable to C-SCRM;
2. Analyzed these controls to determine how they apply to C-SCRM;
3. Evaluated the resulting set of controls and enhancements to determine whether all C-SCRM concerns were addressed;
4. Developed additional controls currently undefined in [NIST SP 800-53 Rev. 5];
5. Identified controls for flow down to relevant sub-level contractors;
6. Assigned applicable levels to each C-SCRM control; and
7. Developed C-SCRM-specific supplemental guidance for each C-SCRM control.

Fig. A-1: C-SCRM Security Controls in NIST SP 800-161 Revision 1, Section 4.5

Note that [NIST SP 800-53 Rev. 5] provides C-SCRM-related controls and control families. These controls may be listed in this publication with a summary or additional guidance and a reference to the original [NIST SP 800-53 Rev. 5] control and supplemental guidance detail.

C-SCRM CONTROLS THROUGHOUT THE ENTERPRISE

As noted in Table 4-1, C-SCRM controls in this publication are designated by the three levels comprising the enterprise. This is to facilitate the selection of C-SCRM controls specific to enterprises, their various missions, and individual systems, as described in Appendix C under the Respond step of the risk management process. During controls selection, enterprises should use the C-SCRM controls in this section to identify appropriate C-SCRM controls for tailoring per risk assessment. By selecting and implementing applicable C-SCRM controls for each level, enterprises will ensure that they have appropriately addressed C-SCRM throughout their enterprises.

APPLYING C-SCRM CONTROLS TO ACQUIRING PRODUCTS & SERVICES

Acquirers may use C-SCRM controls as the basis from which to communicate their C-SCRM requirements to different types of enterprises, described within this publication, that provide products and services to acquirers, including suppliers, developers, system integrators, external

system service providers, and other ICT/OT-related service providers. Acquirers should avoid using generalized requirements statements, such as "ensure compliance with [NIST SP 800-161 Rev. 1] controls." Acquirers must be careful to select the controls relevant to the specific use case of the service or product being acquired. Acquirers are encouraged to integrate C-SCRM throughout their acquisition activities. More detail on the role of C-SCRM in acquisition is provided in Section 3.1 of this document.

It is important to recognize the controls in this section do not provide specific contracting language. Acquirers should develop their own contracting language using this publication as guidance to develop the specific C-SCRM requirements for inclusion. The following sections expand upon the supplier, developer, system integrator, external system service provider, and other ICT/OT-related service provider roles with respect to C-SCRM expectations for acquirers.

Enterprises may use multiple techniques to ascertain whether these controls are in place. Techniques may include supplier self-assessment, acquirer review, or third-party assessments for measurement and adherence to the enterprise's requirements. Enterprises should first look to established third-party assessments to see if they meet their needs. When an enterprise defines C-SCRM requirements, it may discover that established third-party assessments may not address all specific requirements. In this case, additional evidence may be needed to justify unaddressed requirements. Please note that the data obtained for this purpose should be appropriately protected.

SUPPLIERS

Suppliers may provide either Commercial Off-The-Shelf (COTS) or, in federal contexts, Government Off-The-Shelf (GOTS) solutions to the acquirer. COTS solutions include non-developmental items (NDI), such as commercially-licensed solutions/products. GOTS solutions are government-only licensable solutions. Suppliers are a diverse group ranging from very small to large, specialized to diversified, based in a single country to transnational, and ranging widely in the level of sophistication, resources, and transparency/visibility in process and solution.

Suppliers also have diverse levels and types of C-SCRM practices in place. These practices and other related practices may provide the requisite evidence for SCRM evaluation. An example of a federal resource that may be leveraged is the Defense Microelectronics Activity (DMEA) accreditation for Trusted Suppliers. When appropriate, allow suppliers the opportunity to reuse any existing data and documentation that may provide evidence of C-SCRM implementation.

Enterprises should consider whether the cost of doing business with suppliers may be directly impacted by the extent of supply chain cybersecurity requirements imposed on suppliers, the willingness or ability of suppliers to allow visibility into how their products are developed or manufactured, and how they apply security and supply chain practices to their solutions. When enterprises or system integrators require greater levels of transparency from suppliers, they must consider the possible cost implications of such requirements. Suppliers may opt not to participate in procurements to avoid increased costs or perceived risks to their intellectual property, limiting an enterprise's supply or technology choices. Additionally, suppliers may face risk from

customers imposing multiple and different sets of supply chain cybersecurity requirements with which the supplier must comply on a per-customer basis. The amount of transparency required from suppliers should be commensurate to the suppliers' criticality which is sufficient to address inherent risk.

DEVELOPERS AND MANUFACTURERS

Developers and manufactures are personnel that develop or manufacture systems, system components (e.g., software), or system services (e.g., Application Programming Interfaces (APIs)). Development can occur internally within enterprises or through external entities. Developers typically maintain privileged access rights and play an essential role throughout the SDLC. The activities they perform and the work they produce can either enhance security or introduce new vulnerabilities. It is therefore essential that developers are both subject to, and intimately familiar with, C-SCRM requirements and controls.

SYSTEM INTEGRATORS

System integrators are those entities which provide customized services to the acquirer including custom development, test, operations, and maintenance. This group usually replies to a request for proposal from an acquirer with a proposal describing a solution or service that is customized to the acquirer's requirements. Such proposals provided by system integrators can include many layers of suppliers and may include teaming arrangements with other vendors or subcontractors. The system integrator should ensure these business entities are vetted and verified with respect to the acquirer's C-SCRM requirements. Because of the level of visibility that can be obtained in the relationship with the system integrator, the acquirer has the discretion to require rigorous supplier acceptance criteria as well as any relevant countermeasures to address identified or potential risks.

EXTERNAL SYSTEM SERVICE PROVIDERS OF INFORMATION SYSTEM SERVICES

Enterprises use external service providers to perform or support some of their mission and business functions (NIST SP 800-53 Rev. 5). The outsourcing of systems and services creates a set of cybersecurity supply chain concerns that reduces the acquirer's visibility into, and control of, the outsourced functions. Therefore, it requires increased rigor from enterprises in defining C-SCRM requirements, stating them in procurement agreements, and monitoring delivered services and evaluating them for compliance with the stated requirements. Regardless of who performs the services, the acquirer is ultimately responsible and accountable for the risk to the enterprise's systems and data resulting from the use of these services. Enterprises should implement a set of compensating C-SCRM controls to address this risk and work with the mission/business process owner or risk executive to accept this risk. A variety of methods may be used to communicate and subsequently verify and monitor C-SCRM requirements through such vehicles as contracts, interagency agreements, lines of business arrangements, licensing agreements, and/or supply chain transactions.

OTHER ICT/OT-RELATED SERVICE PROVIDERS

Providers of services can perform a wide range of different functions ranging from consulting to publishing website content to janitorial services. Other ICT/OT-related Service Providers encompass those providers that require physical or logical access to ICT/OT or use technology (e.g., an aerial photographer using a drone to take video/pictures or a security firm remotely monitoring a facility using cloud-based video surveillance) as a means to delivering their service. As a result of service provider access or use, the potential for cyber-supply chain risk being introduced to the enterprise arises.

Operational technology possesses unique operational and security characteristics that necessitate the application of specialized skills and capabilities to effectively protect them. Enterprises that have significant OT components throughout their enterprise architecture therefore often turn to specialized service providers for secure implementation and maintenance of these devices, systems, or equipment. Any enterprise or individual providing services which may include authorized access to an ICT or OT system should adhere to enterprise C-SCRM requirements. Enterprises should apply special scrutiny to ICT/OT-related service providers managing mission critical and/or safety-relevant assets.

SELECTING AND TAILORING IMPLEMENTING C-SCRM SECURITY CONTROLS

The C-SCRM controls defined in this section should be selected and tailored according to individual enterprise needs and environments using the guidance in [NIST SP 800-53 Rev. 5] in order to ensure a cost-effective, risk-based approach to providing enterprise-wide C-SCRM. The C-SCRM baseline defined in this publication addresses the basic needs of a broad and diverse set of constituents. Enterprises must select, tailor, and implement the security controls based on: (i) the environments in which enterprise information systems are acquired and operate; (ii) the nature of operations conducted by enterprises; (iii) the types of threats facing enterprises, missions/business processes, supply chains, and information systems; and (iv) the type of information processed, stored, or transmitted by information systems and the supply chain infrastructure.

After selecting the initial set of security controls, the acquirer should initiate the tailoring process according to NIST SP 800-53B *Control Baselines for Information Systems and Organization* in order to appropriately modify and more closely align the selected controls with the specific conditions within the enterprise. The tailoring should be coordinated with and approved by the appropriate enterprise officials (e.g., authorizing officials, authorizing official designated representatives, risk executive (function), chief information officers, or senior information security officers) prior to implementing the C-SCRM controls. Additionally, enterprises have the flexibility to perform the tailoring process at the enterprise level (either as the required tailored baseline or as the starting point for policy-, program- or system-specific tailoring) in support of a specific program at the individual information system level, or using a combination of enterprise-level, program/mission-level, and system-specific approaches.

Selection and tailoring decisions, including the specific rationale for those decisions, should be included within the C-SCRM documentation at Levels 1, 2, and 3 and Appendix C, and approved by the appropriate enterprise officials as part of the C-SCRM plan approval process.

C-SCRM CONTROL FORMAT

Table 4-2 shows the format used in this publication for controls providing supplemental C-SCRM guidance on existing [NIST SP 800-53 Rev. 5] controls or control enhancements.

C-SCRM controls that do not have a parent [NIST SP 800-53 Rev. 5] control generally follow the format described in [NIST SP 800-53 Rev. 5], with the addition of relevant levels. New controls are given identifiers consistent with [NIST SP 800-53 Rev. 5], but do not duplicate existing control identifiers.

Table A-1: C-SCRM Control Format

CONTROL IDENTIFIER	CONTROL NAME
	Supplemental C-SCRM Guidance:
	Level(s):
	Related Control(s):
	Control Enhancement(s):
(1)	*CONTROL NAME | CONTROL ENHANCEMENT NAME*
	Supplemental C-SCRM Guidance:
	Level(s):
	Related Control(s):

An example of the C-SCRM control format is shown below using C-SCRM Control AC-3 and SCRM Control Enhancement AC-3(8):

AC-3 ACCESS ENFORCEMENT

Supplemental C-SCRM Guidance: Ensure that the information systems and the supply chain have appropriate access enforcement mechanisms in place. This includes both physical and logical access enforcement mechanisms, which likely work in coordination for supply chain needs. Enterprises should ensure a detailed definition of access enforcement.

Level(s): 2, 3

Related Control(s): AC-4

Control Enhancement(s):

(8) ACCESS ENFORCEMENT | REVOCATION OF ACCESS AUTHORIZATIONS

(1) Supplemental C-SCRM Guidance: Prompt revocation is critical to ensure that suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers who no longer require access, or who abuse or violate their access privilege, are not able to access an enterprise's system. For example, in a "badge flipping" situation, a contract is transferred from one system integrator enterprise to another with the same personnel supporting the contract. In that situation, the enterprise should disable the existing accounts, retire the old credentials, establish new accounts, and issue completely new credentials.

Level(s): 2, 3

USING C-SCRM CONTROLS IN THIS PUBLICATION

The remainder of Section 4 provides the enhanced C-SCRM overlay of NIST SP 800-53 Rev. 5. This section displays the relationship between NIST SP 800-53 Revision 5 controls and C-SCRM controls in one of the following ways:

- If a [NIST SP 800-53 Rev. 5] control or enhancement was determined to be an information security control that serves as a foundational control for C-SCRM, but is not specific to C-SCRM, it is not included in this publication.
- If a [NIST SP 800-53 Rev. 5] control or enhancement was determined to be relevant to C-SCRM, the levels in which the control applies are also provided.
- If a [NIST SP 800-53 Rev.5] enhancement was determined to be relevant to C-SCRM, but the parent control was not, the parent control number and title is included, but there is no supplemental C-SCRM guidance.
- C-SCRM controls/enhancements that do not have an associated [NIST 800-53 Rev. 5] control/enhancement are listed with their titles and the control/enhancement text.
- All C-SCRM controls include the levels in which the control applies and supplemental C-SCRM guidance as applicable.
- When a control enhancement provides a mechanism for implementing the C-SCRM control, the control enhancement is listed within the Supplemental C-SCRM Guidance and is not included separately.
- If [NIST SP 800-53 Rev. 5] already captures withdrawals or reorganization of prior [NIST SP 800-161] controls, it is not included.

The following new controls and control enhancement have been added:

- The C-SCRM Control MA-8 – Maintenance Monitoring and Information Sharing is added to the Maintenance control family; and
- The C-SCRM Control SR-13 – Supplier Inventory is added to the Supply Chain Risk Management control family.

C-SCRM SECURITY CONTROLS

FAMILY: ACCESS CONTROL

[FIPS 200] specifies the Access Control minimum security requirement as follows:

> *Organizations must limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems) and to the types of transactions and functions that authorized users are permitted to exercise.*

Systems and components that traverse the supply chain are subject to access by a variety of individuals and enterprises, including suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Such access should be defined and managed to ensure that it does not inadvertently result in unauthorized release, modification, or destruction of information. This access should be limited to only the necessary type, duration, and level of access for authorized enterprises (and authorized individuals within those enterprises) and monitored for cybersecurity supply chain impact.

AC-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Enterprises should specify and include in agreements (e.g., contracting language) access control policies for their suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. These should include both physical and logical access to the supply chain and the information system. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

AC-2 ACCOUNT MANAGEMENT

Supplemental C-SCRM Guidance: Use of this control helps establish traceability of actions and actors in the supply chain. This control also helps ensure access authorizations of actors in the supply chain is appropriate on a continuous basis. The enterprise may choose to define a set of roles and associate a level of authorization to ensure proper implementation. Enterprises must ensure that accounts for contractor personnel do not exceed the period of performance of the contract. Privileged accounts should only be established for appropriately vetted contractor personnel. Enterprises should also have processes in place to establish and manage temporary or emergency accounts for contractor personnel that require access to a mission-critical or mission-enabling system during a continuity or emergency event. For example, during a pandemic event, existing contractor personnel who are not able to work due to illness may need to be temporarily backfilled by new contractor staff. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

AC-3 ACCESS ENFORCEMENT

Supplemental C-SCRM Guidance: Ensure that the information systems and the supply chain have appropriate access enforcement mechanisms in place. This includes both physical and logical access enforcement mechanisms, which likely work in coordination for supply chain needs. Enterprises should

ensure a defined consequence framework is in place to address access control violations. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(8) *ACCESS ENFORCEMENT | REVOCATION OF ACCESS AUTHORIZATIONS*

Supplemental C-SCRM Guidance: Prompt revocation is critical to ensure that suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers who no longer require access, or who abuse or violate their access privilege, are not able to access an enterprise's system. Enterprises should include in their agreements a requirement for contractors, and sub-tier contractors, to immediately return access credentials (e.g., tokens, PIV or CAC cards, etc.) to the enterprise and enterprises must have processes in place to promptly process the revocation of access authorizations. For example, in a "badge flipping" situation, a contract is transferred from one system integrator enterprise to another with the same personnel supporting the contract. In that situation, the enterprise should disable the existing accounts, retire the old credentials, establish new accounts, and issue completely new credentials.

Level(s): 2, 3

(9) *ACCESS ENFORCEMENT | CONTROLLED RELEASE*

Supplemental C-SCRM Guidance: Information about the supply chain should be controlled for release between the enterprise and third parties. Information may be exchanged between the enterprise and its suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Controlled release of enterprise information provides protection to manage risks associated with disclosure.

Level(s): 2, 3

AC-4 INFORMATION FLOW ENFORCEMENT

Supplemental C- SCRM Guidance: Supply chain information may traverse a large supply chain to a broad set of stakeholders including the enterprise and its various federal stakeholders, as well as suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Specifying the requirements as well as how information flow is enforced should ensure that only the required information, and not more, is communicated to the various participants in the supply chain. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors. Enterprises should specify the requirements as well as how information flow is enforced to ensure that only the required information, and not more, is communicated to the various participants in the supply chain

Level(s): 2, 3

Control Enhancement(s):

(6) *INFORMATION FLOW ENFORCEMENT | METADATA*

Supplemental C-SCRM Guidance: Metadata relevant to C-SCRM is quite extensive and includes activities within the SDLC. For example, information about systems and system components, acquisition details, and delivery is considered metadata and may require appropriate protections. Enterprises should identify what metadata is directly relevant to their supply chain security and ensure that information flow enforcement is implemented in order to protect applicable metadata.

Level(s): 2, 3

(17) *INFORMATION FLOW ENFORCEMENT | DOMAIN AUTHENTICATION*

Supplemental C-SCRM Guidance: Within the C-SCRM context, enterprises should specify various source and destination points for information about the supply chain and information that flows through the supply chain. This is so that enterprises have visibility of information flow within the supply chain.

Level(s): 2, 3

(19) *INFORMATION FLOW ENFORCEMENT | VALIDATION OF METADATA*

Supplemental C-SCRM Guidance: For C-SCRM, validation of data and the relationship to its metadata are critical. Much of the data transmitted through the supply chain is validated with the verification of the associated metadata that is bound to it. Ensure that proper filtering and inspection is put in place for validation before allowing payloads into the supply chain.

Level(s): 2, 3

(21) *INFORMATION FLOW ENFORCEMENT | PHYSICAL OR LOGICAL SEPARATION OF INFORMATION FLOWS*

Supplemental C-SCRM Guidance: The enterprise should ensure the separation of the information system and supply chain information[18] flow. Various mechanisms can be implemented including, for example, encryption methods (e.g., digital signing). Addressing information flow between the enterprise and its suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers may be challenging, especially when leveraging public networks.

Level(s): 3

AC-5 SEPARATION OF DUTIES

Supplemental C-SCRM Guidance: The enterprise should ensure that appropriate separation of duties is established for decisions requiring the acquisition of both information system and supply chain components. Separation of duties helps to ensure that adequate protections are in place for components entering the enterprise's supply chain. An example may be developers not having privileges to promote code they wrote from development to production environments. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

AC-6 LEAST PRIVILEGE

Supplemental C-SCRM Guidance: For C-SCRM supplemental guidance, see control enhancements.

Control Enhancement(s):

(6) *LEAST PRIVILEGE | PRIVILEGED ACCESS BY NON-ORGANIZATIONAL USERS*

Supplemental C-SCRM Guidance: Enterprises should ensure that protections are in place to prevent non-enterprise users from having privileged access to enterprise supply chain and related supply chain

[18] Supply Chain Cybersecurity Risk Information is defined in the glossary of this document based on the FASCA definition for the term

information. When enterprise users may include independent consultants, suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, relevant access requirements may need to be more precisely defined regarding which information and/or components are accessible, for what duration, at which frequency, using which access methods, and by whom, using least privilege mechanisms. Understanding which components are critical and noncritical can aid in understanding the level of detail that may need to be defined regarding least privilege access for non-enterprise users.

Level(s): 2, 3

AC-17 REMOTE ACCESS

Supplemental C-SCRM Guidance: Evermore frequently, supply chains are accessed remotely. Whether for the purpose of development, maintenance, or operation of information systems, enterprises should implement secure remote access mechanisms and allow remote access only to vetted personnel. Remote access to an enterprise's supply chain (including distributed software development environments) should be limited to the enterprise or contractor personnel and only if and as required to perform their tasks. Remote access requirements, such as a requirement to use a secure VPN, employ multi-factor authentication, limit access to specified business hours, or from specified geographic locations, must be properly defined in agreements. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(6) *REMOTE ACCESS | PROTECTION OF MECHANISM INFORMATION*

Supplemental C-SCRM Guidance: Enterprises should ensure that detailed requirements are properly defined and access to information regarding the information system and supply chain is protected from unauthorized use and disclosure. Since supply chain data and metadata disclosure or access can have significant implications to an enterprise's mission processes, appropriate measures must be taken to vet both the supply chain and personnel processes to ensure that adequate protections are implemented. Ensure that remote access to such information is included in requirements.

Level(s): 2, 3

AC-18 WIRELESS ACCESS

Supplemental C-SCRM Guidance: An enterprise's supply chain may include wireless infrastructure that supports supply chain logistics (e.g., Radio Frequency Identification Device (RFID) support, software call home features). Supply chain systems/components traverse the supply chain as they are moved from one location to another, whether within the enterprise's own environment or during delivery from system integrators or suppliers. Ensuring appropriate access mechanisms are in place within this supply chain enables the protection of the information systems and components, as well as logistics technologies and metadata used during shipping (e.g., within tracking sensors). The enterprise should explicitly define appropriate wireless access control mechanisms for the supply chain in policy and implement appropriate mechanisms.

Level(s): 1, 2, 3

AC-19 ACCESS CONTROL FOR MOBILE DEVICES

Supplemental C-SCRM Guidance: Use of mobile devices (e.g., laptops, tablets, e-readers, smartphones, smartwatches) has become common in the supply chain. They are used in direct support of an enterprise's operations as well as for purposes such as tracking supply chain logistics data as information systems and components traverse enterprise or systems integrator supply chains. Ensure that access control mechanisms are clearly defined and implemented where relevant when managing enterprises supply chain components. An example of such an implementation includes access control mechanisms implemented for use with remote handheld units in RFID for tracking components that traverse the supply chain. Access control mechanisms should also be implemented on any associated data and metadata tied to the devices.

Level(s): 2, 3

AC-20 USE OF EXTERNAL SYSTEMS

Supplemental C-SCRM Guidance: Enterprises' external information systems include those of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Unlike in an acquirer's internal enterprise where direct and continuous monitoring is possible, in the external supplier relationship, information may be shared on an as-needed basis and should be articulated in an agreement. Access to the supply chain from such external information systems should be monitored and audited. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

Control Enhancement(s):

(1) *USE OF EXTERNAL SYSTEMS | LIMITS ON AUTHORIZED USE*

Supplemental C-SCRM Guidance: This enhancement helps limit exposure of the supply chain to the suppliers', developers', system integrators', external system service providers', and other ICT/OT-related service providers' systems.

Level(s): 2, 3

(3) *USE OF EXTERNAL SYSTEMS | NON-ORGANIZATIONALLY OWNED SYSTEMS — RESTRICTED USE*

Supplemental C-SCRM Guidance: Devices that do not belong to the enterprise (e.g., bring your own device (BYOD) policies) increase the enterprise's exposure to cybersecurity risk in the supply chain. This includes devices used by suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Enterprises should review the use of non-enterprise devices by non-enterprise personnel and make a risk-based decision as to whether it will allow use of such devices or furnish devices. Enterprises should furnish devices to those non-enterprise personnel that present unacceptable levels of risk.

Level(s): 2, 3

AC-21 INFORMATION SHARING

Supplemental C-SCRM Guidance: Sharing information within the supply chain can help to manage cybersecurity risk in the supply chain. This information may include vulnerabilities, threats, criticality of systems and components, or delivery information. This information sharing should be carefully managed to ensure that the information is accessible only to authorized individuals within the enterprise's supply chain. Enterprises should clearly define boundaries for information sharing with respect to temporal, informational, contractual, security, access, system, and other requirements. Enterprises should monitor and review for unintentional or intentional information sharing within its supply chain activities including

information sharing with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Level(s): 1, 2

AC-22 PUBLICLY ACCESSIBLE CONTENT

Supplemental C-SCRM Guidance: Within the C-SCRM context, publicly accessible content may include Requests for Information, Requests for Proposal, or information about delivery of systems and components. This information should be reviewed to ensure that only appropriate content is released for public consumption, alone or in aggregation with other information.

Level(s): 2, 3

AC-23 DATA MINING PROTECTION

Supplemental C-SCRM Guidance: Enterprises should require its prime contractors to implement this control as part of their insider threat activities and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

AC-24 ACCESS CONTROL DECISIONS

Supplemental C-SCRM Guidance: Enterprises should assign access control decisions to support authorized accesses to the supply chain. Ensure that if a system integrator or external service provider is used, there is consistency in access control decision requirements and how the requirements are implemented to deliver consistency in support of the enterprise's supply chain needs. This may require defining such requirements in service-level agreements in many cases as part of the upfront relationship established between the enterprise and system integrator or the enterprise and external service provider. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

FAMILY: AWARENESS AND TRAINING

[FIPS 200] specifies the Awareness and Training minimum security requirement as follows:

> *Organizations must: (i) ensure that managers and users of organizational information systems are made aware of the security risks associated with their activities and of the applicable laws, Executive Orders, directives, policies, standards, instructions, regulations, or procedures related to the security of organizational information systems; and (ii) ensure that organizational personnel are adequately trained to carry out their assigned information security-related duties and responsibilities.*

[NIST SP 800-161 Rev. 1] expands the Awareness and Training control of [FIPS 200] to include C-SCRM. Making the workforce aware of C-SCRM concerns is key to a successful C-SCRM strategy. C-SCRM awareness and training provides understanding of the problem space and of the appropriate processes and controls that can help mitigate cybersecurity risk in the supply chain. Enterprises should provide C-SCRM awareness and training to individuals at all levels within the enterprise including, for example, information security, procurement, enterprise risk management, engineering, software development, IT, legal, HR, and others. Enterprises should also work with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to ensure the personnel that interact with an enterprise's supply chains receive C-SCRM awareness and training, as appropriate.

AT-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Enterprises should designate a specific official to manage the development, documentation, and dissemination of the awareness and training policy and procedures that includes C-SCRM as well as role-based specific training for those with supply chain responsibilities. Enterprises should integrate cybersecurity supply chain risk management training and awareness into the security training and awareness policy. The C-SCRM training should target both the enterprise and its contractors. The policy should ensure that supply chain cybersecurity role-based training is required for those individuals or functions that touch or impact the supply chain, such as information system owner, acquisition, supply chain logistics, system engineering, program management, IT, quality, and incident response.

C-SCRM training procedures should address:

a. Roles throughout the supply chain and system/element life cycle to limit opportunities and means available to individuals performing these roles that could result in adverse consequences;
b. Requirements for interaction between an enterprise's personnel and individuals not employed by the enterprise that participate in the supply chain throughout the SDLC; and
c. Incorporating feedback and lessons learned from C-SCRM activities into the C-SCRM training.

Level(s): 1, 2

AT-2 LITERACY TRAINING AND AWARENESS

Supplemental C-SCRM Guidance: C-SCRM-specific supplemental guidance provided in control enhancements.

Control Enhancements:

(1) *LITERACY TRAINING AND AWARENESS | PRACTICAL EXERCISES*

Supplemental C-SCRM Guidance: Enterprises should provide practical exercises in literacy training that simulate supply chain cybersecurity events and incidents. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-level contractors

(2) *LITERACY TRAINING AND AWARENESS | INSIDER THREAT*

Supplemental C-SCRM Guidance: Enterprises should provide literacy training on recognizing and reporting potential indicators of insider threat within the supply chain. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

(3) *LITERACY TRAINING AND AWARENESS | SOCIAL ENGINEERING AND MINING*

Supplemental C-SCRM Guidance: Enterprises should provide literacy training on recognizing and reporting potential and actual instance of supply chain related social engineering and social mining. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-level contractors

(4) *LITERACY TRAINING AND AWARENESS | SUSPICIOUS COMMUNICATIONS AND ANOMALOUS SYSTEM BEHAVIOR*

Supplemental C-SCRM Guidance: Provide literacy training on recognizing suspicious communications on anomalous behavior in enterprise supply chain systems. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-level contractors.

(5) *LITERACY TRAINING AND AWARENESS | ADVANCED PERSISTENT THREAT*

Supplemental C-SCRM Guidance: Provide literacy training on recognizing suspicious communications on advanced persistent threat (APT) in the enterprise's supply chain. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-level contractors

(6) *LITERACY TRAINING AND AWARENESS | CYBER THREAT ENVIRONMENT*

Supplemental C-SCRM Guidance: Provide literacy training on cyber threats specific to the enterprise's supply chain environment. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-level contractors

Level(s): 2

AT-3 ROLE-BASED TRAINING

Supplemental C-SCRM Guidance: Addressing cyber-supply chain risks throughout the acquisition process is essential to performing C-SCRM effectively. Personnel who are part of the acquisition workforce require training on what C-SCRM requirements, clauses, and evaluation factors are necessary to include when conducting a procurement and how to incorporate C-SCRM into each acquisition phase. Similar enhanced training requirements should be tailored for personnel responsible for conducting threat assessments and involved in responding to threats and identified risks require training in counter-intelligence awareness and reporting. Enterprises should ensure that developers receive training on secure development practices as well as the use of vulnerability scanning tools. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Control Enhancement(s):

(7) *SECURITY TRAINING | PHYSICAL SECURITY CONTROLS*

Supplemental C-SCRM Guidance: C-SCRM is impacted by a number of physical security mechanisms and procedures within the supply chain, such as manufacturing, shipping, and receiving, physical access to facilities, inventory management, and warehousing. Enterprise and system integrator personnel providing development and operational support to the enterprise should receive training on how to handle these physical security mechanisms and on the associated cybersecurity risk in the supply chain.

Level(s): 2

(6) *ROLE-BASED TRAINING | COUNTERINTELLIGENCE TRAINING*

Supplemental C-SCRM Guidance: Public sector enterprises should provide specialized counterintelligence awareness training that enables its resources to collect, interpret, and act upon a range of data sources that may signal the presence of a foreign adversary's presence in the supply chain. Counterintelligence training should at a minimum cover known red flags, key information sharing concepts, and reporting requirements.

Level(s): 2

AT-4 TRAINING RECORDS

Supplemental C-SCRM Guidance: Enterprises should maintain documentation for C-SCRM-specific training, especially in regard to key personnel in acquisitions and counterintelligence.

Level(s): 2

FAMILY: AUDIT AND ACCOUNTABILITY

[FIPS 200] specifies the Audit and Accountability minimum security requirement as follows:

> *Organizations must: (i) create, protect, and retain information system audit records to the extent needed to enable the monitoring, analysis, investigation, and reporting of unlawful, unauthorized, or inappropriate information system activity; and (ii) ensure that the actions of individual information system users can be uniquely traced to those users so they can be held accountable for their actions.*

Audit and accountability controls for C-SCRM provide information useful in the event of a supply chain cybersecurity incident or compromise. Enterprises should ensure they designate and audit cybersecurity supply chain-relevant events within their information system boundaries using appropriate audit mechanisms (e.g., system logs, Intrusion Detection System (IDS) logs, firewall logs, paper reports, forms, clipboard checklists, digital records). These audit mechanisms should also be configured to work within reasonable time-frame boundaries, as defined by enterprise policy. Enterprises may encourage their system suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to do the same and may include in agreements requirements for such monitoring. However, enterprises should not deploy audit mechanisms on systems outside of their enterprise boundary, including those of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

AU-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Enterprises must designate a specific official to manage the development, documentation, and dissemination of the audit and accountability policy and procedures to include auditing of the supply chain information systems and network. Audit mechanisms provide data for tracking activities in an enterprise's supply chain information systems and network. Audit and accountability policy and procedures should appropriately address such tracking and its availability for other various supply chain activities, such as configuration management. Suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers activities should not be included in such policy, unless those are performed within the acquirer's supply chain information systems and network. Audit and accountability policy procedures should appropriately address supplier audits as a way to examine the quality of a particular supplier and the risk it presents to the enterprise and the enterprise's supply chain.

Level(s): 1, 2, 3

AU-2 EVENT LOGGING

Supplemental C-SCRM Guidance: An observable occurrence within the information system or supply chain network should be identified as a supply chain auditable event, based on the enterprise's SDLC context and requirements. Auditable events may include software/hardware changes, failed attempts to access supply chain information systems, or movement of source code. Information on such events should be captured by appropriate audit mechanisms and should be traceable and verifiable. Information captured may include type of event, date/time, length, and frequency of occurrence. Among other things, auditing may help detect misuse of the supply chain information systems or network caused by insider threat. Logs are a key resource when identifying operational trends and long-term problems, and as such enterprises should incorporate reviewing logs at contract renewal point for vendors to determine whether there is

systemic problem. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

AU-3 CONTENT OF AUDIT RECORDS

Supplemental C-SCRM Guidance: Audit records of a supply chain event should be handled and maintained in a manner that conforms to record retention requirements, preserves the integrity of the findings, and as appropriate, the confidentiality of the record information and its source(s). In certain instances, such records may be used in administrative or legal proceedings. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

AU-6 AUDIT REVIEW, ANALYSIS, AND REPORTING

Supplemental C-SCRM Guidance: The enterprise should ensure that both supply chain and information security auditable events are appropriately filtered and correlated for analysis and reporting. For example, if new maintenance or a patch upgrade is recognized to have an invalid digital signature, the identification of the patch arrival qualifies as a supply chain auditable event, while invalid signature is an information security auditable event. The combination of these two events may provide information valuable to C-SCRM. The enterprise should adjust the level of audit record review based on risk changes (e.g., active threat intel, risk profile) on a specific vendor. Contracts should explicitly address how audit findings will be reported and adjudicated.

Level(s): 2, 3

Control Enhancement(s):

(9) *AUDIT REVIEW, ANALYSIS, AND REPORTING | CORRELATION WITH INFORMATION FROM NONTECHNICAL SOURCES*

Supplemental C-SCRM Guidance: In a C-SCRM context, nontechnical sources include changes to enterprise security or operational policy, changes to procurement or contracting processes, and notifications from suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers regarding plans to update, enhance, patch, or retire/dispose of a system/component.

Level(s): 3

AU-10 NON-REPUDIATION

Supplemental C-SCRM Guidance: Enterprises should implement non-repudiation techniques to protect both information systems and supply chain network. Examples of what may require non-repudiation include supply chain metadata describing the components, supply chain communication, delivery acceptance information, etc. For information systems, it can be patch or maintenance upgrades for software as well as component replacement in a large hardware system. Verifying that such components originate from the OEM is part of non-repudiation.

Level(s): 3

Control Enhancement(s):

(1) *NON-REPUDIATION | ASSOCIATION OF IDENTITIES*

Supplemental C-SCRM Guidance: This enhancement helps traceability in supply chain. It also facilitates the accuracy of provenance.

Level(s): 2

(2) *NON-REPUDIATION | VALIDATE BINDING OF INFORMATION PRODUCER IDENTITY*

Supplemental C-SCRM Guidance: This enhancement validates the relationship of provenance and a component within the supply chain. Therefore, it ensures integrity of provenance.

Level(s): 2, 3

(3) *NON-REPUDIATION | CHAIN OF CUSTODY*

Supplemental C-SCRM Guidance: Chain of custody is fundamental to provenance and traceability in the supply chain. It also helps verification of system and component integrity.

Level(s): 2, 3

AU-12 AUDIT RECORD GENERATION

Supplemental C-SCRM Guidance: Enterprises should ensure that audit record generation mechanisms are in place to capture all relevant supply chain auditable events. Examples of such events include component version updates, component approvals from acceptance testing results, logistics data-capturing inventory, or transportation information. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

AU-13 MONITORING FOR INFORMATION DISCLOSURE

Supplemental C-SCRM Guidance: Within the C-SCRM context, information disclosure may occur via multiple avenues including open source information. For example, supplier-provided errata may reveal information about an enterprise's system that may provide insight into the system that increases the risk to the system. Enterprises should ensure monitoring is in place for contractor systems to detect unauthorized disclosure of any data and ensure contract language includes a requirement that the vendor will notify the enterprise, in accordance with enterprise-defined timeframes and as soon as possible in the event of any potential or actual unauthorized disclosure. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

AU-14 SESSION AUDIT

Supplemental C-SCRM Guidance: Enterprises should include non-federal contract employees in session audits to identify security risks in the supply chain. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

AU-16 CROSS-ORGANIZATIONAL AUDIT LOGGING

Supplemental C-SCRM Guidance: In a C-SCRM context, this control includes the enterprise's use of system integrator or external service provider infrastructure. Enterprises should add language to contracts on coordinating audit information requirements and information exchange agreements with vendors.

Level(s): 2, 3

Control Enhancement(s):

(2) *CROSS-ORGANIZATIONAL AUDIT LOGGING | SHARING OF AUDIT INFORMATION*

Supplemental C-SCRM Guidance: Whether managing a distributed audit environment or an audit data-sharing environment between enterprises and its system integrators or external services providers, enterprises should establish a set of requirements for the process of sharing audit information. In the case of the system integrator and external service provider and the enterprise, a service-level agreement of the type of audit data required vs. what can be provided must be agreed to in advance to ensure that the enterprise obtains the relevant audit information needed for ensuring that appropriate protections are in place to meet its mission operation protection needs. Ensure that coverage of both information systems and supply chain network are addressed for the collection and sharing of audit information. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-level contractors.

Level(s): 2, 3

FAMILY: ASSESSMENT, AUTHORIZATION, AND MONITORING

[FIPS 200] specifies the Certification, Accreditation, and Security Assessments minimum security requirement as follows:

> *Organizations must: (i) periodically assess the security controls in organizational information systems to determine if the controls are effective in their application; (ii) develop and implement plans of action designed to correct deficiencies and reduce or eliminate vulnerabilities in organizational information systems; (iii) authorize the operation of organizational information systems and any associated information system connections; and (iv) monitor information system security controls on an ongoing basis to ensure the continued effectiveness of the controls.*

Enterprises should integrate C-SCRM, including the supply chain risk management process and the use of relevant controls defined in this publication, into ongoing security assessment and authorization activities. This includes activities to assess and authorize an enterprise's information systems, as well as external assessments of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, where appropriate. Supply chain aspects include documentation and tracking of chain of custody and system interconnections within and between enterprises, verification of supply chain cybersecurity training, verification of suppliers claims of conformance to security, product/component integrity, and validation tools and techniques for noninvasive approaches to detecting counterfeits or malware (e.g., Trojans) using inspection for genuine components including manual inspection techniques.

CA-1 POLICY AND PROCEDURES

Supplemental C- SCRM Guidance: Integrate the development and implementation of assessment and authorization policies and procedures for supply chain cybersecurity into the control assessment and authorization policy, and related C-SCRM Strategy/Implementation Plan(s), policies, and system-level plans. To address cybersecurity risk in the supply chain, enterprises should develop a C-SCRM policy (or, if required, integrate into existing policies) to direct C-SCRM activities for control assessment and authorization. The C-SCRM policy should define C-SCRM roles and responsibilities within the enterprise for conducting control assessment and authorization, any dependencies among those roles, and the interaction among the roles. Enterprise-wide security and privacy risk should be assessed on an ongoing basis and include supply chain risk assessment results.

Level(s): 1, 2, 3

CA-2 CONTROL ASSESSMENTS

Supplemental C-SCRM Guidance: Ensure that the control assessment plan incorporates relevant C-SCRM controls and control enhancements. The control assessment should cover the assessment of both information systems and the supply chain and ensure that an enterprise-relevant baseline set of controls and control enhancements are identified and used for the assessment. Control assessments can include information from supplier audits, reviews, and supply chain-related information. Enterprises should develop a strategy for collecting information, including a strategy for engaging with providers on supply chain risk assessments. Such collaboration helps enterprises leverage information from providers, reduce

redundancy, identify potential courses of action for risk responses, and reduce the burden on providers. C-SCRM personnel should review the control assessment.

Level(s): 2, 3

Control Enhancement(s):

(2) *CONTROL ASSESSMENTS | SPECIALIZED ASSESSMENTS*

Supplemental C-SCRM Guidance: Enterprises should use a variety of assessment techniques and methodologies such as continuous monitoring, insider threat assessment, and malicious user's assessment. These assessment mechanisms are context-specific and require the enterprise to understand its supply chain and to define the required set of measures for assessing and verifying that appropriate protections have been implemented.

Level(s): 3

(3) *CONTROL ASSESSMENTS | LEVERAGING RESULTS FROM EXTERNAL ORGANIZATIONS*

Supplemental C-SCRM Guidance: For C-SCRM, enterprises should use external security assessments for suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. External assessments include certifications, third-party assessments, and, in the federal context, prior assessments performed by other departments and agencies. Enterprises such as the International Enterprise for Standardization (ISO), the National Information Assurance Partnership (Common Criteria), and the Open Group Trusted Technology Forum (OTTF) certifications may also be used by non-federal and federal enterprises alike, if such certifications meet agency needs.

Level(s): 3

CA-3 INFORMATION EXCHANGE

Supplemental C-SCRM Guidance: Exchange of information or data between the system and other systems require scrutiny from a supply chain perspective. This includes understanding the interface characteristics and connections of those components/systems that are directly interconnected to or the data that is shared through those components/systems with developers, system integrators, external system service providers, other ICT/OT-related service providers and, in some cases, suppliers. Ensure that proper service-level agreements are in place to ensure compliance to system information exchange requirements defined by the enterprise, as the transfer of information between systems in different security or privacy domains with different security or privacy policies introduces risk that such transfers violate one or more domain security or privacy policies. Examples of such interconnections can include:

a. A shared development and operational environment between the enterprise and system integrator;
b. Product update/patch management connection to an off-the-shelf supplier; and
c. Data request and retrieval transactions in a processing system residing on an external service provider shared environment.

Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 3

CA-5 PLAN OF ACTION AND MILESTONES

Supplemental C-SCRM Guidance: For system-level plan of actions and milestones (POA&Ms), enterprises need to ensure that a separate POA&M exists for C-SCRM include both information systems and the

supply chain. The C-SCRM POA&M should include tasks to be accomplished with a recommendation for completion before or after system authorization; resources required to accomplish the tasks; milestones established to meet the tasks; and the scheduled completion dates for the milestones and tasks. The enterprise should include in its C-SCRM POA&M relevant weaknesses, impact of weaknesses on information systems or the supply chain, any remediation to address weaknesses, and any continuous monitoring activities. The C-SCRM POA&M should be included as part of the authorization package.

Level(s): 2, 3

CA-6 AUTHORIZATION

Supplemental C-SCRM Guidance: Authorizing officials should include C-SCRM in authorization decisions. To accomplish this, supply chain risks and compensating controls documented in C-SCRM Plans or system security plans, and C-SCRM plan of action and milestones should be included in the authorization package as part of the decision-making process. Risks should be determined and associated compensating controls selected based on output from criticality, threat, and vulnerability analyses. Authorizing officials may use guidance in Section 2 of this document as well as NISTIR 8179 to guide the assessment process.

Level(s): 1, 2, 3

CA-7 CONTINUOUS MONITORING

Supplemental C-SCRM Guidance: For C-SCRM-specific guidance on this control, see Section 2 of this publication.

Level(s): 1, 2, 3

Control Enhancement(s):

(3) *CONTINUOUS MONITORING | TREND ANALYSES*

Supplemental C-SCRM Guidance: Information gathered during continuous monitoring/trend analysis serves as input into C-SCRM decisions including criticality analysis, vulnerability and threat analysis, and risk assessment. It also provides information that can be used in incident response and potentially can identify a supply chain cybersecurity compromise, including insider threat.

Level(s): 3

FAMILY: CONFIGURATION MANAGEMENT

[FIPS 200] specifies the Configuration Management minimum security requirement as follows:

> *Organizations must: (i) establish and maintain baseline configurations and inventories of organizational information systems (including hardware, software, firmware, and documentation) throughout the respective system development life cycles; and (ii) establish and enforce security configuration settings for information technology products employed in organizational information systems.*

Configuration Management helps track systems, components, and documentation within the information systems, networks, and throughout the SDLC. This is important for knowing what changes were made to those systems, components, and documentation, who made the changes, and who authorized the changes. Fundamentally, configuration management provides tools to establish the chain of custody for systems, components, and documentation. Configuration management also provides evidence for investigations of supply chain cybersecurity compromise when determining which changes were authorized and which were not, and therefore provides useful information. Enterprises should apply configuration management controls to their own systems and encourage use of configuration management controls by their suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. See NISTIR 7622 for more information on Configuration Management.

CM-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Configuration management impacts nearly every aspect of the supply chain. Configuration Management is critical for enterprise's ability to establish provenance of components to include tracking and tracing them through the SDLC and through the supply chain. Properly defined and implemented configuration management capability provides greater assurance throughout the SDLC and the supply chain that components are authentic and have not been inappropriately modified. When defining configuration management policy and procedures, enterprises should address the full SDLC. This should include procedures for introducing and removing components to and from the enterprise's information system boundary. Configuration Management policy should incorporate configuration items, data retention for configuration items and corresponding metadata, and tracking of the configuration item and its metadata. The enterprise should coordinate with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers regarding the configuration management policy.

Level(s): 1, 2, 3

CM-2 BASELINE CONFIGURATION

Supplemental C-SCRM Guidance: Enterprises should establish a baseline configuration of both the information system and the development environment including documenting, formally reviewing, and securing the agreement of stakeholders. The purpose of the baseline is to provide a starting point for tracking the changes to components, code, and/or settings throughout the SDLC. Regular reviews and updates of baseline configurations (i.e., re-baselining) are critical for traceability and provenance. The baseline configuration must take into consideration the enterprise's operational environment and any relevant suppliers', developers', system integrators', external system service providers', and other ICT/OT-related service providers' involvement within the organization's information systems and networks. If the

system integrator, for example, uses the existing organization's infrastructure, appropriate measures should be taken to establish a baseline that reflects an appropriate set of agreed-upon criteria for access and operation. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(6) *BASELINE CONFIGURATION | DEVELOPMENT AND TEST ENVIRONMENTS*

Supplemental C-SCRM Guidance: The enterprise should maintain or require the maintenance of a baseline configuration of applicable suppliers', developers', system integrators', external system service providers', and other ICT/OT-related service providers' development, test (and if applicable, staging) environments as well as any configuration of interfaces.

Level(s): 2, 3

CM-3 CONFIGURATION CHANGE CONTROL

Supplemental C-SCRM Guidance: Enterprises should determine, implement, monitor, and audit configuration settings and change controls within the information systems and networks and throughout the SDLC. This control supports traceability for C-SCRM. The below NIST SP 800-53 Rev. 5 control enhancements CM-3 (1), (2), (4), and (8) are mechanisms that can be used for C-SCRM to collect and manage change control data. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

(1) *CONFIGURATION CHANGE CONTROL | AUTOMATED DOCUMENTATION, NOTIFICATION, AND PROHIBITION OF CHANGES*

Supplemental C-SCRM Guidance: Enterprises should define a set of system changes that are critical to the protection of the information system and the underlying or interoperating systems and networks. These changes may be defined based on a criticality analysis (including components, processes, and functions) and where vulnerabilities exist that are not yet remediated (e.g., due to resource constraints). The change control process should also monitor for changes that may affect an existing security control to ensure that this control continues to function as required.

Level(s): 2, 3

(2) *CONFIGURATION CHANGE CONTROL | TESTING, VALIDATION, AND DOCUMENTATION OF CHANGES*

Supplemental C-SCRM Guidance: Test, validate, and document changes to the system before finalizing the implementation of the changes.

Level(s): 2, 3

(4) *CONFIGURATION CHANGE CONTROL | SECURITY AND PRIVACY REPRESENTATIVES*

Supplemental C-SCRM Guidance: Require enterprise security and privacy representatives] to be members of the configuration change control function.

Level(s): 2, 3

(8) *CONFIGURATION CHANGE CONTROL | PREVENT OR RESTRICT CONFIGURATION CHANGES*

Supplemental C-SCRM Guidance: Prevent or restrict changes to the configuration of the system under enterprise-defined circumstances.

Level(s): 2, 3

CM-4 IMPACT ANALYSIS

Supplemental C-SCRM Guidance: Enterprises should take under consideration changes to the information system and underlying or interoperable systems and networks to determine whether the impact of these changes affects existing security control(s) and warrants additional or different protection to maintain an acceptable level of cybersecurity risk in the supply chain. Ensure that stakeholders, such as system engineers and system security engineers are included in the impact analysis activities to provide their perspectives for C-SCRM. NIST SP 800-53 Rev. 5 control enhancement CM-4 (1) is a mechanism that can be used to protect the information system and from vulnerabilities that may be introduced through the test environment.

Level(s): 3

(1) *IMPACT ANALYSES | SEPARATE TEST ENVIRONMENTS*

Analyze changes to the system in a separate test environment before implementation in an operational environment, looking for security and privacy impacts due to flaws, weaknesses, incompatibility, or intentional malice

Level(s): 3

Related Control(s): SA-11, SC-7

CM-5 ACCESS RESTRICTIONS FOR CHANGE

Supplemental C-SCRM Guidance: Enterprises should ensure that requirements regarding physical and logical access restrictions for changes to the information systems and networks are defined and included in the enterprise's implementation of access restrictions. Examples include access restriction for changes to centrally managed processes for software component updates and the deployment of updates or patches.

Level(s): 2, 3

Control Enhancements:

(1) *ACCESS RESTRICTIONS FOR CHANGE | AUTOMATED ACCESS ENFORCEMENT AND AUDIT RECORDS*

Supplemental C-SCRM Guidance: Enterprises should implement mechanisms to ensure automated access enforcement and auditing of the information system and the underlying systems and networks.

Level(s): 3

(6) *ACCESS RESTRICTIONS FOR CHANGE | LIMIT LIBRARY PRIVILEGES*

Supplemental C-SCRM Guidance: Enterprises should note that software libraries may be considered configuration items, access to which should be managed and controlled.

Level(s): 3

CM-6 CONFIGURATION SETTINGS

Supplemental C-SCRM Guidance: Enterprises should oversee the function of modifying configuration settings for their information systems and networks and throughout the SDLC. Methods of oversight include periodic verification, reporting, and review. Resulting information may be shared with various parties that have access to, are connected to, or engage in creation of the enterprise's information systems and networks on a need-to-know basis. Changes should be tested and approved before they are implemented. Configuration settings should be monitored and audited to alert designated enterprise personnel when a change has occurred. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(1) *CONFIGURATION SETTINGS | AUTOMATED MANAGEMENT, APPLICATION, AND VERIFICATION*

Supplemental C-SCRM Guidance: The enterprise should, when feasible, employ automated mechanisms to manage, apply, and verify configuration settings.

Level(s): 3

(2) *CONFIGURATION SETTINGS | RESPOND TO UNAUTHORIZED CHANGES*

Supplemental C-SCRM Guidance: The enterprise should ensure that designated security or IT personnel are alerted regarding unauthorized changes to configuration settings. When suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers are responsible for such unauthorized changes, this qualifies as a C-SCRM incident that should be recorded and tracked to monitor trends. For a more comprehensive view, a specific, predefined set of C-SCRM stakeholders should assess the impact of unauthorized changes in the supply chain. When impact is assessed, relevant stakeholders should help define and implement appropriate mitigation strategies to ensure a comprehensive resolution.

Level(s): 3

CM-7 LEAST FUNCTIONALITY

Supplemental C-SCRM Guidance: Least functionality reduces the attack surface. Enterprises should select components that allow the flexibility and option for specifying and implementing least functionality. Enterprises should ensure least functionality in their information systems and networks and throughout SDLC. NIST SP 800-53 Rev. 5 control enhancement CM-7 (9) mechanism can be used to protect information systems and networks from vulnerabilities that may be introduced by the use of unauthorized hardware being connected to enterprise systems. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 3

Control Enhancement(s):

(1) *LEAST FUNCTIONALITY | PERIODIC REVIEW*

Supplemental C-SCRM Guidance: Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

(4) *LEAST FUNCTIONALITY | UNAUTHORIZED SOFTWARE*

Supplemental C-SCRM Guidance: Enterprises should define requirements and deploy appropriate processes to specify and detect software that is not allowed. This can be aided by defining a requirement to, at a minimum, not use disreputable or unauthorized software. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

(5) *LEAST FUNCTIONALITY | AUTHORIZED SOFTWARE*

Supplemental C-SCRM Guidance: Enterprises should define requirements and deploy appropriate processes to specify allowable software. This can be aided by defining a requirement to use only reputable software. This can include requirements for alerts when new software and updates to software are introduced into the enterprise's environment. An example of such requirements is to allow open source software only if the code is available for an enterprise's evaluation and determined to be acceptable for use.

Level(s): 3

(6) *LEAST FUNCTIONALITY | CONFINED ENVIRONMENTS WITH LIMITED PRIVILEGES*

Supplemental C-SCRM Guidance: The enterprise should ensure that code authentication mechanisms such as digital signatures are implemented when executing code to assure the integrity of software, firmware, and information of the information systems and networks.

Level(s): 2, 3

(7) *LEAST FUNCTIONALITY | CODE EXECUTION IN PROTECTED ENVIRONMENTS*

Supplemental C-SCRM Guidance: The enterprise should obtain binary or machine-executable code directly from the OEM/developer or other acceptable, verified source.

Level(s): 3

(8) *LEAST FUNCTIONALITY | BINARY OR MACHINE EXECUTABLE CODE*

Supplemental C-SCRM Guidance: When exceptions are made to use software products without accompanying source code and with limited or no warranty because of compelling mission or operational requirements, approval by the authorizing official should be contingent upon the enterprise explicitly incorporating cybersecurity supply chain risk assessments as part of broader assessment of such software products and the implementation of compensating controls to address any identified and assessed risks.

Level(s): 2, 3

(9) *LEAST FUNCTIONALITY | PROHIBITING THE USE OF UNAUTHORIZED HARDWARE*

Enterprises should define requirements and deploy appropriate processes to specify and detect hardware that is not allowed. This can be aided by defining a requirement to, at a minimum, not use disreputable or unauthorized hardware. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors

Level(s): 2, 3

CM-8 SYSTEM COMPONENT INVENTORY

Supplemental C-SCRM Guidance: Enterprises should ensure that critical component assets within the information systems and networks are included in the asset inventory. The inventory must include information for critical component accountability. Inventory information includes, for example, hardware inventory specifications, software license information, software version numbers, component owners, and for networked components or devices, machine names and network addresses. Inventory specifications include, for example, manufacturer, device type, model, serial number, and physical location. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors. Enterprises should specify the requirements as well as how information flow is enforced to ensure that only the required information, and not more, is communicated to the various participants in the supply chain. If information is subsetted downstream, there should be information about who created the subset information. Enterprises should mandate that SBOMs are produced for all classes of software including purchased software, open source software, and in-house software. Refer to Appendix F for additional guidance on SBOMs.

Level(s): 2, 3

Control Enhancement(s):

(1) *SYSTEM COMPONENT INVENTORY | UPDATES DURING INSTALLATION AND REMOVAL*

Supplemental C-SCRM Guidance: When installing, updating, or removing an information system, information system component, or network component, the enterprise needs to update the inventory to ensure traceability for tracking critical components. In addition, the information system's configuration needs to be updated to ensure an accurate inventory of supply chain protections, and re-baselined accordingly.

Level(s): 3

(2) *SYSTEM COMPONENT INVENTORY | AUTOMATED MAINTENANCE*

Supplemental C-SCRM Guidance: The enterprise should implement automated maintenance mechanisms to ensure that changes to component inventory for the information systems and networks are monitored for installation, update, and removal. When automated maintenance is performed with a predefined frequency and with the automated collation of relevant inventory information about each defined component, the enterprise should ensure that updates are available to relevant stakeholders for evaluation. Predefined frequencies for data collection should be less predictable in order to reduce the risk of an insider threat bypassing security mechanisms.

Level(s): 3

(4) *SYSTEM COMPONENT INVENTORY | ACCOUNTABILITY INFORMATION*

Supplemental C-SCRM Guidance: The enterprise should ensure that accountability information is collected for information system and network components. The system/component inventory information should identify those individuals who originate an acquisition as well as intended end users, including any associated personnel who may administer or use the system/components.

Level(s): 3

(6) *SYSTEM COMPONENT INVENTORY | ASSESSED CONFIGURATIONS AND APPROVED DEVIATIONS*

Supplemental C-SCRM Guidance: Assessed configurations and approved deviations must be documented and tracked. Any changes to the baseline configurations of information systems and networks require a review by relevant stakeholders to ensure that the changes do not result in increased cybersecurity risk in the supply chain.

Level(s): 3

(7) *SYSTEM COMPONENT INVENTORY | CENTRALIZED REPOSITORY*

Supplemental C-SCRM Guidance: Enterprises may choose to implement centralized inventories that include components from all enterprise information systems, networks, and their components. Centralized repositories of inventories provide opportunities for efficiencies in accounting for information systems, networks, and their components. Such repositories may also help enterprises to rapidly identify the location and responsible individuals of components that have been compromised, breached, or are otherwise in need of mitigation actions. The enterprise should ensure that centralized inventories include supply chain-specific information required for proper component accountability (e.g., supply chain relevance and information system, network, or component owner).

Level(s): 3

(8) *SYSTEM COMPONENT INVENTORY | AUTOMATED LOCATION TRACKING*

Supplemental C-SCRM Guidance: When employing automated mechanisms for tracking of information system components by physical location, the enterprise should incorporate information system, network, and component tracking needs to ensure accurate inventory.

Level(s): 2, 3

(9) *SYSTEM COMPONENT INVENTORY | ASSIGNMENT OF COMPONENTS TO SYSTEMS*

Supplemental C-SCRM Guidance: When assigning components to systems, the enterprise should ensure that the information systems and networks with all relevant components are inventoried, marked, and properly assigned. This facilitates quick inventory of all components relevant to information systems and networks and enables tracking of components that are considered critical and require differentiating treatment as part of the information system and network protection activities.

Level(s): 3

CM-9 CONFIGURATION MANAGEMENT PLAN

Supplemental C-SCRM Guidance: Enterprises should ensure that C-SCRM is incorporated into the configuration management planning activities. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3.

Control Enhancement(s):

(1) *CONFIGURATION MANAGEMENT PLAN | ASSIGNMENT OF RESPONSIBILITY*

Supplemental C-SCRM Guidance: Enterprises should ensure that all relevant roles are defined to address configuration management activities for information systems and networks. Enterprises should ensure requirements and capabilities for configuration management are appropriately addressed or included in the following supply chain activities: requirements definition, development, testing, market research and analysis, procurement solicitations and contracts, component installation or removal, system integration, operations, and maintenance.

Level(s): 2, 3

CM-10 SOFTWARE USAGE RESTRICTIONS

Supplemental C-SCRM Guidance: Enterprises should ensure that licenses for software used within their information systems and networks are documented, tracked, and maintained. Tracking mechanisms should provide for the ability to trace users and use of licenses to access control information and processes. As an example, when an employee is terminated, a "named user" license, should be revoked and license documentation should be updated to reflect this change.

Level(s): 2, 3

Control Enhancement(s):

(1) *SOFTWARE USAGE RESTRICTIONS | OPEN SOURCE SOFTWARE*

Supplemental C-SCRM Guidance: When considering software, enterprises should review all options and corresponding risks including open source or commercially licensed components. When using open source software (OSS), the enterprise should understand and review the open source communities' typical procedures regarding provenance, configuration management, sources, binaries, reusable frameworks, reusable libraries' availability for testing and use, and any other information that may impact levels of cybersecurity risk in the supply chain. Numerous open source solutions are currently in use by enterprises, including in integrated development environments (IDEs) and web servers. The enterprise should:

a. Track the use of OSS and associated documentation;
b. Ensure that the use of OSS adheres to the licensing terms and that these terms are acceptable to the enterprise
c. Document and monitor the distribution of software as it relates to licensing agreement to control copying and distribution; and
d. Evaluate and periodically audit the OSS's supply chain as provided by the open source developer (e.g., information regarding provenance, configuration management, use of reusable libraries, etc.). This evaluation can be done reasonably easily by the enterprise through obtaining existing and often public documents as well as using experience based on software update and download processes in which the enterprise may have participated.

Level(s): 2, 3

CM-11 USER-INSTALLED SOFTWARE

Supplemental C-SCRM Guidance: This control extends to enterprise information system and network users who are not employed by the enterprise. These users may be suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Level(s): 2, 3

CM-12 INFORMATION LOCATION

Supplemental C-SCRM Guidance: Information residing in different physical locations may be subject to different cybersecurity risk in the supply chain, depending on the specific location of the information. Components originating or operating from different physical locations may also be subject to different supply chain risks, depending on the specific location of origination or operations. Enterprises should manage these risks through limiting access control, specifying allowable or disallowable geographic locations for backup/recovery, patching/upgrades, and information transfer/sharing. NIST SP 800-53 Rev. 5 control enhancement CM-12 (1) is a mechanism that can be used to enable automated location of components.

Level(s): 2, 3

Control Enhancement(s):

(1) *INFORMATION LOCATION | AUTOMATED TOOLS TO SUPPORT INFORMATION LOCATION*

Use automated tools to identify enterprise-defined information on enterprise-defined system components to ensure controls are in place to protect enterprise information and individual privacy.

Level(s): 2, 3

CM-13 DATA ACTION MAPPING

Supplemental C-SCRM Guidance: In addition to personally identifiable information, understanding and documenting a map of system data actions for sensitive or classified information is necessary. Data action mapping should also be conducted to map internet of things (IoT) devices, embedded or stand-alone IoT systems, or IoT System of System data actions. Understanding what classified or IoT information is being processed, its sensitivity and/or effect on a physical thing or physical environment, how the sensitive or IoT information is being processed (e.g., if the data action is visible to an individual or is processed in another part of the system), and by whom provides a number of contextual factors that are important to assessing the degree of risk. Data maps can be illustrated in different ways, and the level of detail may vary based on the mission and business needs of the enterprise. The data map may be an overlay of any system design artifact that the enterprise is using. The development of this map may necessitate coordination between program and security personnel regarding the covered data actions and the components that are identified as part of the system.

Level(s): 2, 3

CM-14 SIGNED COMPONENTS

Supplemental C-SCRM Guidance: Enterprises should verify that the acquired hardware and software components are genuine and valid by using digitally signed components. Verifying components before allowing installation helps enterprises reduce cybersecurity risk in the supply chain.

Level(s): 3

FAMILY: CONTINGENCY PLANNING

[FIPS 200] specifies the Contingency Planning minimum security requirement as follows:

> *Organizations must establish, maintain, and effectively implement plans for emergency response, backup operations, and post-disaster recovery for organizational information systems to ensure the availability of critical information resources and continuity of operations in emergency situations.*

Cybersecurity supply chain contingency planning includes planning for alternative suppliers of system components, alternative suppliers of systems and services, denial of service attacks to the supply chain, and planning for alternate delivery routes for critical system components. Such contingency plans help ensure existing service providers have an effective continuity of operations pan, especially, when the provider is delivering services in support of a critical mission function. Additionally, many techniques used for contingency planning, such as alternative processing sites, have their own supply chains with their own attendant cybersecurity risk in the supply chain. Enterprises should ensure they understand and manage cybersecurity risk in the supply chain and dependencies related to the contingency planning activities as necessary.

CP-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Enterprises should integrate C-SCRM into the contingency planning policy and related SCRM Strategy/Implementation Plan, policies, and SCRM Plan. The policy cover information systems and the supply chain network and, at a minimum, address scenarios such as:

a. Unplanned component failure and subsequent replacement;
b. Planned replacement related to feature improvements, maintenance, upgrades, and modernization; and
c. Product and/or service disruption.

Level(s): 1, 2, 3

CP-2 CONTINGENCY PLAN

Supplemental C-SCRM Guidance: Enterprises should define and implement a contingency plan for the supply chain information systems and network to ensure preparations are in place to mitigate against the loss or degradation of data or operations. Contingencies should be put in place for the supply chain, network, and information systems (especially critical components), and processes to ensure protection against compromise, provide appropriate failover, and timely recovery to an acceptable state of operations.

Level(s): 2, 3

Control Enhancement(s):

(1) *CONTINGENCY PLAN | COORDINATE WITH RELATED PLANS*

Supplemental C-SCRM Guidance: Coordinate contingency plan development for supply chain risks with enterprise elements responsible for related plans.

Level(S): 2, 3

(2) *CONTINGENCY PLAN | CAPACITY PLANNING*

Supplemental C-SCRM Guidance: This enhancement helps availability of the supply chain network or information system components.

Level(s): 2, 3

(7) *CONTINGENCY PLAN | COORDINATE WITH EXTERNAL SERVICE PROVIDERS*

Supplemental C-SCRM Guidance: Enterprises should ensure that supply chain network, information systems and components provided by an external service provider have appropriate failover (to include personnel, equipment, and network resources) to reduce or prevent service interruption or ensure timely recovery. Enterprises should ensure that contingency planning requirements are defined as part of the service-level agreement. The agreement may have specific terms addressing critical components and functionality support in case of denial of service to ensure continuity of operation. Enterprises should coordinate with external service providers to identify service providers' existing contingency plan practices and build on them as required by the enterprise's mission and business needs. Such coordination will aid in cost reduction and efficient implementation. Enterprises should require its prime contractors that provide a mission/business-critical or -enabling service or product to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 3

(8) *CONTINGENCY PLAN | IDENTIFY CRITICAL ASSETS*

Supplemental C-SCRM Guidance: Ensure that critical assets (including hardware, software, and personnel) are identified to ensure that appropriate contingency planning requirements are defined and applied to ensure continuity of operation. A key step in this process is to complete a criticality analysis on components, functions, and processes to identify all critical assets. See Section 2 and NISTIR 8179 for additional guidance on criticality analyses.

Level(s): 3

CP-3 CONTINGENCY TRAINING

Supplemental C-SCRM Guidance: Enterprises should ensure that critical suppliers are included in contingency training. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(1) *CONTINGENCY TRAINING | SIMULATED EVENTS*

Supplemental C-SCRM Guidance: Enterprises should ensure that suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers who have roles and responsibilities in providing critical services are included in contingency training exercises.

Level(s): 3

CP-4 CONTINGENCY PLAN TESTING

Supplemental C-SCRM Guidance: Enterprises should ensure that critical suppliers are included in contingency testing. The enterprise, in coordination with the service provider(s) should test whether continuity/resiliency capabilities, such as failover from a primary production site to a back-up site. This

testing may occur separately from a training exercise or be performed during the exercise. Enterprises should reference their C-SCRM threat assessment output to develop scenarios to test how well the enterprise is able to withstand and/or recover from a C-SCRM threat event.

Level(s): 2, 3

CP-6 ALTERNATE STORAGE SITE

Supplemental C-SCRM Guidance: When managed by suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, alternate storage sites are considered within an enterprise's supply chain network. Enterprises should apply appropriate cybersecurity supply chain controls to those storage sites.

Level(s): 2, 3

Control Enhancement(s):

(1) *ALTERNATE STORAGE SITE | SEPARATION FROM PRIMARY SITE*

Supplemental C-SCRM Guidance: This enhancement helps resiliency of supply chain network, information systems, and information system components.

Level(s): 2, 3

CP-7 ALTERNATE PROCESSING SITE

Supplemental C-SCRM Guidance: When managed by suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, alternate storage sites are considered within an enterprise's supply chain. Enterprises should apply appropriate supply chain cybersecurity controls to those processing sites.

Level(s): 2, 3

CP-8 TELECOMMUNICATIONS SERVICES

Supplemental C-SCRM Guidance: Enterprises should incorporate alternate telecommunication service providers for their supply chain and to support critical information systems.

Level(s): 2, 3

Control Enhancement(s):

(3) *TELECOMMUNICATIONS SERVICES | SEPARATION OF PRIMARY AND ALTERNATE PROVIDERS*

Supplemental C-SCRM Guidance: Separation of primary and alternate providers supports cybersecurity resilience of the supply chain.

Level(s): 2, 3

(4) *TELECOMMUNICATIONS SERVICES | PROVIDER CONTINGENCY PLAN*

Supplemental C-SCRM Guidance: For C-SCRM, suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers contingency plans should provide separation in infrastructure, service, process, and personnel, where appropriate.

Level(s): 2, 3

CP-11 ALTERNATE COMMUNICATIONS PROTOCOLS

Supplemental C-SCRM Guidance: Enterprises should ensure critical suppliers are included in contingency plans, training, and testing as part of incorporating alternate communications protocol capability to establish supply chain resilience.

Level(s): 2, 3

FAMILY: IDENTIFICATION AND AUTHENTICATION

[FIPS 200] specifies the Identification and Authentication minimum security requirement as follows:

> *Organizations must identify information system users, processes acting on behalf of users, or devices and authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to organizational information systems.*

NIST SP 800-161, *Supply Chain Risk Management Practices for Federal Information Systems and Organizations,* expands the [FIPS 200] identification and authentication control family to include identification and authentication of components, in addition to individuals (users) and processes acting on behalf of individuals within the supply chain network. Identification and authentication are critical to C-SCRM because it provides traceability of individuals, processes acting on behalf of individuals, and specific systems/components in an enterprise's supply chain network. Identification and authentication are required to appropriately manage cybersecurity risk in the supply chain to both reduce risk of supply chain cybersecurity compromise and to generate evidence in case of supply chain cybersecurity compromise.

IA-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: The enterprise should, at enterprise-defined intervals, review, enhance, and update their identity and access management policies and procedures to ensure that critical roles and processes within the supply chain network are defined and that the enterprise's critical systems, components, and processes are identified for traceability. This should include the identity of critical components that may not have been considered under identification and authentication in the past. Note that providing identification for all items within the supply chain would be cost-prohibitive, and discretion should be used. The enterprise should update related C-SCRM Strategy/Implementation Plan(s), Policies, and C-SCRM Plans.

Level(s): 1, 2, 3

IA-2 IDENTIFICATION AND AUTHENTICATION (ORGANIZATIONAL USERS)

Supplemental C-SCRM Guidance: Enterprises should ensure that identification and requirements are defined and applied for enterprise users accessing an ICT/OT system or supply chain network. An enterprise user may include employees as well as individuals deemed to have the equivalent status of employees (e.g., contractors, guest researchers, etc.) and may include system integrators fulfilling contractor roles. Criteria such as "duration in role" can aid in defining which identification and authentication mechanisms are used. The enterprise may choose to define a set of roles and associate a level of authorization to ensure proper implementation. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

IA-3 DEVICE IDENTIFICATION AND AUTHENTICATION

Supplemental C-SCRM Guidance: Enterprises should implement capabilities to distinctly and positively identify devices and software within their supply chain and, once identified, be able to verify that the

identity is authentic. Devices that require unique device-to-device identification and authentication should be defined by type, by device, or by a combination of type and device. Software that requires authentication should be identified through a software identification tag (SWID) that enables verification of the software package and authentication of the enterprise releasing the software package.

Level(s): 1, 2, 3

IA-4 IDENTIFIER MANAGEMENT

Supplemental C-SCRM Guidance: Identifiers allow for greater discoverability and traceability. Within the enterprise's supply chain, identifiers should be assigned to systems, individuals, documentation, devices, and components. In some cases, identifiers may be maintained throughout a system's life cycle, from concept to retirement, but at a minimum throughout the system's life within the enterprise.

For software development, identifiers should be assigned for those components that have achieved configuration item recognition. For devices and operational systems, identifiers should be assigned when the items enter the enterprise's supply chain, such as when they are transferred to the enterprise's ownership or control through shipping and receiving or via download.

Suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers typically use their own identifiers for tracking purposes within their own supply chain. Enterprises should correlate those identifiers with the enterprise-assigned identifiers for traceability and accountability. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Related Controls: IA-3 (1), IA-3 (2), IA-3 (3), and IA-3 (4)

Control Enhancement(s):

(6) *IDENTIFIER MANAGEMENT | CROSS-ORGANIZATION MANAGEMENT*

Supplemental C-SCRM Guidance: This enhancement helps traceability and provenance of elements within the supply chain, through the coordination of identifier management among the enterprise and its suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. This includes information systems and components as well as individuals engaged in supply chain activities.

Level(s): 1, 2, 3

IA-5 AUTHENTICATOR MANAGEMENT

Supplemental C-SCRM Guidance: This control facilitates traceability and non-repudiation throughout the supply chain. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(5) *AUTHENTICATOR MANAGEMENT | CHANGE AUTHENTICATORS PRIOR TO DELIVERY*

Supplemental C-SCRM Guidance: This enhancement provides verification of chain of custody within the enterprise's supply chain.

Level(s): 3

(9) *AUTHENTICATOR MANAGEMENT | FEDERATED CREDENTIAL MANAGEMENT*

Supplemental C-SCRM Guidance: This enhancement facilitates provenance and chain of custody within the enterprise's supply chain.

Level(s): 3

IA-8 IDENTIFICATION AND AUTHENTICATION (NON-ORGANIZATIONAL USERS)

Supplemental C-SCRM Guidance: Suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers have the potential to engage the enterprise's supply chain for service delivery (development/integration services, product support, etc.). Enterprises should manage the establishment, auditing, use, and revocation of identification credentials and authentication of non-enterprise users within the \ supply chain. Enterprises should ensure promptness in performing identification and authentication activities, especially in the case of revocation management, to help mitigate against cybersecurity risk in the supply chain such as insider threat.

Level(s): 2, 3

IA-9 SERVICE IDENTIFICATION AND AUTHENTICATION

Supplemental C-SCRM Guidance: Enterprises should ensure that identification and authentication is defined and managed for access to services (i.e., web applications using digital certificates or services or applications that query a database as opposed to labor-services) throughout the supply chain. Enterprises should ensure they know what services are being procured and from whom. Services procured should be listed on a validated list of services for the enterprise or have compensating controls in place. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

FAMILY: INCIDENT RESPONSE

[FIPS 200] specifies the Incident Response minimum security requirement as follows:

> *Organizations must: (i) establish an operational incident handling capability for organizational information systems that includes adequate preparation, detection, analysis, containment, recovery, and user response activities; and (ii) track, document, and report incidents to appropriate organizational officials and/or authorities.*

Supply chain compromises may span suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Enterprises should ensure their incident response controls address C-SCRM including what, when and how information about incidents will be reported or shared by, with, or between suppliers, developers, system integrators, external system service providers, other ICT/OT-related service providers, and any relevant interagency bodies. Incident response will help determine whether an incident is related to the supply chain.

IR-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Enterprises should integrate C-SCRM into incident response policy and procedures, and related C-SCRM Strategy/Implementation Plan(s), Policies, and C-SCRM Plan. Policy and procedures must provide direction about how to address supply chain related incidents and those cybersecurity incidents that may complicate or impact the supply chain. Individuals working within specific mission and system environments need to recognize cybersecurity supply chain-related incidents. Incident response policy should state when and how threats and incidents should be handled, reported, and managed.

Additionally, the policy should define when, how, and with whom to communicate to the FASC (Federal Acquisition Security Council), and other stakeholders or partners within the broader supply chain in the event of a cyber threat or incident. Departments and agencies must notify the FASC of supply chain risk information when 1) the FASC requests information relating to a particular source, covered article or procures; or 2) an executive agency has determined there is a reasonable basis to conclude a substantial supply chain risk associated with a source, covered procurement, or covered article exists. In such instances, the executive agency shall provide the FASC with relevant information concerning the source or covered article, including: (i) supply chain risk information identified through the course of the agency's activities in furtherance of mitigating, identifying or managing its supply chain risk; and (ii) supply chain risk information regarding covered procurement actions by the agency under the Federal Acquisition Supply Chain Security Act of 2018 (FASCSA) 41 U.S.C. § 4713; and any orders issued by the agency under 41 U.S.C. § 4713. Bidirectional communication with supply chain partners should be defined in agreements with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to inform all involved parties of a supply chain cybersecurity incident. Incident information may also be shared with enterprises such as the Federal Bureau of Investigation (FBI), US CERT (United States Computer Emergency Readiness Team), and the NCCIC (National Cybersecurity and Communications Integration Center) as appropriate. Depending on the severity of the incident, the need for accelerated communications up and down the supply chain may be necessary. Appropriate agreements should be put in place with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to ensure speed of communication, response, corrective actions, and other related activities. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

In Levels 2 and 3, procedures and enterprise-specific incident response methods must be in place, training completed (consider including Operations Security (OPSEC) and any appropriate threat briefing in training), and coordinated communication established throughout the supply chain to ensure an efficient and coordinated incident response effort.

Level(s): 1, 2, 3

Control Enhancement(s):

(1) *POLICY AND PROCEDURES | C-SCRM INCIDENT INFORMATION SHARING*

Enterprises should ensure that their incident response policies and procedures provide guidance on effective information sharing of incidents and other key risk indicators in the supply chain. Guidance should at a minimum cover the collection, synthesis, and distribution of incident information from a diverse set of data sources such as publicly data repositories, paid subscription services, and in-house threat intelligence teams.

Enterprises operating in the public sector should include specific guidance on when and how to communicate with interagency partnerships such as the FASC (Federal Acquisition Security Council) and other stakeholders or partners within the broader supply chain in the event of a cyber threat or incident.

Departments and agencies must notify the FASC of supply chain risk information when
1) The FASC requests information relating to a particular source, covered article or procures; or
2) An executive agency has determined there is a reasonable basis to conclude a substantial supply chain risk associated with a source, covered procurement, or covered article exists.

In such instances, the executive agency shall provide the FASC with relevant information concerning the source or covered article, including:
i. Supply chain risk information identified through the course of the agency's activities in furtherance of mitigating, identifying, or managing its supply chain risk; and
ii. Supply chain risk information regarding covered procurement actions by the agency under the Federal Acquisition Supply Chain Security Act of 2018 (FASCSA) 41 U.S.C. § 4713; and any orders issued by the agency under 41 U.S.C. § 4713.

Level(s): 1, 2, 3

IR-2 INCIDENT RESPONSE TRAINING

Supplemental C-SCRM Guidance: Enterprises should ensure that critical suppliers are included in incident response training. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

IR-3 INCIDENT RESPONSE TESTING

Supplemental C-SCRM Guidance: Enterprises should ensure that critical suppliers are included in and/or provided incident response testing.

Level(s): 2, 3

IR-4 INCIDENT HANDLING

Supplemental C-SCRM Guidance: C-SCRM-specific supplemental guidance provided in control enhancements.

Level(s): 1,2,3

Control Enhancement(s):

(6) *INCIDENT HANDLING | INSIDER THREATS*

Supplemental C-SCRM Guidance: This enhancement helps limit exposure of the C-SCRM information systems, networks, and processes to insider threats. Enterprises should ensure that insider threat incident handling capabilities account for the potential of insider threats associated with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers' personnel with access to ICT/OT systems within the authorization boundary.

Level(s): 1, 2, 3

(7) *INCIDENT HANDLING | INSIDER THREATS - INTRA-ORGANIZATION*

Supplemental C-SCRM Guidance: This enhancement helps limit exposure of C-SCRM information systems, networks, and processes to insider threats. Enterprises should ensure that insider threat coordination includes suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Level(s): 1, 2, 3

(10) *INCIDENT HANDLING | SUPPLY CHAIN COORDINATION*

Supplemental C-SCRM Guidance: A number of enterprises may be involved in managing incidents and responses for supply chain security. After an initial processing of the incident is completed and a decision is made to take action (in some cases, the action may be "no action"), the enterprise may need to coordinate with their suppliers, developers, system integrators, external system service providers, other ICT/OT-related service providers, and any relevant interagency bodies to facilitate communications, incident response, root cause, and corrective actions activities. Enterprises should securely share information through a coordinated set of personnel in key roles to allow for a more comprehensive incident handling approach. Selecting suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers with mature capabilities for supporting supply chain cybersecurity incident handling is important for reducing cybersecurity risk in the supply chain. If transparency for incident handling is limited due to the nature of the relationship, define a set of acceptable criteria in the agreement (e.g., contract). A review (and potential revision) of the agreement is recommended, based on the lessons learned from previous incidents. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2

(11) *INCIDENT HANDLING | INTEGRATED INCIDENT RESPONSE TEAM*

Supplemental C-SCRM Guidance: An enterprise should include a forensics team and/or capability as part of an integrated incident response team for supply chain incidents. Where relevant and practical, integrated incident response teams should also include necessary geographical representation as well as suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Level(s): 3

IR-5 INCIDENT MONITORING

Supplemental C-SCRM Guidance: Enterprises should ensure agreements with suppliers include requirements to track and document incidents and response decisions and activities.

Level(s): 2, 3

IR-6 INCIDENT REPORTING

Supplemental C-SCRM Guidance: C-SCRM-specific supplemental guidance provided in control enhancement IR-6 (3).

Level(s): 3

Control Enhancement(s):

(3) *INCIDENT REPORTING | SUPPLY CHAIN COORDINATION*

Supplemental C-SCRM Guidance: Communications of security incident information from the enterprise to suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers or vice-verse requires protection. The enterprise should ensure that information is reviewed and approved for sending based on its agreements with the suppliers and any relevant interagency bodies. Any escalation of or exception from this reporting should be clearly defined in the agreement. The enterprise should ensure that incident reporting data is adequately protected for transmission and received by approved individuals only. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 3

IR-7 INCIDENT RESPONSE ASSISTANCE

Supplemental C-SCRM Guidance: C-SCRM-specific supplemental guidance provided in control enhancement IR-7 (2).

Level(s): 3

Control Enhancement(s):

(1) *INCIDENT RESPONSE ASSISTANCE | COORDINATION WITH EXTERNAL PROVIDERS*

Supplemental C-SCRM Guidance: Enterprise's agreements with prime contractors should specify the conditions under which a government-approved or -designated third party will be available or may be required to provide assistance with incident response, as well as describe the role and responsibility of that third party.

Level(s): 3

IR-8 INCIDENT RESPONSE PLAN

Supplemental C-SCRM Guidance: Enterprises should coordinate, develop, and implement an incident response plan that includes information sharing responsibilities with critical suppliers and, in a federal context, interagency partners and the FASC. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Related Control(s): IR-10

Level(s): 2, 3

IR-9 INFORMATION SPILLAGE RESPONSE

Supplemental C-SCRM Guidance: The supply chain is vulnerable to information spillage. The enterprise should include supply chain-related information spills in its information spillage response plan. This may require coordination with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. The details of how this coordination is to be conducted should be included in the agreement (e.g., contract). Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 3

Related Controls: SA-4

FAMILY: MAINTENANCE

[FIPS 200] specifies the Maintenance minimum security requirement as follows:

> *Organizations must: (i) perform periodic and timely maintenance on organizational information systems; and (ii) provide effective controls on the tools, techniques, mechanisms, and personnel used to conduct information system maintenance.*

Maintenance is frequently performed by an entity that is separate from the enterprise. As such, maintenance becomes part of the supply chain. Maintenance includes performing updates and replacements. C-SCRM should be applied to maintenance situations including assessing the cybersecurity risk in the supply chain, selecting C-SCRM controls, implementing these controls, and monitoring them for effectiveness.

MA-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Enterprises should ensure that C-SCRM is included in maintenance policies and procedures, and related SCRM Strategy/Implementation Plan, SCRM Policies, and SCRM Plan(s) for all enterprise information systems and networks. With many maintenance contracts, information on mission, enterprise, and system-specific objectives and requirements is shared between the enterprise and its suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, allowing for vulnerabilities and opportunities for attack. In many cases, the maintenance of systems is outsourced to a system integrator and as such, appropriate measures must be taken. Even when maintenance is not outsourced, the upgrades and patches, frequency of maintenance, replacement parts, and other aspects of system maintenance are affected by the supply chain.

Maintenance policies should be defined both for the system and the network. The maintenance policy should reflect controls based on a risk assessment (including criticality analysis), including controls such as remote access, roles and attributes of maintenance personnel that have access, the frequency of updates, duration of contract, logistical path and method used for updates or maintenance, and monitoring and audit mechanisms. The maintenance policy should state which tools are explicitly allowed or not allowed. For example, in the case of software maintenance, source code, test cases, and other item accessibility to maintain a system or components should be stated in the contract.

Maintenance policies should be refined and augmented at each level. At Level 1, the policy should explicitly assert that C-SCRM should be applied throughout the SDLC, including maintenance activities. At Level 2, the policy should reflect the mission operation's needs and critical functions. At Level 3 it should reflect the specific system needs. The requirements in Level 1, such as nonlocal maintenance, should flow to Levels 2 and 3; for example, when nonlocal maintenance is not allowed by Level 1, it should also not be allowed at Levels 2 and 3.

The enterprise should communicate applicable maintenance policy requirements to relevant prime contractors and require they implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

MA-2 CONTROLLED MAINTENANCE

Supplemental C-SCRM Guidance: C-SCRM-specific supplemental guidance is provided in control enhancement MA-2 (2).

Control Enhancement(s):

(2) *CONTROLLED MAINTENANCE | AUTOMATED MAINTENANCE ACTIVITIES*

Supplemental C-SCRM Guidance: Enterprises should ensure that all automated maintenance activities for supply chain systems and networks are controlled and managed according to the maintenance policy. Examples of automated maintenance activities can include COTS product patch updates, call home features with failure notification feedback, etc. Managing these activities may require establishing staging processes with appropriate supporting mechanisms to provide vetting or filtering as appropriate. Staging processes may be especially important for critical systems and components.

Level(s): 3

MA-3 MAINTENANCE TOOLS

Supplemental C-SCRM Guidance: Maintenance tools are considered part of the supply chain. They also have a supply chain of their own. C-SCRM should be integrated when the enterprise acquires or upgrades a maintenance tool (e.g., an update to development environment or testing tool), including during the selection, ordering, storage, and integration of the maintenance tool. The enterprise should perform continuous review and approval of maintenance tools, to include those maintenance tools in use by external service providers. The enterprise should also integrate C-SCRM when evaluating replacement parts for maintenance tools. This control may be performed at both Levels 2 and 3, depending on how an agency handles the acquisition, operations, and oversight of maintenance tools.

Level(s): 2, 3

Control Enhancement(s):

(1) *MAINTENANCE TOOLS | INSPECT TOOLS*

Supplemental C-SCRM Guidance: The enterprise should deploy acceptance testing to verify that the maintenance tools of the ICT supply chain infrastructure are as expected. Maintenance tools should be authorized with appropriate paperwork, verified as claimed through initial verification, and tested for vulnerabilities, appropriate security configurations, and stated functionality.

Level(s): 3

(2) *MAINTENANCE TOOLS | INSPECT MEDIA*

Supplemental C-SCRM Guidance: The enterprise should verify that the media containing diagnostic and test programs that suppliers use on the enterprise's information systems operate as expected and provide only required functions. Use of media from maintenance tools should be consistent with enterprise's policies and procedures and pre-approved. Enterprises should also ensure the functionality does not exceed that which was agreed upon.

Level(s): 3

(3) *MAINTENANCE TOOLS | PREVENT UNAUTHORIZED REMOVAL*

Supplemental C-SCRM Guidance: Unauthorized removal of systems and network maintenance tools from the supply chain may introduce supply chain risk including, for example, unauthorized modification, replacement with counterfeit, or malware insertion while the tool is outside of the enterprise's control. Systems and network maintenance tools can include integrated development environment (IDE), testing, or vulnerability scanning. For C-SCRM, it is important that enterprises should explicitly authorize, track, and audit any removal of maintenance tools. Once systems and

network tools are allowed access to an enterprise/information system, they should remain the property/asset of the system owner and tracked if removed and used elsewhere in the enterprise. ICT maintenance tools either currently in use or in storage should not be allowed to leave the enterprise's premises until they are properly vetted for removal (i.e., maintenance tool removal should not exceed in scope what was authorized for removal and should be completed in accordance with the enterprise's established policies and procedures).

Level(s): 3

MA-4 NONLOCAL MAINTENANCE

Supplemental C-SCRM Guidance: Nonlocal maintenance may be provided by contractor personnel. Appropriate protections should be in place to manage associated risks. Controls applied to internal maintenance personnel are applied to any suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers performing a similar maintenance role and enforced through contractual agreements with their external service providers.

Level(s): 2, 3

Control Enhancement(s):

(3) *NONLOCAL MAINTENANCE | COMPARABLE SECURITY AND SANITIZATION*

Supplemental C-SCRM Guidance: Should any nonlocal maintenance or diagnostic services be performed to systems components or systems by suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, the enterprise should ensure that:

- Appropriate measures are taken to verify that the nonlocal environment meets appropriate security levels for maintenance and diagnostics per agreements between the enterprise and vendor;
- Appropriate levels of sanitizing are completed to remove any enterprise-specific data residing in components; and
- Appropriate diagnostics are completed to ensure that components are sanitized, preventing malicious insertion prior to returning to the enterprise system and or supply chain network.

The enterprise should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

MA-5 MAINTENANCE PERSONNEL

Supplemental C-SCRM Guidance: Maintenance personnel may be employed by a supplier, developer, system integrators, external system service providers, or other ICT/OT-related service providers. As such, appropriate protections should be in place to manage associated risks. The same controls applied to internal maintenance personnel should be applied to any contractor personnel performing a similar maintenance role and enforced through contractual agreements with their external service providers.

Level(s): 2, 3

Control Enhancement(s):

(4) *MAINTENANCE PERSONNEL | FOREIGN NATIONALS*

Supplemental C-SCRM Guidance: Vetting of foreign nationals with access to critical non-national security systems/services must take C-SCRM into account and be extended to all relevant contractor personnel. Enterprises should specify in agreements any restrictions or vetting requirements that pertain to foreign nationals and flow requirement down to relevant sub-contractors.

Level(s): 2, 3

MA-6 TIMELY MAINTENANCE

Supplemental C-SCRM Guidance: For spare parts, replacement parts, or alternate sources, the enterprise should purchase through original equipment manufacturers (OEMs), authorized distributors or authorized reseller and ensure appropriate lead times. If OEMs are not available, it is preferred to acquire from authorized distributors. If an OEM or an authorized distributor is not available, then it is preferred to acquire from an authorized reseller. Enterprises should obtain verification on whether the distributor or reseller is authorized. Where possible, enterprises should use an authorized distributor/dealer approved list. If the only alternative is to purchase from a non-authorized distributor or secondary market, a risk assessment should be performed, including a revisit of criticality and threat analysis to identify additional risk mitigations to be used. For example, the enterprise should check the source of supply for history of counterfeits, inappropriate practices, or a criminal record. See Section 2 for criticality and threat analysis details. The enterprise should maintain a bench stock of critical OEM parts, if feasible, when acquisition of such parts may not be able to be accomplished within needed timeframes.

Level(s): 3

MA-7 FIELD MAINTENANCE

Supplemental C-SCRM Guidance: Enterprises should use trusted facilities when additional rigor and quality control checks are needed, if at all practical or possible. Trusted facilities should be on an approved list and have additional controls in place.

Related Control(s): MA-2, MA-4, MA-5.

Level(s): 3

MA-8 MAINTENANCE MONITORING AND INFORMATION SHARING (NEW)

Control: The enterprise monitors the status of systems and components and communicates out-of-bounds and out-of-spec performance to suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. The enterprise should also report this information to the Government-Industry Data Exchange Program (GIDEP).

Supplemental C-SCRM Guidance: Tracking failure rates of components provides useful information to the acquirer to help plan for contingencies, alternate sources of supply, and replacements. Failure rates are also useful for monitoring quality and reliability of systems and components. This information provides useful feedback to suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers for corrective action and continuous improvement. In Level 2, agencies should track and communicate the failure rates to suppliers (OEM and/or an authorized distributor). The failure rates and the issues that can indicate failures including root causes should be identified by an enterprise's technical personnel (e.g., developers, administrators, or maintenance engineers) in Level 3 and communicated to Level 2. These individuals are able to verify the problem and identify technical alternatives.

Related Control(s): IR-4(10)

Level(s): 3

FAMILY: MEDIA PROTECTION

[FIPS 200] specifies the Media Protection minimum security requirement as follows:

> *Organizations must: (i) protect information system media, both paper and digital; (ii) limit access to information on information system media to authorized users; and (iii) sanitize or destroy information system media before disposal or release for reuse.*

Media itself can be a component traversing the supply chain or containing information about the enterprise's supply chain. This includes both physical and logical media including, for example, system documentation on paper or in electronic files, shipping and delivery documentation with acquirer information, memory sticks with software code, or complete routers or servers that include permanent media. The information contained on the media may be sensitive or proprietary information. Additionally, the media is used throughout the SDLC, from concept to disposal. Enterprises should ensure that Media Protection controls are applied to both an enterprise's media and the media received from suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers throughout the SDLC.

MP-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Various documents and information on a variety of physical and electronic media are disseminated throughout the supply chain. This information may contain a variety of sensitive information and intellectual property from suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers and should be appropriately protected. Media protection policies and procedures should address supply chain concerns including media in the enterprise's supply chain, as well as media throughout the SDLC.

Level(s): 1, 2

MP-4 MEDIA STORAGE

Supplemental C-SCRM Guidance: Media storage controls should include C-SCRM activities. Enterprises should specify and include in agreements (e.g., contracting language) media storage policies for their suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. The enterprise should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2

MP-5 MEDIA TRANSPORT

Supplemental C-SCRM Guidance: The enterprise should incorporate C-SCRM activities when media is transported, either by enterprise or non-enterprise personnel. Some of the techniques to protect media during transport and storage include cryptographic techniques and approved custodian services.

Level(s): 1, 2

MP-6 MEDIA SANITIZATION

Supplemental C-SCRM Guidance: Enterprises should specify and include in agreements (e.g., contracting language) media sanitization policies for their suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Media is used throughout the SDLC. Media traversing or residing in the supply chain may originate anywhere including from suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. It can be new, refurbished, or reused. Media sanitization is critical to ensure that information is removed before the media is used, reused, or discarded. For media containing privacy or other sensitive information (e.g., CUI), the enterprise should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Related Controls: MP-6(1), MP-6(2), MP-6(3), MP-6(7), MP-6(8)

FAMILY: PHYSICAL AND ENVIRONMENTAL PROTECTION

[FIPS 200] specifies the Physical and Environmental Protection minimum security requirement as follows:

> *Organizations must: (i) limit physical access to information systems, equipment, and the respective operating environments to authorized individuals; (ii) protect the physical plant and support infrastructure for information systems; iii) provide supporting utilities for information systems; (iv) protect information systems against environmental hazards; and (v) provide appropriate environmental controls in facilities containing information systems.*

Supply chains span the physical and logical world. Physical factors include, for example, weather and road conditions that may have an impact on transporting cyber components (or devices) from one location to another between persons or enterprises within a supply chain. If not properly addressed as a part of the C-SCRM risk management processes, physical and environmental risks may have a negative impact on the enterprise's ability to receive critical components in a timely manner, which may in turn impact their ability to perform mission operations. Enterprises should require implementation of appropriate physical and environmental control within their supply chain.

PE-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: The enterprise should integrate C-SCRM practices and requirements into their own physical and environmental protection policy and procedures. The degree of protection should be commensurate with the degree of integration. The physical and environmental protection policy should ensure that the physical interfaces of the supply chain have adequate protection and audit for such protection.

Level(s): 1, 2, 3

PE-2 PHYSICAL ACCESS AUTHORIZATIONS

Supplemental C-SCRM Guidance: Enterprises should ensure only authorized individuals with a need for physical access have access to information, systems, or data centers (e.g., sensitive or classified). Such authorizations should specify what the individual is permitted or not permitted to do with regard to their physical access (e.g., view, alter/configure, insert something, connect something, remove, etc.). Agreements should address physical access authorization requirements and the enterprise should require its prime contractors to implement this control, flowing down this requirement to relevant sub-tier contractors. Authorization for non-Federal employees should follow an approved protocol, which includes documentation of the authorization, to include specifying any prerequisites or constraints that pertain to such authorization (e.g., individual must be escorted by a Federal employee, individual must be badged, individual is permitted physical access during normal business hours, etc.).

Level(s): 2, 3

Control Enhancement(s):

(1) *PHYSICAL ACCESS AUTHORIZATIONS | ACCESS BY POSITION OR ROLE*

Supplemental C-SCRM Guidance: Role-based authorizations for physical access should include federal (e.g., agency/department employees) and non-federal employees (e.g., suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers). When role-based authorization is used, the type and level of access allowed for that role or position must be pre-established and documented.

Level(s): 2, 3

PE-3 PHYSICAL ACCESS CONTROL

Supplemental C-SCRM Guidance: Physical access control should include individuals and enterprises engaged in the enterprise's supply chain. A vetting process should be in place based on enterprise-defined requirements and policy prior to granting access to the supply chain infrastructure and any relevant elements. Access establishment, maintenance, and revocation processes should meet enterprise access control policy rigor. The speed of revocation for suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers needing access to physical facilities and data centers, either enterprise-owned or external service provider-owned, should be managed in accordance with the activities performed in their contracts. Prompt revocation is critical when either individual or enterprise need no longer exists.

Level(s): 2, 3

Control Enhancement(s):

(1) *PHYSICAL ACCESS CONTROL | SYSTEM ACCESS*

Supplemental C-SCRM Guidance: Physical access controls should be extended to contractor personnel. Any contractor resources providing services support with physical access to the supply chain infrastructure and any relevant elements should adhere to access controls. Policies and procedures should be consistent with those applied to employee personnel with similar levels of physical access.

Level(s): 2, 3

(2) *PHYSICAL ACCESS CONTROL | FACILITY AND SYSTEMS*

Supplemental C-SCRM Guidance: When determining the extent, frequency, and/or randomness of facility security checks of facilities, enterprises should account for exfiltration risks resulting from covert listening devices. Such devices may include wiretaps, roving bugs, cell site simulators, and other eavesdropping technologies that can transfer sensitive information out of enterprises.

Level(s): 2, 3

(5) *PHYSICAL ACCESS CONTROL | TAMPER PROTECTION*

Supplemental C-SCRM Guidance: Tamper protection is critical for reducing cybersecurity risk in the supply chain in products. The enterprise should implement validated tamper protections techniques within the supply chain. For critical products, the enterprise should require and assess whether and to what extent a supplier has implemented tamper protection mechanism. The assessment may also include whether and how such mechanisms are required and applied by the supplier's upstream supply chain entities.

Level(s): 2, 3

PE-6 MONITORING PHYSICAL ACCESS

Supplemental C-SCRM Guidance: Individuals physically accessing the enterprise or external service provider's facilities, data centers, information, or physical asset(s), including via the supply chain, may be employed by the enterprise's employees, on-site or remotely located contractors, visitors, other third parties (e.g., maintenance personnel under contract with the contractor enterprise), or an individual affiliated with an enterprise in the upstream supply chain. The enterprise should monitor these individuals' activities to reduce associated cybersecurity risk in the supply chain or require monitoring in agreements.

Level(s): 1, 2, 3

PE-16 DELIVERY AND REMOVAL

Supplemental C-SCRM Guidance: This control enhancement reduces cybersecurity risk in the supply chain introduced during the physical delivery and removal of hardware components from the enterprise's information systems or supply chain.

Level(s): 3

PE-17 ALTERNATE WORK SITE

Supplemental C-SCRM Guidance: The enterprise should incorporate protections to guard against cybersecurity risk in the supply chain associated with enterprise employees or contractor personnel within or accessing the supply chain infrastructure using alternate work sites. This can include third party personnel who may also work from alternate worksites.

Level(s): 3

PE-18 LOCATION OF SYSTEM COMPONENTS

Supplemental C-SCRM Guidance: Physical and environmental hazards or disruptions have an impact on the availability of products that are or will be acquired and physically transported to the enterprise's locations. For example, enterprises should incorporate the manufacturing, warehousing, or distribution location of information system components critical for agency operations when planning for alternative suppliers for these components.

Level(s): 1, 2, 3

Related Controls: CP-6, CP-7

PE-20 ASSET MONITORING AND TRACKING

Supplemental C-SCRM Guidance: The enterprise should, whenever possible and practical, use asset location technologies to track system and components transported between entities across the supply chain, between protected areas, or in storage awaiting implementation, testing, maintenance, or disposal. Methods include RFID, digital signatures, or blockchains. These technologies help protect against:

a. Diverting system or component for counterfeit replacement;
b. Loss of confidentiality, integrity, or availability of system or component function and data (including data contained within the component and data about the component); and
c. Interrupting supply chain and logistics processes for critical components. In addition to providing protection capabilities, asset location technologies also help gather data that can be used for incident management.

Level(s): 2, 3

PE-23 FACILITY LOCATION

Supplemental C-SCRM Guidance: Enterprises should incorporate Facility Location (e.g., data centers) when assessing risk associated with suppliers. Factors may include geographic location (e.g., Continental United States (CONUS), Outside the Continental United States (OCONUS)), physical protections in place at one or more of the relevant facilities, local management and control of such facilities, environmental hazard potential (e.g., Located in a high-risk seismic zone), and alternative facility locations. For critical vendors or products, enterprises should specifically address any requirements or restrictions concerning the vendors (or their upstream supply chain providers) facility locations in contracts and flow down this requirement to relevant sub-level contractors.

Level(s): 2, 3

Related Controls: SA-9(8)

FAMILY: PLANNING

[FIPS 200] specifies the Planning minimum security requirement as follows:

> *Organizations must develop, document, periodically update, and implement security plans for organizational information systems that describe the security controls in place or planned for the information systems and the rules of behavior for individuals accessing the information systems.*

C-SCRM should influence security planning, including such activities as security architecture, coordination with other enterprise entities, and development of System Security Plans. When acquiring products and services from suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, enterprises may be sharing facilities with those enterprises, have employees of these entities on the enterprise's premises, or use information systems that belong to those entities. In these and other applicable situations, enterprises should coordinate their security planning activities with these entities to ensure appropriate protection of an enterprise's processes, information systems, as well as of the systems and components traversing the supply chain. When establishing security architectures, enterprises should provide for component and supplier diversity to manage the cybersecurity risk in the supply chain to include suppliers going out of business or stopping the production of specific components. Finally, as stated in Section 2 and Appendix C, enterprises should integrate C-SCRM controls into their Risk Response Frameworks (Levels 1 and 2) as well as C-SCRM Plans (Level 3).

PL-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Security planning policy and procedures should integrate C-SCRM. This includes creating, disseminating, and updating security policy, operational policy, and procedures for C-SCRM to shape acquisition or development requirements and the follow-on implementation, operations, and maintenance of systems and system interfaces and network connections. The C-SCRM policy and procedures provide inputs into and take guidance from C-SCRM Strategy & Implementation Plan at Level 1. The C-SCRM policy and procedures provide guidance to and take inputs from System Security Plan and C-SCRM Plan at Level 3. In Level 3, ensure that the full SDLC is covered from the C-SCRM perspective.

Level(s): 2

Related Controls: PL-2, PM-30

PL-2 SYSTEM SECURITY AND PRIVACY PLANS

Supplemental C-SCRM Guidance: The system security plan (SSP) should integrate C-SCRM. The enterprise may choose to develop a stand-alone C-SCRM plan for an individual system or integrate SCRM controls into their SSP. The system security plan and/or system-level C-SCRM plan provide inputs into and take guidance from the C-SCRM Strategy & Implementation Plan at Level 1 and C-SCRM policy at Levels 1 and 2. In addition to coordinating within the enterprise, the enterprise should coordinate with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to develop and maintain their SSPs. For example, building and operating a system requires a significant amount of coordination and collaboration between the enterprise and system integrator personnel. Such coordination and collaboration should be addressed in the system security plan or stand-

alone C-SCRM plan. These plans should also take into account that suppliers or external service providers may not be able to customize to the acquirer's requirements. It is recommended that suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers also develop C-SCRM plans for non-federal (i.e., contractor) systems that are processing federal agency information, and flow down this requirement to relevant sub-level contractors.

Section 2, Appendix C, and Appendix D provide guidance on C-SCRM strategy, policy, and plan. Controls in this publication (NIST SP 800-161 Rev. 1) should be used for the C-SCRM portion of the SSP.

Level(s): 3

Related Controls: PM-30

PL-4 RULES OF BEHAVIOR

Supplemental C-SCRM Guidance: Rules of behavior apply to contractor personnel as well as to internal agency personnel. Contractor enterprises are responsible for ensuring that their employees follow applicable rules of behavior. Individual contractors should not be granted access to agency systems or data until they have acknowledged and demonstrated compliance with this control. Failure to meet this control can result in removal of access for such individuals.

Level(s): 2, 3

PL-7 CONCEPT OF OPERATIONS

Supplemental C-SCRM Guidance: Concept of operations (CONOPS) should describe how the enterprise intends to operate the system from the perspective of C-SCRM. It should integrate C-SCRM and be managed and updated throughout the SDLC to address cybersecurity risk in the supply chain to the applicable system.

Level(s): 3

PL-8 SECURITY AND PRIVACY ARCHITECTURES

Supplemental C-SCRM Guidance: Security and privacy architecture defines and directs implementation of security and privacy-protection methods, mechanisms, and capabilities to the underlying systems and networks, as well as the information system that is being created. Security architecture is fundamental to C-SCRM because it helps to ensure security is built-in throughout the SDLC. Enterprises should consider implementing zero-trust architectures. enterprise should also ensure that the security architecture is well understood by system developers/engineers and system security engineers. This control applies to both federal agency and non-federal agency employees.

Level(s): 2, 3

Control Enhancement(s):

(2) *SECURITY AND PRIVACY ARCHITECTURES | SUPPLIER DIVERSITY*

Supplemental C-SCRM Guidance: Supplier diversity provides options for addressing information security and supply chain concerns. The enterprise should incorporate this control as it relates to suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

The enterprise should plan for potential replacement of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers in case one is no longer able to meet the enterprise's requirements (e.g., company goes out of business or does not meet contractual obligations).

Incorporate supplier diversity for off-the-shelf (commercial or government) components during acquisition security assessments. Evaluation of alternatives should include, for example, feature parity, interoperability, commodity components, and ability to provide multiple delivery paths. For example, having the source code, build scripts, and tests for a software component could enable an enterprise to have someone else maintain it if necessary

Level(s): 2, 3

PL-9 CENTRAL MANAGEMENT

Supplemental C-SCRM Guidance: C-SCRM controls are managed centrally at Level 1 through C-SCRM Strategy & Implementation Plan, and at Levels 1 and 2 through C-SCRM Policy. C-SCRM PMO described in Section 2, centrally manages C-SCRM controls at those two Levels. At Level 3, C-SCRM controls are managed on an information system basis though SSP and/or C-SCRM Plan.

Level(s): 1, 2

PL-10 BASELINE SELECTION

Supplemental C-SCRM Guidance: Enterprises should include C-SCRM controls in their control baselines. Enterprises should identify and select C-SCRM controls based on C-SCRM requirements identified within each of the levels. A C-SCRM PMO may assist in identifying C-SCRM control baselines that meet common C-SCRM requirements for different groups, communities of interest, or the enterprise as a whole.

Level(s): 1, 2

FAMILY: PROGRAM MANAGEMENT

[FIPS 200] does not specify Program Management minimum security requirements.

[NIST SP 800-53 Rev. 5] states that "the program management controls … are implemented at the enterprise level and not directed at individual information systems." Those controls apply to the entire enterprise (i.e., federal agency) and support the enterprise's overarching information security program. Program management controls support and provide inputs and feedback to enterprise-wide C-SCRM activities.

All Program Management controls should be applied in a C-SCRM context. Within federal agencies the C-SCRM PMO function or a similar is responsible for implementing Program Management controls. Section 3 provides guidance on C-SCRM PMO and its functions and responsibilities.

PM-2 INFORMATION SECURITY PROGRAM LEADERSHIP ROLE

Supplemental C-SCRM Guidance: Senior information security officer (e.g., CISO) and senior agency official responsible for acquisition (e.g., Chief Acquisition Officer (CAO) or Senior Procurement Executive (SPE)) have key responsibilities for C-SCRM and the overall cross-enterprise coordination and collaboration with other applicable senior personnel within the enterprise such as the CIO, the head of facilities/physical security, and the risk executive (function). This coordination should occur regardless of specific department and agency enterprise structure and specific titles of relevant senior personnel. The coordination could be executed by C-SCRM PMO or another similar function. Section 2 provides more guidance on C-SCRM roles and responsibilities.

Level(s): 1, 2

PM-3 INFORMATION SECURITY AND PRIVACY RESOURCES

Supplemental C-SCRM Guidance: An enterprise's C-SCRM program- requires dedicated, sustained funding and human resources to successfully implement agency C-SCRM requirements. Section 3 of this document provides guidance on dedicated funding for C-SCRM programs. The enterprise should also ensure that C-SCRM requirements are integrated into major IT investments to ensure that the funding is appropriately allocated through the capital planning and investment request process. For example, should an RFID infrastructure be required to improve C-SCRM to secure and improve inventory or logistics management efficiency of the enterprise's supply chain, appropriate IT investments are likely required to ensure successful planning and implementation. Other examples include any investment into the development or test environment for critical components. In such a case, funding and resources are needed to acquire and maintain appropriate information systems, networks, and components to meet specific C-SCRM requirements that support the mission.

Level(s): 1, 2

PM-4 PLAN OF ACTION AND MILESTONES PROCESS

Supplemental C-SCRM Guidance: C-SCRM items should be included in the POA&M at all levels.

Level(s): 2, 3

Related Controls: CA-5, PM-30

PM-5 SYSTEM INVENTORY

Supplemental C-SCRM Guidance: Having a current system inventory is foundational for C-SCRM. Not having a system inventory may lead to enterprise's inability to identify system and supplier criticality which will result in inability to conduct C-SCRM activities. To ensure that all applicable suppliers are identified and categorized for criticality, enterprises should include relevant supplier information in the system inventory and maintain its currency and accuracy. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

PM-6 MEASURES OF PERFORMANCE

Supplemental C-SCRM Guidance: Enterprises should use measures of performance to track implementation, efficiency, effectiveness, and impact of C-SCRM activities. C-SCRM PMO is responsible for creating C-SCRM measures of performance in collaboration with other applicable stakeholders to include identifying appropriate audience and decision makers and providing guidance on data collection, analysis, and reporting.

Level(s): 1, 2

PM-7 ENTERPRISE ARCHITECTURE

Supplemental C-SCRM Guidance: C-SCRM should be integrated when designing and maintaining enterprise architecture.

Level(s): 1, 2

PM-8 CRITICAL INFRASTRUCTURE PLAN

Supplemental C-SCRM Guidance: C-SCRM should be integrated when developing and maintaining critical infrastructure plan.

Level(s): 1

PM-9 RISK MANAGEMENT STRATEGY

Supplemental C-SCRM Guidance: Risk management strategy should address cybersecurity risk in the supply chain. Section 2, Appendix C, and Appendix D of this document provide guidance on integrating C-SCRM into Risk Management Strategy.

Level(s): 1

PM-10 AUTHORIZATION PROCESS

Supplemental C-SCRM Guidance: C-SCRM should be integrated when designing and implementing authorization processes.

Level(s): 1, 2

PM-11 MISSION AND BUSINESS PROCESS DEFINITION

Supplemental C-SCRM Guidance: Enterprise's mission and business processes should address cybersecurity risk in the supply chain. When addressing mission/business process definitions, the enterprise should ensure that C-SCRM activities are incorporated into the support processes for achieving mission success. For example, a system supporting a critical mission function that has been designed and implemented for easy removal and replacement should a component fail may require the use of somewhat unreliable hardware components. A C-SCRM activity may need to be defined to ensure that the supplier makes component spare parts readily available if replacement is needed.

Level(s): 1, 2, 3

PM-12 INSIDER THREAT PROGRAM

Supplemental C-SCRM Guidance: An insider threat program should include C-SCRM and be tailored for both federal and non-federal agency individuals who have access to agency systems and networks. This control applies to contractors and subcontractors and should be implemented throughout the SDLC.

Level(s): 1, 2, 3

PM-13 SECURITY AND PRIVACY WORKFORCE

Supplemental C-SCRM Guidance: Security and privacy workforce development and improvement should ensure that relevant C-SCRM topics are integrated into the content and initiatives produced by the program. Section 2 provides information on C-SCRM roles and responsibilities. NIST SP 800-161 can be used as a source of topics and activities to include in the security and privacy workforce program.

Level(s): 1, 2

PM-14 TESTING, TRAINING, AND MONITORING

Supplemental C-SCRM Guidance: Enterprise's testing, training, and monitoring processes should include C-SCRM activities. C-SCRM PMO can provide guidance and support on how to integrate C-SCRM into testing, training, and monitoring plans.

Level(s): 1, 2

PM-15 SECURITY AND PRIVACY GROUPS AND ASSOCIATIONS

Supplemental C-SCRM Guidance: Contact with security and privacy groups and associations should include C-SCRM practitioners and those with C-SCRM responsibilities. Acquisition, legal, critical infrastructure, and supply chain groups and associations should be incorporated. C-SCRM PMO can help

identify agency personnel who could benefit from participation, specific groups to participate in, and relevant topics.

Level(s): 1, 2

PM-16 THREAT AWARENESS PROGRAM

Supplemental C-SCRM Guidance: Threat awareness program should include threats emanating from the supply chain. When addressing supply chain threat awareness, knowledge should be shared between stakeholders within the boundaries of the enterprise's information sharing policy. C-SCRM PMO can help identify C-SCRM stakeholders to include in threat information sharing, as well as potential sources of information for supply chain threats.

Level(s): 1, 2

PM-17 PROTECTING CONTROLLED UNCLASSIFIED INFORMATION ON EXTERNAL SYSTEMS

Supplemental C-SCRM Guidance: Policy and procedures for controlled unclassified information (CUI) on external systems should include protecting relevant supply chain information. Conversely, it should include protecting agency information residing in external systems, because such external systems are part of agency supply chain.

Level(s): 2

PM-18 PRIVACY PROGRAM PLAN

Supplemental C-SCRM Guidance: Privacy Program Plan should include C-SCRM. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2

PM-19 PRIVACY PROGRAM LEADERSHIP ROLE

Supplemental C-SCRM Guidance: Privacy program leadership role should be included is a stakeholder in applicable C-SCRM initiatives and activities.

Level(s): 1

PM-20 DISSEMINATION OF PRIVACY PROGRAM INFORMATION

Supplemental C-SCRM Guidance: Dissemination of privacy program information should be protected from cybersecurity risk in the supply chain.

Level(s): 1, 2

PM-21 ACCOUNTING OF DISCLOSURES

Supplemental C-SCRM Guidance: Accounting of disclosures should be protected from cybersecurity risk in the supply chain.

Level(s): 1, 2

PM-22 PERSONALLY IDENTIFIABLE INFORMATION QUALITY MANAGEMENT

Supplemental C-SCRM Guidance: Personally identifiable information (PII) quality management should take into account and manage cybersecurity risk in the supply chain to this information.

Level(s): 1, 2

PM-23 DATA GOVERNANCE BODY

Supplemental C-SCRM Guidance: Data governance body is a stakeholder in C-SCRM and as such should be included in cross-agency collaboration and information sharing of C-SCRM activities and initiatives (e.g., by participating in inter-agency bodies such as the FASC).

Level(s): 1

PM-25 MINIMIZATION OF PERSONALLY IDENTIFIABLE INFORMATION USED IN TESTING, TRAINING, AND RESEARCH

Supplemental C-SCRM Guidance: Supply chain related cybersecurity risks to personally identifiable information should be addressed by minimization policies and procedures described in this control.

Level(s): 2

PM-26 COMPLAINT MANAGEMENT

Supplemental C-SCRM Guidance: Complaint management process and mechanisms should be protected from cybersecurity risk in the supply chain. Enterprises should also integrate C-SCRM security and privacy controls when fielding complaints from vendors or the general public (e.g., departments and agencies fielding inquiries related to exclusions and removals).

Level(s): 2, 3

PM-27 PRIVACY REPORTING

Supplemental C-SCRM Guidance: Privacy reporting process and mechanisms should be protected from cybersecurity risk in the supply chain.

Level(s): 2, 3

PM-28 RISK FRAMING

Supplemental C-SCRM Guidance: C-SCRM should be included in risk framing. Section 2 and Appendix C provide detail guidance on integrating C-SCRM into risk framing.

Level(s): 1

PM-29 RISK MANAGEMENT PROGRAM LEADERSHIP ROLES

Supplemental C-SCRM Guidance: Risk management program leadership roles should include C-SCRM responsibilities and be included in C-SCRM collaboration across the enterprise. Section 2 and Appendix C provide detail guidance C-SCRM roles and responsibilities.

Level(s): 1

PM-30 SUPPLY CHAIN RISK MANAGEMENT STRATEGY

Supplemental C-SCRM Guidance: Supply Chain Risk Management Strategy (also known as C-SCRM Strategy) should be complemented with a C-SCRM Implementation Plan that lays out detailed initiatives and activities for the enterprise with timelines and responsible parties. This implementation plan can be a POA&M or be included in a POA&M. Based on the C-SCRM Strategy and Implementation Plan at Level 1, the enterprise should select and document common C- SCRM controls that need to address the enterprise, program, and system-specific needs. These controls should be iteratively integrated the C-SCRM Policy at Levels 1 and 2, and C-SCRM Plan (or SSP if required) at Level 3. See Section 2 and Appendix C for further guidance on risk management.

Level(s): 1, 2

Related Controls: PL-2

PM-31 CONTINUOUS MONITORING STRATEGY

Supplemental C-SCRM Guidance: Continuous monitoring strategy and program should integrate C-SCRM controls at Levels 1, 2, and 3 in accordance with Supply Chain Risk Management Strategy.

Level(s): 1, 2, 3

Related Controls: PM-30

PM-32 PURPOSING

Supplemental C-SCRM Guidance: Extending systems assigned to support specific mission or business functions beyond their initial purpose subjects those systems to unintentional risks to include cybersecurity risk in the supply chain. Application of this control should include explicit incorporation of cybersecurity supply chain exposures.

Level(s): 2, 3

FAMILY: PERSONNEL SECURITY

[FIPS 200] specifies the Personnel Security minimum security requirement as follows:

> *Organizations must: (i) ensure that individuals occupying positions of responsibility within organizations (including third-party service providers) are trustworthy and meet established security criteria for those positions; (ii) ensure that organizational information and information systems are protected during and after personnel actions such as terminations and transfers; and (iii) employ formal sanctions for personnel failing to comply with organizational security policies and procedures.*

Personnel that have access to an enterprise's supply chain should be covered by the enterprise's personnel security controls. These personnel include acquisition and contracting professionals, program managers, supply chain and logistics professionals, shipping and receiving staff, information technology professionals, quality professionals, mission and business owners, system owners, and information security engineers. Enterprises should also work with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to ensure they apply appropriate personnel security controls to the personnel that interact with the enterprise's supply chain, as appropriate.

PS-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: At each level, personnel security policy and procedures, and related C-SCRM Strategy/Implementation Plan, C-SCRM Policies, and C-SCRM Plan(s) need to define the roles for the personnel who are engaged in the acquisition, management, and execution of supply chain security activities. These roles also need to state acquirer personnel responsibilities with regards to relationships with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Policies and procedures need to consider the full system development life cycle of systems and the roles and responsibilities needed to address the various supply chain infrastructure activities.

Level 1: Applicable roles include risk executive, CIO, CISO, contracting, logistics, delivery/receiving, acquisition security, and other functions providing supporting supply chain activities.

Level 2: Applicable roles include program executive and individuals (e.g., non-federal employees including contractors) within the acquirer enterprise responsible for program success (e.g., Program Manager and other individuals).

Level 3: Applicable roles include system engineers or system security engineers throughout the operational system life cycle from requirements definition, development, test, deployment, maintenance, updates, replacements, delivery/receiving, and IT.

Roles for supplier, developer, system integrator, external system service provider, and other ICT/OT-related service provider personnel responsible for the success of the program should be noted in an agreement between acquirer and these parties (e.g., contract).

The enterprise should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

Related Control(s): SA-4

PS-3 PERSONNEL SCREENING

Supplemental C-SCRM Guidance: To mitigate insider threat risks, personnel screening policies and procedures should be extended to any contractor personnel with authorized access to information systems, system components, or information system services. Continuous monitoring activities should be commensurate with the contractor's level of access to sensitive, classified, or regulated information and should be consistent with broader enterprise policies. Screening requirements should be incorporated into agreements and flow down to sub-tier contractors.

Level(s): 2, 3

PS-6 ACCESS AGREEMENTS

Supplemental C-SCRM Guidance: The enterprise should define and document access agreements for all contractors or other external personnel that may have a need to access the enterprise's data, systems, or network, whether physically or logically. Access agreements should state the appropriate level and method of access to the information system and supply chain network. Additionally, terms of access should be consistent with the enterprise's information security policy and may need to specify additional restrictions, such as allowing access during specific timeframes, from specific locations, or by only personnel who have satisfied additional vetting requirements. The enterprise should deploy audit mechanisms to review, monitor, update, and track access by these parties in accordance with the access agreement. As personnel vary over time, the enterprise should implement a timely and rigorous personnel security update process for the access agreements.

When information systems and network products and services are provided by an entity within the enterprise, there may be an existing access agreement in place. When such an agreement does not exist, it should be established.

NOTE: While the audit mechanisms may be implemented in Level 3, the agreement process with required updates should be implemented at Level 2 as a part of program management activities.

The enterprise should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

PS-7 EXTERNAL PERSONNEL SECURITY

Supplemental C-SCRM Guidance: Third-party personnel that have access to enterprise's information systems and networks must meet the same personnel security requirements as enterprise personnel. Examples of such third-party personnel can include the system integrator, developer, supplier, or external service provider used for delivery, contractors or service providers that are using the ICT/OT systems, or supplier maintenance personnel brought in to address component technical issues not solvable by the enterprise or system integrator.

Level(s): 2

FAMILY: PERSONALLY IDENTIFIABLE INFORMATION PROCESSING AND TRANSPARENCY

Personally identifiable information processing and transparency is a new control family, developed specifically to address PII processing and transparency concerns.

The enterprise should keep in mind that some suppliers have comprehensive security and privacy practices and systems that may go above and beyond the enterprise's requirements. The enterprises should work with suppliers to understand the extent of their privacy practices and how they meet the enterprise's needs.

PT-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Enterprises should ensure that supply chain concerns are included in PII processing and transparency policies and procedures, and related C-SCRM Strategy/Implementation Plan, C-SCRM Policies, and C-SCRM Plan. The policy can be included as part of the general security and privacy policy or can be represented by multiple policies.

The procedures can be established for the security and privacy program in general and individual information systems. These policy and procedures should address purpose, scope, roles, responsibilities, management commitment, coordination among enterprise entities, and privacy compliance to support systems/components within information systems or the supply chain.

Policies and procedures need to be in place to ensure contracts state what PII data will be shared, which contractor personnel may have access to the PII, controls protecting PII, and how long it can be kept and what happens to it at the end of a contract.

a. When working with a new supplier, ensure that the agreement includes the most recent set of applicable security requirement.

b. Contractors need to abide by relevant laws and policies regarding information (PII and other sensitive information).

c. The enterprise should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

FAMILY: RISK ASSESSMENT

[FIPS 200] specifies the Risk Assessment minimum security requirement as follows:

> *Organizations must periodically assess the risk to organizational operations (including mission, functions, image, or reputation), organizational assets, and individuals, resulting from the operating of organizational information systems and the associated processing, storage, or transmission of organizational information.*

[NIST SP 800-161 Rev. 1] provides guidance for managing an enterprise's cybersecurity risk in supply chains and expands this control to integrate assessments of cybersecurity risk in supply chains, as described in *Section 2* and *Appendix C*.

RA-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: Risk assessments should be performed at the enterprise, mission/program, and operational levels of the enterprise. The system-level risk assessment should include both the supply chain infrastructure (e.g., development and testing environments, and delivery systems) and the information system/components traversing the supply chain. System-level risk assessments significantly intersect with the SDLC and should complement the enterprises broader RMF activities which take part during the SDLC. A criticality analysis will ensure that mission-critical functions and components are given higher priority due to their impact to the mission, if compromised. The policy should include supply chain-relevant cybersecurity roles applicable to performing and coordinating risk assessments across the enterprise (see Section 2 for the listing and description of roles). Applicable roles within suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers should be defined.

Level(s): 1, 2, 3

RA-2 SECURITY CATEGORIZATION

Supplemental C-SCRM Guidance: Security categorization is critical to C-SCRM at Levels 1, 2, and 3. In addition to [FIPS 199] categorization, for C-SCRM, security categorization should be based on the criticality analysis which is performed as part of the SDLC. See Section 2 and [NISTIR 8179] for a detailed description of criticality analysis.

Level(s): 1, 2, 3

Related Controls: RA-9

RA-3 RISK ASSESSMENT

Supplemental C-SCRM Guidance: Risk assessments should include an analysis of criticality, threats, vulnerabilities, likelihood, and impact, as described in detail in Appendix C, *C-SCRM Activities in the Risk Management Process*. Data to be reviewed and collected includes C-SCRM-specific roles, processes, and results of system/component and services acquisitions, implementation, and integration. Risk assessments should be performed at Levels 1, 2, and 3. Risk assessments at higher levels should consist primarily of a synthesis of various risk assessments performed at lower levels and used for understanding the overall impact with the Level (e.g., at the enterprise or mission/function levels). C-SCRM risk assessments should complement and inform risk assessments which are performed as ongoing activities throughout the SDLC, and processes should be appropriately aligned to or integrated into ERM processes and governance.

Level(s): 1, 2, 3

Related Control(s): RA-3(1)

RA-5 VULNERABILITY MONITORING AND SCANNING

Supplemental C-SCRM Guidance: Vulnerability monitoring should cover suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers in the enterprise's supply chain. This includes employing data collection tools to maintain a continuous state of awareness about potential vulnerability to suppliers as well as the information systems/ system components/ and raw inputs they provide through the cybersecurity supply chain. Vulnerability monitoring activities should take place at all three levels of the enterprise. Scoping vulnerability monitoring activities requires enterprises to consider suppliers as well as their sub-suppliers. Enterprises should consider use of the *Impact Analysis Tool for Interdependent Cyber Supply Chain Risks* outlined in NISTIR 8272 to track and maintain visibility into the relevant components within their supply chain. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(3) *VULNERABILITY MONITORING AND SCANNING | BREADTH AND DEPTH OF COVERAGE*

Supplemental C-SCRM Guidance: Enterprises monitoring the supply chain for vulnerabilities should express breadth of monitoring based on the criticality and/or risk profile of the supplier or product/component, and the depth of monitoring based on the level of the supply chain monitoring takes place at (e.g., sub-supplier). Where possible – a component inventory (e.g., hardware, software) may aid enterprises in capturing the breadth and depth of the products/components within their supply chain that may need to be monitored and scanned for vulnerabilities.

Level(s): 2, 3

(6) *VULNERABILITY MONITORING AND SCANNING | AUTOMATED TREND ANALYSIS*

Supplemental C-SCRM Guidance: Enterprises should track trends, over time, in vulnerability to components within the supply chain. This information may help enterprises develop procurement strategies that reduce risk exposure density within the supply chain.

Level(s): 2, 3

RA-7 RISK RESPONSE

Supplemental C-SCRM Guidance: Enterprises should integrate capabilities to respond to cybersecurity risk in the supply chain into the overall enterprise's response posture, ensuring these responses are aligned to and fall within the boundaries of the enterprise's tolerance for risk. Risk Response should include consideration of risk response identification, evaluation of alternatives, and risk response decision activities.

Level(s): 1, 2, 3

RA-9 CRITICALITY ANALYSIS

Supplemental C-SCRM Guidance: Enterprises should complete a criticality analysis as a prerequisite input to assessments activities focused on cybersecurity supply chain risk management activities. First, enterprises complete a criticality analysis as part of the *Frame* step of the C-SCRM Risk Management Process. Then, findings generated in *Assess* step activities (e.g., criticality analysis, threat analysis, vulnerability analysis, and mitigation strategies) update and tailor the criticality analysis. A symbiotic relationship exists between the criticality analysis and other *Assess* step activities in that they inform and enhance one another. For a high-quality criticality analysis – enterprises should employ it iteratively throughout the SLDC and concurrently across the 3 levels. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

RA-10 THREAT HUNTING

Supplemental C-SCRM Guidance: C-SCRM Threat Hunting activities should supplement the enterprises internal Threat Hunting activities. As a critical part of the cybersecurity supply chain risk management process – enterprises should actively monitor for threats to their supply chain. This requires a collaborative effort between C-SCRM and other cyber defense-oriented functions within the enterprise. Threat hunting capabilities may also be provided via a shared services enterprise, especially when an enterprise lacks the resources to perform threat hunting activities themselves. Typical activities include information sharing with peer enterprises and actively consuming threat intelligence feeds that flag potential indicators of increased cybersecurity risk in the supply chain, such as cyber incidents, mergers and acquisitions, and Foreign Ownership, Control or Influence (FOCI) that may be of concern. Supply Chain Threat intelligence should seek out threats to the enterprise's suppliers as well as information systems/ system components/ and raw inputs they provide. Intelligence gathered enables enterprises to proactively identify and respond to threats emanating from the supply chain.

Level(s): 1, 2, 3

FAMILY: SYSTEM AND SERVICES ACQUISITION

[FIPS 200] specifies the System and Services Acquisition minimum security requirement as follows:

> *Organizations must: (i) allocate sufficient resources to adequately protect organizational information systems; (ii) employ system development life cycle processes that incorporate information security considerations; (iii) employ software usage and installation restrictions; and (iv) ensure that third-party providers employ adequate security measures to protect information, applications, and/or services outsourced from the organization.*

Enterprises acquire ICT/OT products and services through system and services acquisition. These controls address the activities of an acquirer, as well as the activities of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers and related upstream supply chain relationships. They address both physical and logical aspects of supply chain security, from detection to SDLC and security engineering principles. C-SCRM concerns are already prominently addressed in [NIST SP 800-53 Rev. 5]. [NIST SP 800-161 Rev. 1] adds further detail and refinement to these controls.

SA-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: System and services acquisition policy and procedures should address C-SCRM throughout the acquisition management life cycle process, to include purchases made via charge cards. C-SCRM procurement actions and resultant contracts should include requirements language or clauses that address which controls are mandatory or desirable and may include implementation specifications, state what is accepted as evidence that the requirement is satisfied, and how conformance to requirements will be verified and validated. C-SCRM should also be included as an evaluation factor. These applicable procurements should not be limited to only those that are directly related to providing an ICT/OT product or service; while C-SCRM considerations must be applied to these purchases, C-SCRM should also be considered for any and all procurements of products or services in which there may be an unacceptable risk of a supplied product or service contractor compromising the integrity, availability, or confidentiality of an enterprise's information. This initial assessment should occur during the acquisition planning phase and will be minimally informed by an identification and understanding of the criticality of the enterprise's mission functions, its high value assets, and the sensitivity of the information that may be accessible by the supplied product or service provider. In addition, enterprises should develop policies and procedures that address supply chain risks that may arise during contract performance, such as a change of ownership or control of the business or when actionable information is learned that indicates a supplier or a product is a target of a supply chain threat. Supply chains evolve continuously through mergers and acquisitions, joint ventures, and other partnership agreements. The policy should help enterprises understand these changes and use thus obtained information to inform their C-SCRM activities. Enterprises can obtain status of such changes through, for example, monitoring public announcements about company activities or any communications initiated by suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. See Section 3 for further guidance on C-SCRM in the federal acquisition process.

Level(s): 1, 2, 3

SA-2 ALLOCATION OF RESOURCES

Supplemental C-SCRM Guidance: The enterprise should incorporate C-SCRM requirements when determining and establishing the allocation of resources.

Level(s): 1, 2

SA-3 SYSTEM DEVELOPMENT LIFE CYCLE

Supplemental C-SCRM Guidance: There is a strong relationship between the SDLC and C-SCRM activities. The enterprise should ensure that C-SCRM activities integrated into the SDLC for both the enterprise and for applicable suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. In addition to traditional SDLC activities, such as requirements and design, the SDLC includes activities such as inventory management, acquisition and procurement, and logical delivery of systems and components. See *Section 2* and *Appendix C* for further guidance on SDLC.

Level(s): 1, 2, 3

SA-4 ACQUISITION PROCESS

Supplemental C-SCRM Guidance: Enterprises are to include C-SCRM requirements, descriptions, and criteria in applicable contractual agreements.

a. Enterprises are to establish baseline and tailor-able C-SCRM requirements to apply and incorporate into contractual agreements when procuring a product or service from suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers; These include but are not limited to:
   1. C-SCRM requirements that cover regulatory mandates (e.g. prohibition of certain ICT/OT or suppliers) address identified and selected controls that are applicable to reducing cyber-supply chain risk that may be introduced by a procured product or service and provide assurance that the contractor is sufficiently responsible, capable, and trustworthy;
   2. Requirements for critical elements in the supply chain to demonstrate a capability to remediate emerging vulnerabilities based on open source information and other sources;
   3. Requirements for managing intellectual property ownership and responsibilities for elements such as software code, data and information, the manufacturing/development/integration environment, designs, and proprietary processes when provided to the enterprise for review or use;
   4. Requirements that address the expected life span of the product or system and any element(s) which may be in a critical path based on their life span, as well as what is required when end-of-life is near or has been reached. Enterprises should conduct research or solicit information from bidders or existing providers under contract to understand what end-of-life options exist (i.e., replace, upgrade, migrate to a new system, etc.);
   5. Articulate any circumstances when secondary market components may be permitted.
   6. Requirements for functional properties, configuration, and implementation information, as well as any development methods, techniques, or practices which may be relevant; Identify and specify C-SCRM evaluation criteria, to include weighting of such criteria.

b. Enterprises should:
   1. Establish a plan for acquisition of spare parts to ensure adequate supply and execute the plan, if/when applicable;
   2. Establish a plan for acquisition of alternative sources of supply, as may be necessary during continuity events or if/when a disruption to the supply chain occurs;
   3. Work with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to identify and define existing and acceptable incident response and information-sharing processes, including inputs on vulnerabilities from other enterprises within their supply chains.

c. Establish and maintain verification procedures and acceptance criteria for delivered products and services;

d. Ensure that the continuous monitoring plan includes supply chain aspects in its criteria such as. including the monitoring of functions/ports/protocols in use. See Section 2 and Appendix C;
e. Ensure the contract addresses the monitoring of suppliers', developers', system integrators', external system service providers', and other ICT/OT-related service providers' information systems located within the supply chain infrastructure. Monitor and evaluate the acquired work processes and work products where applicable;
f. Communicate processes for reporting information security weaknesses and vulnerabilities detected during the use of ICT/OT products or services and ensure reporting to appropriate stakeholders, including OEMs where relevant;
g. Review and confirm sustained compliance s with the terms and conditions of the agreement on an ongoing basis.

Level(s): 1, 2, 3

Related Controls: SA-4 (1), (2), (3), (6) and (7)

Control Enhancement(s):

(5) *ACQUISITION PROCESS | SYSTEM, COMPONENT, AND SERVICE CONFIGURATIONS*

Supplemental C-SCRM Guidance: If an enterprise needs to purchase components, they need to ensure that the product specifications are "fit for purpose" and meet the enterprise's requirements, whether purchasing directly from the OEM, channel partners, or secondary market.

Level(s): 3

(7) *ACQUISITION PROCESS | NIAP-APPROVED PROTECTION PROFILES*

Supplemental C-SCRM Guidance: This control enhancement requires that the enterprise build, procure, and/or use U.S. government protection profile-certified information assurance (IA) components when possible. NIAP certification can be achieved for OTS (COTS and GOTS).

Level(s): 2, 3

(8) *ACQUISITION PROCESS | CONTINUOUS MONITORING PLAN FOR CONTROLS*

Supplemental C-SCRM Guidance: This control enhancement is relevant to C-SCRM and plans for continuous monitoring of control effectiveness and should therefore be extended to suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Level(s): 2, 3

SA-5 SYSTEM DOCUMENTATION

Supplemental C-SCRM Guidance: Information system documentation should include relevant C- SCRM concerns (e.g., C-SCRM plan).

Level(s): 3

SA-8 SECURITY AND PRIVACY ENGINEERING PRINCIPLES

Supplemental C-SCRM Guidance: The following security engineering techniques are helpful in managing cybersecurity risk in the supply chain:

a. Anticipate the maximum possible ways that the ICT/OT product or service can be misused and abused in order to help identify how to protect the product or system from such uses. Address intended and unintended use scenarios in architecture and design;
b. Design network and security architectures, systems and components based on the enterprise's risk tolerance as determined by risk assessments (see Section 2 and Appendix C);
c. Document and gain management acceptance and approval for risks that are not fully mitigated;
d. Limit the number, size, and privilege levels of critical elements; using criticality analysis will aid in determining which elements or functions are critical. See criticality analysis in Appendix C, and NISTIR 8179 *Criticality Analysis Process Model: Prioritizing Systems and Components*;
e. Use security mechanisms that help to reduce opportunities to exploit supply chain cybersecurity vulnerabilities, including, for example, encryption, access control, identity management, and malware or tampering discovery;
f. Design information system components and elements to be difficult to disable (e.g., tamper-proofing techniques) and, if disabled, trigger notification methods such as audit trails, tamper evidence, or alarms;
g. Design delivery mechanisms (e.g., downloads for software) to avoid unnecessary exposure or access to the supply chain and the systems/components traversing the supply chain during delivery; and
h. Design relevant validation mechanisms to be used during implementation and operation.

Level(s): 1, 2, 3

SA-9 EXTERNAL SYSTEM SERVICES

Supplemental C-SCRM Guidance: C-SCRM supplemental guidance is provided in control enhancements.

Control Enhancement(s):

(1) *EXTERNAL SYSTEM SERVICES | RISK ASSESSMENTS AND ORGANIZATIONAL APPROVALS*

Supplemental C-SCRM Guidance: See Appendix C - Assess, and Appendices D and E.

Level(s): 2, 3

(3) *EXTERNAL SYSTEM SERVICES | ESTABLISH AND MAINTAIN TRUST RELATIONSHIP WITH PROVIDERS*

Supplemental C-SCRM Guidance: Relationships with providers ("providers" within the context of this enhancement may include suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers) should meet the following supply chain security requirements:
a. Requirements definition is complete and reviewed for accuracy and completeness including the assignment of criticality to various components as well as defining operational concepts and associated scenarios for intended and unintended use in requirements;
b. Requirements are based on needs, relevant compliance drivers, criticality analysis, and assessments of cybersecurity risk in the supply chain;
c. Cyber-supply chain threats, vulnerabilities, and associated risks are identified and documented;
d. Enterprise data and information integrity, confidentiality, and availability requirements are defined and shared with the system suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers as appropriate;
e. Consequences of noncompliance with C-SCRM requirements and information system security requirements are defined and documented;
f. Clear delineation of accountabilities, roles, and responsibilities between contractors when multiple disparate providers are engaged in supporting a system or mission/business function;
g. Requirements for service contract completion and what defines the end of the suppliers', developers', system integrators', external system service providers', or other ICT/OT-related

5235 service providers' relationship. This is important to know for re-compete, potential change in
5236 provider, and to manage system end-of-life processes;
5237 h. Establish negotiated agreements for relationship termination to ensure a safe and secure
5238 termination, for example removing data from cloud environments.
5239
5240 Level(s): 1, 2, 3

5241 **(4)** *EXTERNAL SYSTEM SERVICES | CONSISTENT INTERESTS OF CONSUMERS AND PROVIDERS*

5242 Supplemental C-SCRM Guidance: "Providers" in the context of this enhancement may include
5243 suppliers, developers, system integrators, external system service providers, and other ICT/OT-related
5244 service providers.
5245
5246 Level(s): 3

5247 **(5)** *EXTERNAL SYSTEM SERVICES | PROCESSING, STORAGE, AND SERVICE LOCATION*

5248 Supplemental C-SCRM Guidance: Location may be under the control of the suppliers, developers,
5249 system integrators, external system service providers, and other ICT/OT-related service providers.
5250 Enterprises should assess C-SCRM risks associated with a given geographic location and apply an
5251 appropriate risk response, which may include defining locations that are or are not acceptable and
5252 ensuring appropriate protections are in place to address any associated C-SCRM risks.
5253
5254 Level(s): 3

5255 **SA-10 DEVELOPER CONFIGURATION MANAGEMENT**

5256 Supplemental C-SCRM Guidance: Developer configuration management is critical for reducing
5257 cybersecurity risk in the supply chain. By conducting configuration management activities, developers
5258 reduce occurrence and likelihood of flaws, while increasing accountability and ownership for the changes.
5259 Developer configuration management should be performed both by developers internal to federal agencies
5260 and integrators or external service providers.
5261
5262 Level(s): 2, 3
5263
5264 Related Controls: SA-10 (1), (2), (3), (4), (5), and (6)

5265 **SA-11 DEVELOPER TESTING AND EVALUATION**

5266 Supplemental C-SCRM Guidance: Depending on the origins of components, this control may be
5267 implemented differently. For OTS (off-the-shelf) components, the acquirer should conduct research (e.g.,
5268 via publicly available resources) or request proof to determine whether the supplier (OEM) has performed
5269 such testing as part of their quality/security processes. When the acquirer has control over the application
5270 and the development processes, they should require this testing as part of the SDLC. In addition to the
5271 specific types of testing activities described in the enhancements, examples of C-SCRM-relevant testing
5272 include testing for counterfeits, verifying the origins of components, examining configuration settings prior
5273 to integration, and testing interfaces. These types of tests may require significant resources and should be
5274 prioritized based on criticality, threat, and vulnerability analyses (described in Section 2 and Appendix C),
5275 and the effectiveness of testing techniques. Enterprises may also require third-party testing as part of
5276 developer security testing.
5277
5278 Level(s): 1, 2, 3
5279
5280 Related Controls: SA-11 (1), (2), (3), (4), (5), (6), (7), (8), and (9)

5281 **SA-15 DEVELOPMENT PROCESS, STANDARDS, AND TOOLS**

Supplemental C-SCRM Guidance: Providing documented and formalized development processes to guide internal and system integrator developers is critical to enterprises efforts to effectively mitigate cybersecurity risk in the supply chain. The enterprise should apply national and international standards and best practices when implementing this control. Using existing standards promotes consistency of implementation, reliable and defendable process, if implemented properly, and interoperability. The enterprise's development/maintenance, test, and deployment environments should all be covered by this control. The tools included in this control can be manual or automated. Use of automated tools aids thoroughness, efficiency, and scale of analysis that helps address cybersecurity risk in the supply chain in the development process. Additionally, the output of such activities and tools provides useful inputs for C-SCRM processes described in Section 2 and Appendix C. This control has applicability to both the internal enterprise's processes, information systems, and networks as well as applicable system integrators' processes, systems, and networks.

Level(s): 2, 3

Related Controls: SA-15 enhancements (1), (2), (5), (6), and (7)

Control Enhancement(s):

(3) *DEVELOPMENT PROCESS, STANDARDS, AND TOOLS | CRITICALITY ANALYSIS*

Supplemental C-SCRM Guidance: This enhancement identifies critical components within the information system. Doing so will help determine the specific C-SCRM activities to be implemented for critical components. See C-SCRM Criticality Analysis described in Appendix C for additional context.

Level(s): 2, 3

(4) *DEVELOPMENT PROCESS, STANDARDS, AND TOOLS | THREAT MODELING AND VULNERABILITY ANALYSIS*

Supplemental C-SCRM Guidance: This enhancement provides threat modeling/vulnerability analysis for the relevant federal agency and contractor products, applications, information systems, and networks. Performing this analysis will help integrate C-SCRM into code refinement and modification activities. See C-SCRM threat and vulnerability analyses described in Appendix C for additional context.

Level(s): 2, 3

Related Control(s): SA-15(5), SA-15(6), SA-15(7)

(8) *DEVELOPMENT PROCESS, STANDARDS, AND TOOLS | REUSE OF THREAT AND VULNERABILITY INFORMATION*

Supplemental C-SCRM Guidance: This enhancement encourages developers to reuse threat and vulnerability information produced by prior development efforts and lessons learned from using the tools to inform ongoing development efforts. Doing so will help determine C-SCRM activities described in Section 2 and Appendix C.

Level(s): 3

SA-16 DEVELOPER-PROVIDED TRAINING

Supplemental C-SCRM Guidance: Developer-provided training for external and internal (in-house) developers is critical to C-SCRM. It addresses training the individuals responsible for federal systems and

networks to include applicable development environments. Developer-provided training in this control also applies to the individuals who select system and network components. Developer-provided training should include C-SCRM material to ensure that 1) developers are aware of potential threats and vulnerabilities when developing, testing, and maintaining hardware and software; and 2) individuals responsible for selecting system and network components incorporate C-SCRM when choosing such components. Developer training should also cover training for secure coding and use of tools to find vulnerabilities in software. Refer to Appendix F for additional guidance on security for critical software.

Level(s): 2, 3

Related Controls: AT-3

SA-17 DEVELOPER SECURITY AND PRIVACY ARCHITECTURE AND DESIGN

Supplemental C-SCRM Guidance: This control facilitates the use of C-SCRM information to influence system architecture, design, and component selection decisions, including security functions. Examples include identifying components that compose system architecture and design or selecting specific components to ensure availability through multiple supplier or component selections.

Level(s): 2, 3

Related Controls: SA-17 (1) and (2)

SA-20 CUSTOMIZED DEVELOPMENT OF CRITICAL COMPONENTS

Supplemental C-SCRM Guidance: The enterprise may decide, based on their assessments of cybersecurity risk in the supply chain, that they require customized development of certain critical components. This control provides additional guidance on this activity. Enterprises should work with suppliers and partners to ensure critical components are identified. Organizations should ensure they have a continued ability to maintain custom developed critical software components. For example, having the source code, build scripts, and tests for a software component could enable an organization to have someone else maintain it if necessary.

Level(s): 2, 3

SA-21 DEVELOPER SCREENING

Supplemental C-SCRM Guidance: The enterprise should implement screening processes for their internal developers. For system integrators who may be providing key developers that address critical components, the enterprise should ensure that appropriate processes for developer screening have been used. Screening of developers should be included as a contractual requirement and be a flow-down requirement to relevant sub-level subcontractors who provide development services or who have access to the development environment.

Level(s): 2, 3

Control Enhancement(s):

(1) *DEVELOPER SCREENING | VALIDATION OF SCREENING*

Supplemental C-SCRM Guidance: Internal developer screening should be validated. Enterprises may validate system integrator developer screening by requesting summary data from the system integrator to be provided post-validation.

Level(s): 2, 3

5377 **SA-22 UNSUPPORTED SYSTEM COMPONENTS**

5378 Supplemental C-SCRM Guidance: Acquiring products directly from qualified original equipment
5379 manufacturers (OEMs) or their authorized distributors and resellers significantly reduces much
5380 cybersecurity risks in the supply chain. In the case of unsupported system components, the enterprise
5381 should use authorized distributors with an ongoing relationship with the supplier of the unsupported system
5382 components.
5383
5384 When purchasing alternate sources for continued support, enterprises should acquire directly from vetted
5385 original equipment manufacturers (OEMs) or their authorized distributors and resellers. Decisions about
5386 using alternate sources require input from the enterprise's engineering resources regarding the differences
5387 in alternate component options. For example, if an alternative is to acquire an open source software
5388 component, what are the open source community development, test, acceptance, and release processes?
5389
5390 Level(s): 2, 3
5391
5392

FAMILY: SYSTEM AND COMMUNICATIONS PROTECTION

[FIPS 200] specifies the System and Communications Protection minimum security requirement as follows:

> *Organizations must: (i) monitor, control, and protect organizational communications (i.e., information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems; and (ii) employ architectural designs, software development techniques, and systems engineering principles that promote effective information security within organizational information systems.*

An enterprise's communications infrastructure is composed of ICT/OT components and systems, which have their own supply chains. These communications allow users or administrators to remotely access an enterprise's systems and to connect to the Internet, with other ICT/OT within the enterprise, contractor systems, and occasionally supplier systems. An enterprise's communications infrastructure may be provided and supported by suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

SC-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: System and communications protection policies and procedures should address cybersecurity risk in the supply chain to the enterprise's processes, systems, and networks. Enterprise-level and program-specific policies help establish and clarify these requirements and corresponding procedures provide instructions for meeting these requirements. Policies and procedures should include the coordination of communications among and across multiple enterprise entities within the enterprise as well as communications methods, external connections, and processes used between the enterprise and its suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Level(s): 1, 2, 3

SC-4 INFORMATION IN SHARED RESOURCES

Supplemental C-SCRM Guidance: The enterprise may share information system resources with system suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Protecting information in shared resources in support of various supply chain activities is challenging when outsourcing key operations. Enterprises may either share too much, increasing their risk, or share too little, making it difficult for the suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to be efficient in their service delivery. The enterprise should work with developers to define a structure/process of information sharing including the data shared, method of sharing, and to whom (the specific roles) it is provided. Appropriate privacy, dissemination, handling, and clearance requirements should be accounted for in the information sharing process.

Level(s): 2, 3

SC-5 DENIAL-OF-SERVICE PROTECTION

Supplemental C-SCRM Guidance: C-SCRM Guidance supplemental guidance is provided in control enhancement SC-5 (2).

Control Enhancement(s):

(2) *DENIAL-OF-SERVICE PROTECTION | CAPACITY, BANDWIDTH, AND REDUNDANCY*

Supplemental C-SCRM Guidance: The enterprise should include requirements for excess capacity, bandwidth, and redundancy into agreements with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Level(s): 2

SC-7 BOUNDARY PROTECTION

Supplemental C-SCRM Guidance: The enterprise should implement appropriate monitoring mechanisms and processes at the boundaries between the agency systems and suppliers', developers', system integrators', external system service providers', and other ICT/OT-related service providers' systems. Provisions for boundary protections should be incorporated into agreements with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. There may be multiple interfaces throughout the enterprise and supplier systems and networks and the SDLC. Appropriate vulnerability, threat, and risk assessments should be performed to ensure proper boundary protections for both supply chain components as well as supply chain information flow. The vulnerability, threat, and risk assessment can aid in scoping boundary protection to a relevant set of criteria and help manage associated costs. For contracts with external service providers, enterprises should ensure that the provider satisfies boundary control requirements pertinent to environments and networks within their span of control. Further detail is provided in Section 2 and Appendix C. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2

Control Enhancement(s):

(13) *BOUNDARY PROTECTION | ISOLATION OF SECURITY TOOLS, MECHANISMS, AND SUPPORT COMPONENTS*

Supplemental C-SCRM Guidance: The enterprise should provide separation and isolation of development, test, and security assessment tools, and operational environments and relevant monitoring tools within the enterprise's information systems and networks. This control applies the entity responsible for creating software and hardware, to include federal agencies and prime contractors. As such this controls applies to the federal agency and applicable supplier information systems and networks. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors. If a compromise or information leakage happens in any one environment, the other environments should still be protected through the separation/isolation mechanisms or techniques.

Level(s): 3

Related Controls: SR-3(3)

(14) *BOUNDARY PROTECTION | PROTECT AGAINST UNAUTHORIZED PHYSICAL CONNECTIONS*

Supplemental C-SCRM Guidance: This control is relevant to C-SCRM as it applies to external service providers.

Level(s): 2,3

Related Controls: SR-3(3)

(19) *BOUNDARY PROTECTION | BLOCKS COMMUNICATION FROM NON-ORGANIZATIONALLY CONFIGURED HOSTS*

Supplemental C-SCRM Guidance: This control is relevant to C-SCRM as it applies to external service providers.

Level(s): 3

SC-8 TRANSMISSION CONFIDENTIALITY AND INTEGRITY

Supplemental C-SCRM Guidance: Requirements for transmission confidentiality and integrity should be integrated into agreements with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Acquirers, suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers may repurpose existing security mechanisms (e.g., authentication, authorization, or encryption) to achieve enterprise confidentiality and integrity requirements. The degree of protection should be based on the sensitivity of information to be transmitted and the relationship between the enterprise and the suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

SC-18 MOBILE CODE

Supplemental C-SCRM Guidance: The enterprise should use this control in various applications of mobile code within their information systems and networks. Examples include acquisition processes such as electronic transmission of supply chain information (e.g., email), receipt of software components, logistics information management in RFID, or transport sensors infrastructure.

Level(s): 3

Control Enhancement(s):

(2) *MOBILE CODE | ACQUISITION, DEVELOPMENT, AND USE*

Supplemental C-SCRM Guidance: The enterprise should employ rigorous supply chain protection techniques in the acquisition, development, and use of mobile code to be deployed in the information system. Examples include ensuring that mobile code originates from vetted sources when acquired, that vetted system integrators are used for the development of custom mobile code or prior to installing, and that verification processes are in place for acceptance criteria prior to install in order to verify the source and integrity of code. Note that mobile code can be both code for the underlying information systems and networks (e.g., RFID device applications) or for information systems/components.

Level(s): 3

SC-27 PLATFORM-INDEPENDENT APPLICATIONS

Supplemental C-SCRM Guidance: The use of trusted platform-independent applications is essential to C-SCRM. Platform-independent applications' enhanced portability enables enterprises to switch external service providers more readily in the event that one becomes compromised, thereby reducing vendor-dependent cybersecurity risk in the supply chain. This is especially relevant for critical applications on which multiple systems may rely.

Level(s): 2, 3

SC-28 PROTECTION OF INFORMATION AT REST

Supplemental C-SCRM Guidance: The enterprise should include provisions for protection of information at rest into their agreements with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. The enterprise should also ensure that they provide appropriate protections within the information systems and networks for data at rest for the suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers information, such as source code, testing data, blueprints, and intellectual property information. This control should be applied throughout the SDLC including during requirements, development, manufacturing, test, inventory management, maintenance, and disposal. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Related Controls: SR-3(3)

SC-29 HETEROGENEITY

Supplemental C-SCRM Guidance: Heterogeneity techniques include use of different operating systems, virtualization techniques, and multiple sources of supply. Multiple sources of supply can improve component availability and reduce the impact of a supply chain cybersecurity compromise. In case of a supply chain cybersecurity compromise, an alternative source of supply will allow the enterprises to more rapidly switch to an alternative system/component which may not be affected by the compromise. Also, heterogeneous components decrease the attack surface by limiting the impact to the subset of the infrastructure that is using vulnerable components.

Level(s): 2, 3

SC-30 CONCEALMENT AND MISDIRECTION

Supplemental C-SCRM Guidance: Concealment and misdirection techniques for C-SCRM include the establishment of random resupply times, concealment of location, random change of fake location used, and random change/shifting of information storage into alternate servers/storage mechanisms.

Level(s): 2, 3

Control Enhancement(s):

(2) *CONCEALMENT AND MISDIRECTION | RANDOMNESS*

Supplemental C-SCRM Guidance: Supply chain processes are necessarily structured with predictable, measurable, and repeatable processes for the purpose of efficiency and cost reduction. This opens up the opportunity for potential breach. In order to protect against compromise, the enterprise should employ techniques to introduce randomness into enterprise operations and assets in the enterprise's systems or networks (e.g., randomly switching among several delivery enterprises or routes, or changing the time and date of receiving supplier software updates if previously predictably scheduled).

Level(s): 2, 3

(3) *CONCEALMENT AND MISDIRECTION | CHANGE PROCESSING AND STORAGE LOCATIONS*

Supplemental C-SCRM Guidance: Changes in processing or storage locations can be used to protect downloads, deliveries, or associated supply chain metadata. The enterprise may leverage such

techniques within the enterprises' information systems and networks to create uncertainty into the activities targeted by adversaries. Establishing a few process changes and randomizing the use of them, whether it is for receiving, acceptance testing, storage, or other supply chain activities, can aid in reducing the likelihood of a supply chain event.

Level(s): 2, 3

(4) *CONCEALMENT AND MISDIRECTION | MISLEADING INFORMATION*

Supplemental C-SCRM Guidance: The enterprise can convey misleading information as part of concealment and misdirection efforts to protect the information system being developed and the enterprise's systems and networks. Examples of such efforts in security include honeynets or virtualized environments. Implementations can be leveraged in conveying misleading information. These may be considered advanced techniques requiring experienced resources to effectively implement them. If an enterprise decides to use honeypots, it should be done in concert with legal counsel or following the enterprise's policies.

Level(s): 2, 3

(5) *CONCEALMENT AND MISDIRECTION | CONCEALMENT OF SYSTEM COMPONENTS*

Supplemental C-SCRM Guidance: The enterprise may employ various concealment and misdirection techniques to protect information about the information system being developed and the enterprise's information systems and networks. For example, delivery of critical components to a central or trusted third-party depot can be used to conceal or misdirect any information regarding the component use or the enterprise using the component. Separating components from their associated information into differing physical and electronic delivery channels and obfuscating the information through various techniques can be used to conceal information and reduce the opportunity for potential loss of confidentiality of the component or its use, condition, and other attributes.

Level(s): 2, 3

SC-36 DISTRIBUTED PROCESSING AND STORAGE

Supplemental C-SCRM Guidance: Processing and storage can be distributed both across the enterprise's systems and networks and across the SDLC. The enterprise should ensure that these techniques are applied in both contexts. The following activities can use distributed processing and storage: development, manufacturing, configuration management, test, maintenance, and operations. This control applies to the entity responsible for processing and storage functions or related infrastructure, to include federal agencies and contractors. As such this controls applies to the federal agency and applicable supplier information systems and networks. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Related Controls: SR-3(3)

SC-37 OUT-OF-BAND CHANNELS

Supplemental C-SCRM Guidance: C-SCRM-specific supplemental guidance is provided in control enhancement SC-37 (1).

Control Enhancement(s):

(1) *OUT-OF-BAND CHANNELS | ENSURE DELIVERY AND TRANSMISSION*

Supplemental C-SCRM Guidance: The enterprise should employ security safeguards to ensure that only specific individuals or information systems receive the information about the information system or its development environment and processes. For example, proper credentialing and authorization documents should be requested and verified prior to the release of critical components such as custom chips, custom software, or information during delivery.

Level(s): 2, 3

SC-38 OPERATIONS SECURITY

Supplemental C-SCRM Guidance: The enterprise should ensure that appropriate supply chain threat and vulnerability information is obtained from and provided to the applicable operational security processes.

Level(s): 2, 3

Related Control(s): SR-7

SC-47 ALTERNATE COMMUNICATIONS PATHS

Supplemental C-SCRM Guidance: If necessary and appropriate, suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers should be included in the alternate communication paths described in this control.

Level(s): 1, 2, 3

FAMILY: SYSTEM AND INFORMATION INTEGRITY

[FIPS 200] specifies the System and Information Integrity minimum security requirement as follows:

> *Organizations must: (i) identify, report, and correct information and information system flaws in a timely manner; (ii) provide protection from malicious code at appropriate locations within organizational information systems; and (iii) monitor information system security alerts and advisories and take appropriate actions in response.*

System and information integrity for systems and components traversing the supply chain is critical for managing cybersecurity risk in the supply chain. Insertion of malicious code and counterfeits are two primary examples of cybersecurity risk in the supply chain, both of which can at least partially be addressed by deploying system and information integrity controls. Enterprises should ensure that adequate system and information integrity protections are part of C-SCRM.

SI-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: The enterprise should include C-SCRM in system and information integrity policy and procedures, including ensuring that program-specific requirements for employing various integrity verification tools and techniques are clearly defined. System and information integrity for information systems and components and the underlying information systems and networks is critical for managing cybersecurity risk in the supply chain. Insertion of malicious code and counterfeits are two primary examples of cybersecurity risk in the supply chain, both of which can be at least partially addressed by deploying system and information integrity controls.

Level(s): 1, 2, 3

Related Controls: SR-1, 9, 10, 11

SI-2 FLAW REMEDIATION

Supplemental C-SCRM Guidance: Output of flaw remediation activities provides useful input into ICT/OT SCRM processes described in Section 2 and Appendix C. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Control Enhancement(s):

(5) *FLAW REMEDIATION | AUTOMATIC SOFTWARE AND FIRMWARE UPDATES*

Supplemental C-SCRM Guidance: The enterprise should specify the various software assets within its information systems and networks that require automated updates (both indirect and direct). This specification of assets should be defined from criticality analysis results, which provide information on critical and noncritical functions and components (see Section 2 and Appendix C). A centralized patch management process may be employed for evaluating and managing updates prior to deployment. Those software assets that require direct updates from a supplier should only accept updates

originating directly from the OEM unless specifically deployed by the acquirer, such as with a centralized patch management process.

Level(s): 2

SI-3 MALICIOUS CODE PROTECTION

Supplemental C-SCRM Guidance: Because the majority of code operated in federal system is not developed by the federal government, malicious code threat often originates from the supply chain. This controls applies to the federal agency and contractors with code-related responsibilities (e.g., code-development, installing patched, performing system upgrades, etc.) as well as applicable contractor information systems and networks. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Related Controls: SA-11; SI-7(15); SI-3(4), (6), (8), and (10); SR-3(3)

SI-4 SYSTEM MONITORING

Supplemental C-SCRM Guidance: This control includes monitoring of vulnerabilities resulting from past supply chain cybersecurity compromises, such as malicious code implanted during software development and set to activate after deployment. System monitoring is frequently performed by external service providers. Service-level agreements with these providers should be structured to appropriately reflect this control. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

Control Enhancement(s):

(17) *SYSTEM MONITORING | INTEGRATED SITUATIONAL AWARENESS*

Supplemental C-SCRM Guidance: System monitoring information may be correlated with that of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, if appropriate. The results of correlating monitoring information may point to supply chain cybersecurity vulnerabilities that require mitigation or compromises.

Level(s): 2, 3

(19) *SYSTEM MONITORING | RISK FOR INDIVIDUALS*

Supplemental C-SCRM Guidance: Persons identified as being of higher risk may include enterprise employees, contractors, and other third parties (e.g., volunteers, visitors) that may have the need or ability to access to an enterprise's system, network, or system environment. In accordance with policies and procedures and, if relevant, terms of an agreement, and in coordination with appropriate officials, the enterprise may implement enhanced oversight of these higher-risk individuals.

Level(s): 2, 3

SI-5 SECURITY ALERTS, ADVISORIES, AND DIRECTIVES

Supplemental C-SCRM Guidance: The enterprise should evaluate security alerts, advisories, and directives for cybersecurity supply chain impact and follow up if needed. U.S. Cert, FASC, and other authoritative entities, generate security alerts and advisories that are applicable to C-SCRM. Additional laws and regulations will impact who and how additional advisories are provided. Enterprises should ensure their

information sharing protocols and processes include sharing alerts, advisories, and directives with relevant parties with whom they have an agreement to deliver products or perform services. Enterprises should provide direction or guidance as to what actions are to be taken in response to sharing such an alert, advisory, or directive. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 1, 2, 3

SI-7 SOFTWARE, FIRMWARE, AND INFORMATION INTEGRITY

Supplemental C-SCRM Guidance: This control applies to the federal agency and applicable supplier products, applications, information systems, and networks. The integrity of all applicable systems and networks should be systematically tested and verified to ensure that it remains as required so that the systems/components traversing through the supply chain are not impacted by unanticipated changes. The integrity of systems and components should also be tested and verified. Applicable verification tools include digital signature or checksum verification; acceptance testing for physical components; confining software to limited privilege environments such as sandboxes; code execution in contained environments prior to use; and ensuring if only binary or machine-executable code is available, that it is obtained directly from the OEM or a verified supplier or distributer. Mechanisms for this control are discussed in detail in NIST SP 800-53 Rev. 5. This control applies to the federal agency and applicable supplier information systems and networks. When purchasing an ICT/OT product, an enterprise should perform due diligence to understand what a supplier's integrity assurance practices are. Enterprises should require their prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Related Controls: SR-3(3)

Control Enhancement(s):

(14) *SOFTWARE, FIRMWARE, AND INFORMATION INTEGRITY | BINARY OR MACHINE EXECUTABLE CODE*

Supplemental C-SCRM Guidance: The enterprise should obtain binary or machine-executable code directly from the OEM/developer or other verified source.

Level(s): 2, 3

(15) *SOFTWARE, FIRMWARE, AND INFORMATION INTEGRITY | CODE AUTHENTICATION*

Supplemental C-SCRM Guidance: The enterprise should ensure that code authentication mechanisms such as digital signatures are implemented to assure the integrity of software, firmware, and information.

Level(s): 3

SI-12 INFORMATION MANAGEMENT AND RETENTION

Supplemental C-SCRM Guidance: C-SCRM should be included in information management and retention requirements, especially when system integrator, supplier, and external service provider sensitive and proprietary information is concerned.

Level(s): 3

SI-20 TAINTING

Supplemental C-SCRM Guidance: Suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers may have access to federal agency sensitive information. In this instance, enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors.

Level(s): 2, 3

Related Controls: SR-9

FAMILY: SUPPLY CHAIN RISK MANAGEMENT

[FIPS 200] does not specify Supply Chain Risk Management minimum security requirements. [NIST SP 800-53 Rev. 5] established a new control family: Supply Chain Risk Management. Supplemental guidance below expands upon the SR controls and provides further information and context for their application. This is a new family in SP 800-53 Revision 5. A large amount of the guidance is already in SP 800-53 Revision 5. This SP (800-161 R1) includes all SR control enhancements from SP 800-53 Revision 5 below. The following SR controls and control enhancements have been added to NIST SP 800-53 Rev5: [SR-13]. Readers should consult NIST SP 800-53 Rev5 SR controls together with the controls in this section.

SR-1 POLICY AND PROCEDURES

Supplemental C-SCRM Guidance: C-SCRM policies is developed at Level 1 for the overall enterprise and at Level 2 for specific missions and functions. C-SCRM policies can be implemented at Levels 1, 2, and 3, depending on the level of depth and detail. C-SCRM procedures are developed at Level 2 for specific missions and functions and at Level 3 for specific systems. Enterprise functions including but not limited to information security, legal, risk management, and acquisition should review and concur on the development of C-SCRM policies and procedures or provide guidance to system owners for developing system-specific C-SCRM procedures.

Level(s): 1, 2, 3

SR-2 SUPPLY CHAIN RISK MANAGEMENT PLAN

Supplemental C-SCRM Guidance: C-SCRM plans describes implementations, requirements, constraints, and implications at the system level. C-SCRM plans are influenced by the enterprise's other risk assessment activities and may inherit, and tailor common control baselines defined at Level 1 and 2. C-SCRM plans defined at Level 3 works in collaboration with the enterprise's C-SCRM Strategy and Policies (Levels 1 & 2), and the C-SCRM Implementation Plan (Levels 1 & 2) to provide a systematic and holistic approach for cybersecurity supply chain risk management across the enterprise.

C-SCRM plans should be developed as a standalone document and only integrated in existing system security plans if enterprise constraints require it.

Level(s): 3

Related Controls: PL-2

SR-3 SUPPLY CHAIN CONTROLS AND PROCESSES

Supplemental C-SCRM Guidance: Section 2 and Appendix C of this document provide detailed guidance on implementing this control.

Level(s): 1, 2, 3

Control Enhancement(s):

(1) *SUPPLY CHAIN CONTROLS AND PROCESSES | DIVERSE SUPPLY BASE*

Supplemental C-SCRM Guidance: Enterprises should diversify their supply base, especially for critical ICT/OT products and services. As a part of this exercise, the enterprise should attempt to identify single points of failure and risk among primes and lower-level entities in the supply chain. Criticality analysis as described in NISTIR 8272, *Impact Analysis Tool for Interdependent Cyber Supply Chain Risks* can help determine which suppliers are critical. See Section 2, Appendix C, and RA-9 for guidance on conducting criticality analysis.

Level(s): 2, 3

Related Controls: RA-9

(3) *SUPPLY CHAIN CONTROLS AND PROCESSES | SUB-TIER FLOW DOWN*

Supplemental C-SCRM Guidance: Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors throughout the SDLC. The use of the acquisition process provides an important vehicle to protect the supply chain. Enterprise should include as part of procurement requirements the need for suppliers to flow down controls to subcontractors throughout the SDLC. As part of market research and analysis activities, enterprise should conduct robust due diligence research on potential suppliers or products as well as their upstream dependencies (e.g., 4th and 5th party suppliers), which can help enterprises avoid single points of failure within their supply chains. The results of this research can be helpful in shaping the sourcing approach and refining requirements. Then, during the solicitation and contract award phase, an evaluation of the cybersecurity risk in the supply chain associated with a supplier, product, or service should be completed prior to the contract award decision to ensure the holistic risk profile is well understood and serves as a weighted factor in award decisions. During the period of performance, suppliers should be monitored for conformance to the defined controls and requirements, as well as changes in risk conditions. See Section 3 for guidance on the Role of C-SCRM in the Acquisition Process.

Level(s): 2, 3

SR-4 PROVENANCE

Supplemental C-SCRM Guidance: Provenance should be applied to systems, system components, and associated data throughout the SDLC. Wherever possible and applicable, enterprises should mandate that SBOMs are produced for all classes of software including purchased software, open source software, and in-house software. SBOMs can play a critical role in enabling organizations to maintain provenance. Refer to Appendix F for additional guidance on security for critical software.

Level(s): 2, 3

SR-5 ACQUISITION STRATEGIES, TOOLS, AND METHODS

Supplemental C-SCRM Guidance: Section 3 and SA controls provide additional guidance on acquisition strategies, tools, and methods.

Level(s): 1, 2, 3

Related Controls: SA Control Family

SR-6 SUPPLIER ASSESSMENTS AND REVIEWS

Supplemental C-SCRM Guidance: In general, an enterprise should consider any information pertinent to the security, integrity, resilience, quality, trustworthiness, or authenticity of the supplier, or their provided services or products. Enterprises should consider applying this information against a consistent set of core baseline factors and assessment criteria to facilitate equitable comparison (between suppliers as well as over time). Depending upon the specific context and purpose for which the assessment is being conducting, the enterprise may select additional factors. The quality of information (e.g., its relevance, completeness, accuracy, etc.) relied upon for an assessment is also an important consideration. Reference sources for assessment information should also be documented. The C-SCRM PMO can help define requirements, methods, and tools for enterprise's supplier assessments.

Level(s): 2, 3

SR-7 SUPPLY CHAIN OPERATIONS SECURITY

Supplemental C-SCRM Guidance: C-SCRM PMO can help determine OPSEC controls that apply to specific missions and functions. OPSEC controls are particularly important when there is specific concern about an adversarial threat from or to the enterprise's supply chain or an element within the supply chain or the nature of the enterprise's mission or business operations, its information, and/or its service/product offerings may make it a more attractive target of an adversarial threat.

Level(s): 2, 3

SR-8 NOTIFICATION AGREEMENTS

Supplemental C-SCRM Guidance: Enterprises should require their suppliers, minimally, have established notification agreements with those entities within their supply chain that have a role or responsibility related to that critical service or product.

Level(s): 2, 3

Related Controls: RA-9

SR-9 TAMPER RESISTANCE AND DETECTION

Supplemental C-SCRM Guidance: Enterprises should apply tamper resistance and detection control to critical components, at a minimum. Criticality analysis can help determine which components are critical. See Section 2, Appendix C, and RA-9 for guidance on conducting criticality analysis. C-SCRM PMO can help identify critical components, especially those that are used by multiple missions, functions, and systems within an enterprise.

Level(s): 2, 3

Related Controls: RA-9

SR-10 INSPECTION OF SYSTEMS OR COMPONENTS

Supplemental C-SCRM Guidance: Enterprises should inspect critical systems and components, at a minimum, for assurance that tamper resistance controls are in place and to examine whether there is evidence of tampering. Products or components should be inspected prior to use and periodically thereafter. Inspection requirements should also be included in contracts with suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. Enterprises should require its prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors and flow down to subcontractors, when relevant.

Criticality analysis can help determine which systems and components are critical and should therefore be subjected to inspection. See Section 2, Appendix C, and RA-9 for guidance on conducting criticality analysis. C-SCRM PMO can help identify critical systems and components, especially those that are used by multiple missions, functions, and systems (for components) within an enterprise.

Level(s): 2, 3

Related Controls: RA-9

SR-11 COMPONENT AUTHENTICITY

Supplemental C-SCRM Guidance: Development of anti-counterfeit policy and procedures requires input from and coordination with acquisition, Information Technology, IT Security, legal, and the C-SCRM PMO. The policy and procedures should address regulatory compliance requirements, contract requirements/clauses as well as counterfeit reporting processes to enterprises such as GIDEP and/or other appropriate enterprises.

Level(s): 1, 2, 3

Control Enhancement(s):

(1) *COMPONENT AUTHENTICITY | ANTI-COUNTERFEIT TRAINING*

Supplemental C-SCRM Guidance: C-SCRM PMO can assist in identifying resources that can provide anti-counterfeit training and/or may be able to conduct such training for the enterprise. The C-SCRM PMO can also assist in identifying which personnel should receive the training.

Level(s): 2, 3

(2) *COMPONENT AUTHENTICITY | CONFIGURATION CONTROL FOR COMPONENT SERVICE AND REPAIR*

Supplemental C-SCRM Guidance: Information Technology, IT Security, or the C-SCRM PMO should be responsible for establishing and implementing configuration control processes for component service and repair, to include, if applicable, integrating component service and repair into the overall enterprise configuration control processes. Component authenticity should be addressed in contracts when procuring component servicing and repair support.

Level(s): 2, 3

(3) *COMPONENT AUTHENTICITY | ANTI-COUNTERFEIT SCANNING*

Supplemental C-SCRM Guidance: Enterprises should conduct anti-counterfeit scanning for critical components, at a minimum. Criticality analysis can help determine which components are critical and should be subjected to this scanning. See Section 2, Appendix C, and RA-9 for guidance on conducting criticality analysis. C-SCRM PMO can help identify critical components, especially those used by multiple missions, functions, and systems within an enterprise.

Level(s): 2, 3

Related Controls: RA-9

SR-12 COMPONENT DISPOSAL

Supplemental C-SCRM Guidance: IT Security, in coordination with the C-SCRM PMO, can help establish appropriate component disposal policies, procedures, mechanisms, and techniques.

Level(s): 2, 3

SR-13 SUPPLIER INVENTORY (NEW)

Control:

a. Develop, document, and maintain an accurate and complete inventory of suppliers that present cybersecurity risk in the supply chain. This inventory should:
   1. Document enterprise suppliers;
   2. Identify whether the supplier provides a product and/or service;
   3. For each supplier, indicate which programs, projects, and systems are using supplier products and services;
   4. For each supplier, assign criticality level to each supplier enterprise that aligns to the criticality of the program, project and/or system (or component of system).

b. Review and update supplier inventory [*Assignment: enterprise-defined frequency*].

Supplemental C-SCRM Guidance: Enterprises rely on numerous suppliers to execute their missions and functions. Many suppliers provide products and services in support of multiple missions, functions, programs, projects, and systems. Some suppliers are more critical than others, based on the criticality of missions, functions, programs, projects, systems that their products and services support, as well as the enterprise's level of dependency on the supplier. Enterprises should use criticality analysis to help determine which products and services are critical to determine criticality of suppliers to be documented in the supplier inventory. See Section 2, Appendix C, and RA-9 for guidance on conducting criticality analysis.

Level(s): 2, 3

Related Controls: RA-9

5994
5995

APPENDIX B: C-SCRM CONTROL SUMMARY

This appendix lists the C-SCRM controls in this publication and maps them to their corresponding [NIST SP 800-53 Rev. 5] controls as appropriate. Table B-1 indicates those controls that are defined in [NIST SP 800-53 Rev. 5] Low baseline requirements and are deemed to be C-SCRM relevant. Some C-SCRM controls were added to this baseline to form the C-SCRM Baseline. Additionally, controls that should flow down from prime contractors to their relevant sub-tier contractors are listed as Flow Down Controls. Given that C-SCRM is an enterprise-wide activity that requires selection and implementation of controls at the enterprise, mission/business, and operational levels (Levels 1, 2, and 3 of the enterprise according to [NIST SP 800-39], Table B-1 indicates the enterprise levels in which the controls should be implemented. C-SCRM controls and control enhancements not in [NIST SP 800-53 Rev. 5] are noted with an asterisk next to the control identifier, viz., MA-8 and SR-13.

Table B-1: C-SCRM Control Summary

Control Identifier	Control (or Control Enhancement) Name	C-SCRM Baseline	Flow Down Control	Levels		
				1	2	3
AC-1	**Policy and Procedures**	x	x	x	x	x
AC-2	**Account Management**	x	x		x	x
AC-3	**Access Enforcement**	x	x		x	x
AC-3(8)	*Access Enforcement | Revocation of Access Authorizations*				x	x
AC-3(9)	*Access Enforcement | Controlled Release*				x	x
AC-4	**Information Flow Enforcement**		x		x	x
AC-4(6)	*Information Flow Enforcement | Metadata*				x	x
AC-4(17)	*Information Flow Enforcement | Domain Authentication*				x	x
AC-4(19)	*Information Flow Enforcement | Validation of Metadata*				x	x
AC-4(21)	*Information Flow Enforcement | Physical or Logical Separation of Information Flows*					x
AC-5	**Separation of Duties**		x		x	x
AC-6(6)	*Least Privilege | Privileged Access by Non-organizational Users*				x	x
AC-17	**Remote Access**	x	x		x	x
AC-17(6)	*Remote Access | Protection of Mechanism Information*				x	x
AC-18	**Wireless Access**	x		x	x	x
AC-19	**Access Control for Mobile Devices**	x			x	x
AC-20	**Use of External Systems**	x	x	x	x	x
AC-20(1)	*Use of External Systems | Limits on Authorized Use*				x	x
AC-20(3)	*Use of External Systems | Non-organizationally Owned Systems — Restricted Use*				x	x
AC-21	**Information Sharing**			x	x	
AC-22	**Publicly Accessible Content**	x			x	x
AC-23	**Data Mining Protection**		x		x	x
AC-24	**Access Control Decisions**		x	x	x	x
AT-1	**Policy and Procedures**	x		x	x	
AT-2(1)	*Literacy Training and Awareness | Practical Exercises*				x	
AT-2(2)	*Literacy Training and Awareness | Insider Threat*	x	x		x	

AT-2(3)	*Literacy Training and Awareness | Social Engineering and Mining*				x	
AT-2(4)	*Literacy Training and Awareness | Suspicious Communications and Anomalous System Behavior*				x	
AT-2(5)	*Literacy Training and Awareness | Advanced Persistent Threat*				x	
AT-2(6)	*Literacy Training and Awareness | Cyber Threat Environment*				x	
AT-3	**Role-based Training**	x	x		x	
AT-3(2)	*Role-based Training | Physical Security Controls*				x	
AT-4	**Training Records**	x			x	
AU-1	**Policy and Procedures**	x		x	x	x
AU-2	**Event Logging**	x	x	x	x	x
AU-3	**Content of Audit Records**	x	x	x	x	x
AU-6	**Audit Record Review, Analysis, and Reporting**	x			x	x
AU-6(9)	*Audit Record Review, Analysis, and Reporting | Correlation with Information from Nontechnical Sources*					x
AU-10	**Non-repudiation**					x
AU-10(1)	*Non-repudiation | Association of Identities*				x	
AU-10(2)	*Non-repudiation | Validate Binding of Information Producer Identity*				x	x
AU-10(3)	*Non-repudiation | Chain of Custody*				x	x
AU-12	**Audit Record Generation**	x	x		x	x
AU-13	**Monitoring for Information Disclosure**		x		x	x
AU-14	**Session Audit**		x		x	x
AU-16	**Cross-organizational Audit Logging**				x	x
AU-16(2)	*Cross-organizational Audit Logging | Sharing of Audit Information*		x		x	x
CA-1	**Policy and Procedures**	x		x	x	x
CA-2	**Control Assessments**	x			x	x
CA-2(2)	*Control Assessments | Specialized Assessments*					x
CA-2(3)	*Control Assessments | Leveraging Results from External Organizations*					x
CA-3	**Information Exchange**	x	x			x
CA-5	**Plan of Action and Milestones**	x			x	x
CA-6	**Authorization**	x		x	x	x
CA-7(3)	*Continuous Monitoring | Trend Analyses*					x
CM-1	**Policy and Procedures**	x		x	x	x
CM-2	**Baseline Configuration**	x	x		x	x
CM-2(6)	*Baseline Configuration | Development and Test Environments*				x	x
CM-3	**Configuration Change Control**		x		x	x
CM-3(1)	*Configuration Change Control | Automated Documentation, Notification, and Prohibition of Changes*				x	x
CM-3(2)	*Configuration Change Control | Testing, Validation, and Documentation of Changes*				x	x
CM-3(4)	*Configuration Change Control | Security and Privacy Representatives*				x	x
CM-3(8)	*Configuration Change Control | Prevent or Restrict Configuration Changes*				x	x
CM-4	**Impact Analyses**	x				x
CM-4(1)	*Impact Analyses | Separate Test Environments*					x

CM-5	**Access Restrictions for Change**	x			x	x
CM-5(1)	*Access Restrictions for Change | Automated Access Enforcement and Audit Records*					x
CM-5(6)	*Access Restrictions for Change | Limit Library Privileges*					x
CM-6	**Configuration Settings**	x	x		x	x
CM-6(1)	*Configuration Settings | Automated Management, Application, and Verification*					x
CM-6(2)	*Configuration Settings | Respond to Unauthorized Changes*					x
CM-7	**Least Functionality**	x	x			x
CM-7(1)	*Least Functionality | Periodic Review*				x	x
CM-7(4)	*Least Functionality | Unauthorized Software*				x	x
CM-7(5)	*Least Functionality | Authorized Software*					x
CM-7(6)	*Least Functionality | Confined Environments with Limited Privileges*				x	x
CM-7(7)	*Least Functionality | Code Execution in Protected Environments*					x
CM-7(8)	*Least Functionality | Binary or Machine Executable Code*				x	x
CM-7(9)	*Least Functionality | Prohibiting the Use of Unauthorized Hardware*				x	x
CM-8	**System Component Inventory**	x	x		x	x
CM-8(1)	*System Component Inventory | Updates During Installation and Removal*					x
CM-8(2)	*System Component Inventory | Automated Maintenance*					x
CM-8(4)	*System Component Inventory | Accountability Information*					x
CM-8(6)	*System Component Inventory | Assessed Configurations and Approved Deviations*					x
CM-8(7)	*System Component Inventory | Centralized Repository*					x
CM-8(8)	*System Component Inventory | Automated Location Tracking*				x	x
CM-8(9)	*System Component Inventory | Assignment of Components to Systems*					x
CM-9	**Configuration Management Plan**		x		x	x
CM-9(1)	*Configuration Management Plan | Assignment of Responsibility*				x	x
CM-10	**Software Usage Restrictions**	x			x	x
CM-10(1)	*Software Usage Restrictions | Open source Software*				x	x
CM-11	**User-installed Software**	x			x	x
CM-12	**Information Location**				x	x
CM-12(1)	*Information Location | Automated Tools to Support Information Location*				x	x
CM-13	**Data Action Mapping**				x	x
CM-14	**Signed Components**					x
CP-1	**Policy and Procedures**	x		x	x	x
CP-2	**Contingency Plan**	x			x	x
CP-2(1)	*Contingency Plan | Coordinate with Related Plans*				x	x
CP-2(2)	*Contingency Plan | Capacity Planning*				x	x
CP-2(7)	*Contingency Plan | Coordinate with External Service Providers*		x			x
CP-2(8)	*Contingency Plan | Identify Critical Assets*					x

CP-3	**Contingency Training**	x	x		x	x
CP-3(1)	*Contingency Training | Simulated Events*				x	x
CP-4	**Contingency Plan Testing**	x			x	x
CP-6	**Alternate Storage Site**				x	x
CP-6(1)	*Alternate Storage Site | Separation from Primary Site*				x	x
CP-7	**Alternate Processing Site**				x	x
CP-8	**Telecommunications Services**				x	x
CP-8(3)	*Telecommunications Services | Separation of Primary and Alternate Providers*				x	x
CP-8(4)	*Telecommunications Services | Provider Contingency Plan*				x	x
CP-11	**Alternate Communications Protocols**				x	x
IA-1	**Policy and Procedures**	x		x	x	x
IA-2	**Identification and Authentication (organizational Users)**	x	x	x	x	x
IA-3	**Device Identification and Authentication**			x	x	x
IA-4	**Identifier Management**	x	x		x	x
IA-4(6)	*Identifier Management | Cross-organization Management*			x	x	x
IA-5	**Authenticator Management**	x	x		x	x
IA-5(5)	*Authenticator Management | Change Authenticators Prior to Delivery*					x
IA-5(9)	*Authenticator Management | Federated Credential Management*					x
IA-8	**Identification and Authentication (non-organizational Users)**	x			x	x
IA-9	**Service Identification and Authentication**		x		x	x
IR-1	**Policy and Procedures**	x	x	x	x	x
IR-2	**Incident Response Training**	x	x		x	x
IR-3	**Incident Response Testing**				x	x
IR-4(6)	*Incident Handling | Insider Threats*			x	x	x
IR-4(7)	*Incident Handling | Insider Threats — Intra-organization Coordination*			x	x	x
IR-4(10)	*Incident Handling | Supply Chain Coordination*		x		x	
IR-4(11)	*Incident Handling | Integrated Incident Response Team*					x
IR-5	**Incident Monitoring**	x			x	x
IR-6(3)	*Incident Reporting | Supply Chain Coordination*		x			x
IR-7(2)	*Incident Response Assistance | Coordination with External Providers*		x			x
IR-8	**Incident Response Plan**	x	x		x	x
IR-9	**Information Spillage Response**		x			x
MA-1	**Policy and Procedures**	x	x	x	x	x
MA-2(2)	*Controlled Maintenance | Automated Maintenance Activities*					x
MA-3	**Maintenance Tools**				x	x
MA-3(1)	*Maintenance Tools | Inspect Tools*					x
MA-3(2)	*Maintenance Tools | Inspect Media*					x
MA-3(3)	*Maintenance Tools | Prevent Unauthorized Removal*					x
MA-4	**Nonlocal Maintenance**	x	x		x	x
MA-4(3)	*Nonlocal Maintenance | Comparable Security and Sanitization*				x	x
MA-5	**Maintenance Personnel**	x			x	x

MA-5(4)	*Maintenance Personnel | Foreign Nationals*		x		x	x
MA-6	**Timely Maintenance**					x
MA-7	**Field Maintenance**					x
MA-8	**Maintenance Monitoring and Information Sharing**					x
MP-1	**Policy and Procedures**	x		x	x	
MP-4	**Media Storage**		x	x	x	
MP-5	**Media Transport**			x	x	
MP-6	**Media Sanitization**	x	x		x	x
PE-1	**Policy and Procedures**	x		x	x	x
PE-2	**Physical Access Authorizations**	x	x		x	x
PE-2(1)	*Physical Access Authorizations | Access by Position or Role*				x	x
PE-3	**Physical Access Control**	x			x	x
PE-3(1)	*Physical Access Control | System Access*				x	x
PE-3(2)	*Physical Access Control | Facility and Systems*				x	x
PE-3(5)	*Physical Access Control | Tamper Protection*				x	x
PE-6	**Monitoring Physical Access**	x		x	x	x
PE-16	**Delivery and Removal**	x				x
PE-17	**Alternate Work Site**					x
PE-18	**Location of System Components**			x	x	x
PE-20	**Asset Monitoring and Tracking**				x	x
PE-23	**Facility Location**		x		x	x
PL-1	**Policy and Procedures**	x			x	
PL-2	**System Security and Privacy Plans**	x	x			x
PL-4	**Rules of Behavior**	x			x	x
PL-7	**Concept of Operations**					x
PL-8	**Security and Privacy Architectures**				x	x
PL-8(2)	*Security and Privacy Architectures | Supplier Diversity*				x	x
PL-9	**Central Management**			x	x	
PL-10	**Baseline Selection**	x			x	x
PM-2	**Information Security Program Leadership Role**			x	x	
PM-3	**Information Security and Privacy Resources**			x	x	
PM-4	**Plan of Action and Milestones Process**				x	x
PM-5	**System Inventory**		x		x	x
PM-6	**Measures of Performance**			x	x	
PM-7	**Enterprise Architecture**			x	x	
PM-8	**Critical Infrastructure Plan**			x		
PM-9	**Risk Management Strategy**			x		
PM-10	**Authorization Process**			x	x	
PM-11	**Mission and Business Process Definition**			x	x	x
PM-12	**Insider Threat Program**			x	x	x
PM-13	**Security and Privacy Workforce**			x	x	
PM-14	**Testing, Training, and Monitoring**			x	x	
PM-15	**Security and Privacy Groups and Associations**			x	x	
PM-16	**Threat Awareness Program**			x	x	
PM-17	**Protecting Controlled Unclassified Information on External Systems**				x	
PM-18	**Privacy Program Plan**		x	x	x	
PM-19	**Privacy Program Leadership Role**			x		
PM-20	**Dissemination of Privacy Program Information**			x	x	
PM-21	**Accounting of Disclosures**			x	x	

PM-22	**Personally Identifiable Information Quality Management**			x	x	
PM-23	**Data Governance Body**			x		
PM-25	**Minimization of Personally Identifiable Information Used in Testing, Training, and Research**				x	
PM-26	**Complaint Management**				x	x
PM-27	**Privacy Reporting**				x	x
PM-28	**Risk Framing**			x		
PM-29	**Risk Management Program Leadership Roles**			x		
PM-30	**Supply Chain Risk Management Strategy**			x	x	
PM-31	**Continuous Monitoring Strategy**			x	x	x
PM-32	**Purposing**				x	x
PS-1	**Policy and Procedures**	x	x	x	x	x
PS-3	**Personnel Screening**	x	x		x	x
PS-6	**Access Agreements**	x	x		x	x
PS-7	**External Personnel Security**	x			x	
PT-1	**Policy and Procedures**		x	x	x	x
RA-1	**Policy and Procedures**	x		x	x	x
RA-2	**Security Categorization**	x		x	x	x
RA-3	**Risk Assessment**	x		x	x	x
RA-5	**Vulnerability Monitoring and Scanning**	x	x		x	x
RA-5(3)	*Vulnerability Monitoring and Scanning | Breadth and Depth of Coverage*				x	x
RA-5(6)	*Vulnerability Monitoring and Scanning | Automated Trend Analyses*				x	x
RA-7	**Risk Response**	x		x	x	x
RA-9	**Criticality Analysis**		x	x	x	x
RA-10	**Threat Hunting**			x	x	x
SA-1	**Policy and Procedures**	x		x	x	x
SA-2	**Allocation of Resources**	x		x	x	
SA-3	**System Development Life Cycle**	x		x	x	x
SA-4	**Acquisition Process**	x		x	x	x
SA-4(5)	*Acquisition Process | System, Component, and Service Configurations*					x
SA-4(7)	*Acquisition Process | NIAP-approved Protection Profiles*				x	x
SA-4(8)	*Acquisition Process | Continuous Monitoring Plan for Controls*				x	x
SA-5	**System Documentation**	x				x
SA-8	**Security and Privacy Engineering Principles**	x		x	x	x
SA-9(1)	*External System Services | Risk Assessments and Organizational Approvals*				x	x
SA-9(3)	*External System Services | Establish and Maintain Trust Relationship with Providers*			x	x	x
SA-9(4)	*External System Services | Consistent Interests of Consumers and Providers*					x
SA-9(5)	*External System Services | Processing, Storage, and Service Location*					x
SA-10	**Developer Configuration Management**				x	x
SA-11	**Developer Testing and Evaluation**			x	x	x
SA-15	**Development Process, Standards, and Tools**				x	x

SA-15(3)	*Development Process, Standards, and Tools | Criticality Analysis*				x	x
SA-15(4)	*Development Process, Standards, and Tools | Threat Modeling and Vulnerability Analysis*				x	x
SA-15(8)	*Development Process, Standards, and Tools | Reuse of Threat and Vulnerability Information*					x
SA-16	**Developer-provided Training**				x	x
SA-17	**Developer Security and Privacy Architecture and Design**				x	x
SA-20	**Customized Development of Critical Components**				x	x
SA-21	**Developer Screening**		x		x	x
SA-21(1)	*Developer Screening | Validation of Screening*				x	x
SA-22	**Unsupported System Components**	x			x	x
SC-1	**Policy and Procedures**	x		x	x	x
SC-4	**Information in Shared System Resources**				x	x
SC-5(2)	*Denial-of-service Protection | Capacity, Bandwidth, and Redundancy*				x	
SC-7	**Boundary Protection**	x	x		x	
SC-7(13)	*Boundary Protection | Isolation of Security Tools, Mechanisms, and Support Components*		x			x
SC-7(14)	*Boundary Protection | Protect Against Unauthorized Physical Connections*				x	x
SC-7(19)	*Boundary Protection | Block Communication from Non-organizationally Configured Hosts*					x
SC-8	**Transmission Confidentiality and Integrity**		x		x	x
SC-18	**Mobile Code**					x
SC-18(2)	*Mobile Code | Acquisition, Development, and Use*					x
SC-27	**Platform-independent Applications**				x	x
SC-28	**Protection of Information at Rest**		x		x	x
SC-29	**Heterogeneity**				x	x
SC-30	**Concealment and Misdirection**				x	x
SC-30(2)	*Concealment and Misdirection | Randomness*				x	x
SC-30(3)	*Concealment and Misdirection | Change Processing and Storage Locations*				x	x
SC-30(4)	*Concealment and Misdirection | Misleading Information*				x	x
SC-30(5)	*Concealment and Misdirection | Concealment of System Components*				x	x
SC-36	**Distributed Processing and Storage**		x		x	x
SC-37(1)	*Out-of-band Channels | Ensure Delivery and Transmission*				x	x
SC-38	**Operations Security**				x	x
SC-47	**Alternate Communications Paths**			x	x	x
SI-1	**Policy and Procedures**	x		x	x	x
SI-2	**Flaw Remediation**	x	x		x	x
SI-2(5)	*Flaw Remediation | Automatic Software and Firmware Updates*				x	
SI-3	**Malicious Code Protection**	x	x		x	x
SI-4	**System Monitoring**	x	x	x	x	x
SI-4(17)	*System Monitoring | Integrated Situational Awareness*				x	x
SI-4(19)	*System Monitoring | Risk for Individuals*				x	x
SI-5	**Security Alerts, Advisories, and Directives**	x	x	x	x	x

SI-7	**Software, Firmware, and Information Integrity**		x		x	x
SI-7(14)	*Software, Firmware, and Information Integrity | Binary or Machine Executable Code*				x	x
SI-7(15)	*Software, Firmware, and Information Integrity | Code Authentication*					x
SI-12	**Information Management and Retention**	x				x
SI-20	**Tainting**		x		x	x
SR-1	**Policy and Procedures**	x		x	x	x
SR-2	**Supply Chain Risk Management Plan**	x				x
SR-3	**Supply Chain Controls and Processes**	x		x	x	x
SR-3(1)	*Supply Chain Controls and Processes | Diverse Supply Base*				x	x
SR-3(3)	*Supply Chain Controls and Processes | Sub-tier Flow Down*		x		x	x
SR-4	**Provenance**				x	x
SR-5	**Acquisition Strategies, Tools, and Methods**	x		x	x	x
SR-6	**Supplier Assessments and Reviews**				x	x
SR-7	**Supply Chain Operations Security**				x	x
SR-8	**Notification Agreements**	x			x	x
SR-9	**Tamper Resistance and Detection**				x	x
SR-10	**Inspection of Systems or Components**	x	x		x	x
SR-11	**Component Authenticity**	x		x	x	x
SR-11(1)	*Component Authenticity | Anti-counterfeit Training*	x			x	x
SR-11(2)	*Component Authenticity | Configuration Control for Component Service and Repair*	x			x	x
SR-11(3)	*Component Authenticity | Anti-counterfeit Scanning*				x	x
SR-12	**Component Disposal**	x			x	x
SR-13	**Supplier Inventory**				x	x

6010
6011

APPENDIX C: RISK EXPOSURE FRAMEWORK

There are numerous opportunities for vulnerabilities that impact the enterprise environment or the system/element to be intentionally or unintentionally inserted, created, or exploited throughout the supply chain. Exploitation of these vulnerabilities is known as a supply chain threat event. *A Threat Scenario is a set of discrete threat events, associated with a specific potential or identified existing threat source or multiple threat sources, partially ordered in time.* Developing and analyzing threat scenarios can help enterprises have a more comprehensive understanding of the various types of threat events that can occur and lay the ground work for analyzing the likelihood and impact a specific event or events would have on an enterprise. Conducting this analysis is a useful way to discover gaps in controls and to identify and prioritize appropriate mitigating strategies.[19]

Threat scenarios are generally used in two ways:

- To translate the often disconnected information garnered from a risk assessment, as is described in [NIST SP 800-30 Rev. 1], into a more narrowly scoped and tangible story-like situation for further evaluation. These stories can help enterprises discover dependencies and additional vulnerabilities requiring mitigation and used for training; and

- To determine the impact a successful exercise of a specific vulnerability would have on the enterprise and identify the benefits of mitigating strategies.

Threat scenarios serve as a critical component of the enterprise's cybersecurity supply chain risk management process described in Appendix C of this publication. An enterprise forms a threat scenario to analyze a disparate set of threat and vulnerability conditions to assemble a cohesive story that can be analyzed as part of a risk assessment. With a threat scenario defined, the enterprise can complete a risk assessment to understand how likely the scenario is and what would happen (i.e., the impact) as a result. Ultimately the analyzed components of a threat scenario are used to reach a risk determination which represents the conclusion of an enterprise's level of exposure to cybersecurity risk in the supply chain.

Once a risk determination has been made, the enterprise will determine a path for responding to the risk using the Risk Exposure Framework. Within the Risk Exposure Framework, enterprises will document the threat scenario, the risk analysis, and the identified a risk response strategy and any associated C-SCRM controls.

This appendix provides an example of a Risk Exposure Framework for C-SCRM that can be used by enterprises to develop a tailored Risk Exposure Framework for potential and identified threats that best suits their needs. It contains six examples of how this framework may be used. The examples differ slightly in their implementation of the framework so as to show how the framework may be tailored by an enterprise. Each example identifies one or more vulnerabilities, describes a specific threat source, identifies the expected impact on the enterprise, and proposes [SP 800-161, Rev. 1] C-SCRM controls that would help mitigate the resulting risk.

[19] Additional example threat scenarios and threat lists can be found in the ICT SCRM Task Force: Threat Scenarios Report, February 2021, https://www.cisa.gov/publication/ict-scrm-task-force-threat-scenarios-report. This report leveraged the 2015 version of the NIST SP 800-161.

RISK EXPOSURE FRAMEWORK

Step 1: Create a Plan for Developing and Analyzing Threat Scenarios

- Identify the purpose of the threat scenario analysis in terms of the objectives, milestones, and expected deliverables;
- Identify the scope of enterprise applicability, level of detail, and other constraints;
- Identify resources to be used, including personnel, time, and equipment; and
- Define a Risk Exposure Framework to be used for analyzing scenarios.

Step 2: Characterize the Environment

- Identify core mission/business processes and key enterprise dependencies;
- Describe threat sources that are relevant to the enterprise. Include the motivation and resources available to the threat source, if applicable;
- List known vulnerabilities or areas of concern. (Note: areas of concern include the planned outsourcing of a manufacturing plant, the pending termination of a maintenance contract, or the discontinued manufacture of an element);
- Identify existing and planned controls;
- Identify related regulations, standards, policies, and procedures; and
- Define an acceptable level of risk (risk threshold) per the enterprise's assessment of Tactics, Techniques, and Procedures (TTPs), system criticality, and a risk owner's set of mission or business priorities. The level of risk or risk threshold can be periodically revisited and adjusted to reflect the elasticity of the global supply chain, enterprise changes, and new mission priorities.

Step 3: Develop and Select Threat Event(s) for Analysis

- List possible ways threat sources could exploit known vulnerabilities or impact areas of concern to create a list of events. (Note: historical data is useful in determine this information);
- Briefly outline the series of consequences that could occur as a result of each threat event. These may be as broad or specific as necessary. If applicable, estimate the likelihood and impact of each event;
- Eliminate those events that are clearly outside the defined purpose and scope of the analysis;
- Describe in more detail the remaining potential threat events. Include the TTPs a threat source may use to carry out attacks. (Note: the level of detail in the description is dependent upon the needs of the enterprise); and
- Select for analysis those events that best fit the defined purpose and scope of the analysis. More likely or impactful events, areas of concern to the enterprise, and an event that can represent several of the other listed events are generally useful candidates.

Step 4: Conduct an Analysis using the Risk Exposure Framework

- For each threat event, note any immediate consequences of the event and identify those enterprise units and processes that would be affected, taking into account existing and planned controls and the extent to which those controls are able to effectively prevent, withstand, or otherwise mitigate the harm that could result from the threat event, and applicable regulations, standards, policies, and procedures;
- Estimate the impact these consequences would have on the mission/business processes, information, assets, as well as the enterprise units or other stakeholders affected, preferably in quantitative terms from historical data and taking into account existing and planned controls, and applicable regulations, standards, policies, and procedures. (Note: it may be beneficial to identify a "most likely" impact level and a "worst-case" or "100-year" impact level); and

- Identify those enterprise units, processes, information (access or flows), and/or assets that may or would be subsequently affected, the consequences and the impact levels, until each affected critical item has been analyzed, taking into account existing and planned controls and applicable regulations, standards, policies, and procedures (e.g., if a critical server goes down, one of the first processes affected may be the technology support department, but if they determine a new part is needed to bring the server backup, the procurement department may become involved).

Step 5: Determine C-SCRM Applicable Controls

- Determine if and which threat scenario events create a risk level that exceeds a risk owner's acceptable level of risk (risk threshold). (Note: in some cases, the level of acceptable risk may be dependent on the capability to implement, or the cost of, mitigating strategies.) Identify opportunities to strengthen existing controls or potential new mitigating controls. Using a list of standards or recommended controls can make this process simpler. This appendix uses the controls in Section 4 of [NIST SP 800-161 Rev. 1];
- Estimate the effectiveness of existing and planned controls at reducing the risk of a scenario;
- Estimate the capability and resources needed (in terms of money, personnel, time) to implement potential new or strengthened controls; and
- Identify those C-SCRM controls or combinations of C-SCRM controls that could cause the estimated residual risk of a threat event to drop to an acceptable level in the most resource-effective manner, taking into account any rules or regulations that may apply. (Note: consideration should be given to the potential that one control will help mitigate the risk from more than one event, or that a control may increase the risk of a separate event).

Step 6: Evaluate / Feedback

- Develop a plan to implement the selected controls and evaluate their effectiveness; and
- Evaluate the effectiveness of the Risk Exposure Framework and make improvements as needed.

6129
6130

Table C-1: Sample Risk Exposure Framework

Threat Scenario	**Threat**	
	Threat Event Description	*Describe possible ways threat sources could exploit known vulnerabilities or impact areas of concern to create a list of events.* Threat event: An event or situation that has the potential for causing undesirable consequences or impact.
	Threat Event Outcome	*Describe the outcome of the threat event.* Threat Event Outcome: The effect a threat acting upon a vulnerability has on the confidentiality, integrity, and/or availability of the enterprise's operations, assets, and/or individuals.
Enterprise units / processes/information/ assets/stakeholders affected		*List the affected enterprise units / processes/information/ assets/stakeholders affected.*
Risk	**Impact**	*Enter the estimate of the impact the outcome of the consequences would have on the mission/business processes, information, assets, as well as the enterprise units or other stakeholders affected, preferably in quantitative terms from historical data and taking into account existing and planned controls, and applicable regulations, standards, policies, and procedures (Note: It may be beneficial to identify a "most likely" impact level and a "worst-case" or "100-year" impact level.)* The effect on enterprise operations, enterprise assets, individuals, other enterprises, or the Nation (including the national security interests of the United States) of a loss of confidentiality, integrity, or availability of information or a system.
	Likelihood	*Enter the likelihood a specific event or events would have on an enterprise* Likelihood: Chance of something happening
	Risk Score (Impact x Likelihood)	*Enter the risk score by multiplying impact x likelihood.* *A measure of the extent to which an entity is threatened by a potential circumstance or event, and typically a function of: (i) the adverse impacts that would arise if the circumstance or event occurs; and (ii) the likelihood of occurrence.*
	Acceptable Level of Risk	*Define an acceptable level of risk (risk threshold) per the enterprise's assessment of Tactics, Techniques, and Procedures (TTPs), system criticality, risk appetite and tolerance, and a risk owner's set strategic goals and objectives.* Acceptable Risk: A level of residual risk to the enterprise's operations, assets, or individuals that falls within the defined risk appetite and risk tolerance thresholds set by the enterprise.
Mitigation	**Potential Mitigating Strategies / C-SCRM Controls**	*List the potential mitigating risk strategies and any relevant C-SCRM controls.* C-SCRM Risk Mitigation: A systematic process for managing exposures to cybersecurity risk in supply chains, threats, and vulnerabilities throughout the supply chain and developing risk response strategies to the cybersecurity

		risk in the supply chain presented by the supplier, the supplied products and services, or the supply chain.
	Estimated Cost of Mitigating Strategies	*Enter estimated cost of risk mitigating strategies.*
	Change in Likelihood	*Identify potential changes in likelihood.*
	Change in Impact	*Identify potential changes in impact.*
	Selected Strategies	*List selected strategies to reduce impact.*
	Estimated Residual Risk	*Enter the estimated amount of residual risk* Residual Risk: Portion of risk remaining after security measures have been applied.

6131
6132

SAMPLE SCENARIOS

This appendix provides six example threat scenarios specific to the U.S. government using a fictitious 'ABC Company' and the Risk Exposure Framework described above. The examples purposely vary in level of specificity and detail to show that threat scenarios can be as broad or specific—as detailed or generic—as necessary. While these scenarios use percentages and basic scoring measures (High, Moderate, Low) for likelihood, impact, and risk, enterprises may use any number of different units of measure (e.g., CVSS score, etc.). Additionally, these scenarios vary slightly in implementation of the risk response framework to show the Risk Exposure Framework can be adapted as needed.

SCENARIO 1: Influence or Control by Foreign Governments Over Suppliers[20]

Background

An enterprise has decided to perform a threat scenario analysis of its Printed Circuit Board (PCB) suppliers. The scenario will focus on the sensitivity of the business to unforeseen fluctuations in component costs.

Threat Source

ABC Company designs, assembles, and ships 3.5 million personal computers per year. It has a global footprint both in terms of customer and supply bases. Five years ago, in an effort to reduce the cost of goods sold, ABC Company shifted a majority of its PCB procurement to Southeast Asia. To avoid being single sourced, ABC Company finalized agreements with five different suppliers within the country and has enjoyed a positive partnership with each during this time.

Vulnerability

Though sourcing from multiple vendors, ABC Company relies on suppliers in a single country (i.e., Southeast Asia). This exposes ABC Company to geopolitical threats due to the potential for policies of a single government to have a dramatic impact on the availability of supplied inputs.[23]

Threat Event Description

The enterprise has established the following fictitious threat for the analysis exercise: Last year, the country where ABC Company does most of their PCB business has seen a new regime take over the government. This regime has been more focused on improving finances and business environment within the country, allowing larger firms who set up headquarters and other major centers within country advantages to do business more easily and cost-efficiently with suppliers within the same region. In February of 2019, this now-corrupt regime has passed new legislation establishing an additional 20 percent tax on all electronic components and goods sold outside of the country. This new law was to take effect on June 1, 2019.

When the new law was announced, the current ABC Company inventory of PCBs was about 10 percent of yearly demand, which was the typical inventory level with which they were comfortable. Before June, ABC Company reached out to all five suppliers to order additional materials, but there was quickly a

[20] Scenario 1 prose is slightly modified (e.g., changed company names) from ICT SCRM Task Force: Threat Scenarios Report, February 2021, https://www.cisa.gov/publication/ict-scrm-task-force-threat-scenarios-report. This report leveraged the 2015 version of the NIST SP 800-161.

shortage due to higher demand from many foreign customers of these products. By June 1, the day the new tax law took effect, ABC Company had reached an inventory level of up to 15 percent of yearly demand.

Outcome

Between February and June, ABC Company also looked to partner with new suppliers, but there were several issues identified. One in every 10 new suppliers ABC Company reached out to require a lead time for ramping up to desired demand of anywhere from 6 months to 18 months. This would necessitate additional work on ABC Company's part, including testing samples of the supplier PCBs and finalizing logistical details, to monitoring supplier-side activities such as procurement of raw materials and acquisition of additional personnel, production space, etc. necessary to meet the new demand.

The second issue due to the current contracts with all five current suppliers in Southeast Asia involved meeting minimum demand requirements, in that ABC Company was committed to purchasing at minimum 100,000 PCB's per month for the duration of the contracts (which ranged anywhere from 3 months to 24 months in length). This would mean ABC Company could not easily avoid the cost implications of the new tax. Could ABC Company absorb the cost of the PCBs? With a 20 percent cost increase, this eroded the margins of a PC from 13.5 percent down to 4.5 percent on average. For some of the lower-margin ABC Company offerings, it would likely result in discontinuing the line and using the now more expensive PCB's on higher-end models that could carry more margin.

Enterprise Units / Processes Affected

N/A

Potential Mitigating Strategies / C-SCRM Controls

- Perform regular assessment and review of supplier risk;[21]
- Diversify suppliers not only by immediate location, but also by country, region and other factors;
- Build cost implications into supplier contracts, making it easier to part ways with suppliers when costs rise too high (whether by fault of the supplier or otherwise);
- Adjust desired inventory levels to better account for unexpected shortage of demand at critical times; and
- Employ more resources in countries or regions of critical suppliers with the intent to source advanced notice of new legislature that may negatively affect business.

[21] Regular assessment and review of supplier risk mitigating strategy was added to original Scenario 1 text from ICT SCRM Task Force: Threat Scenarios Report, February 2021, https://www.cisa.gov/publication/ict-scrm-task-force-threat-scenarios-report. This report leveraged the 2015 version of the NIST SP 800-161.

6216

Table B-2: Scenario 1

Threat Scenario	**Threat Source**	Dynamic geopolitical conditions that impact the supply of production components for PCs
	Vulnerability	Geographical concentration of suppliers for a key production component
	Threat Event Description	ABC Company shifted a majority of its Printed Circuit Board (PCB) procurement to Southeast Asia to reduce cost of goods sold. In an effort to avoid being single sourced, ABC Company finalized agreements with five different suppliers within the country. The country in which ABC Company conducts most of their PCB business has seen a new regime assume governmental authority. In February of 2019, this now-corrupt regime passed legislation establishing an additional 20 percent tax on all electronic components and goods sold outside of the country. This law was to take effect on June 1, 2019. When the new law was announced, the current ABC Company inventory of PCBs was about 10 percent of yearly demand, at the typical level of inventory with which they were comfortable. Before June, ABC Company reached out to all five suppliers to order additional materials, but there was quickly a shortage due to higher demand from many foreign customers of these products. By June 1, the day the new tax law took effect, ABC Company had reached an inventory level up to 15 percent of annual demand.
	Threat Event Outcome	ABC Company also looked to partner with new suppliers, but there were issues identified with this approach: 1) One out of every 10 new suppliers to which ABC Company reached out required a lead time to ramp up to desired demand of anywhere from 6 months to 18 months; and 2) Current contracts with all five active suppliers in Southeast Asia stipulated minimum demand requirements, meaning ABC Company was committed to purchasing a minimum of 100,000 PCB's per month for the duration of the contracts (which ranged anywhere from 3 months to 24 months in length). This would mean ABC Company could not easily avoid the cost implications of this new tax. With a 20 percent cost increase, the margins of a PC eroded from 13.5 percent to 4.5 percent, on average.
Enterprise units / processes affected		N/A
Risk	**Impact**	High: $40,000,000 decline in PC product line profit
	Likelihood	Moderate: 10% annualized probability of occurrence
	Risk Score (Impact x Likelihood)	High: Inherent Risk Exposure equal to approx. $4,000,000 in product line profit
	Acceptable Level of Risk	No greater than 10% probability of greater than $10,000,000 in product line profit

Mitigation	**Potential Mitigating Strategies / C-SCRM Controls**	Assess and review supplier risk to include FOCI [SR-6(1)], employ supplier diversity requirements [C-SCRM_PL-3(1)], employ supplier diversity [SCRM_PL-8(2)], and adjust inventory levels [CM-8]	Perform regular assessment and review of supplier risk; Diversify suppliers not just by immediate location, but by country, region and other factors; Build cost implications into supplier contracts, making it easier to walk away from suppliers when costs rise too high (whether its fault of the supplier or not); Adjust desired inventory levels to better account for unexpected shortage of demand at critical times; and Employ more resources in countries or regions of critical suppliers with the intent to source advanced notice of new legislature that may negatively affect business.
	Estimated Cost of Mitigating Strategies	N/A	
	Change in Likelihood	Low: 10% probability of occurrence	
	Change in Impact	Moderate: $2,000,000 in product line profit	
	Selected Strategies	Combination of strategies using the mitigation noted.	
	Estimated Residual Risk	Low: Residual risk exposure 0.02% of PC product line profit margin	

SCENARIO 2: Telecommunications Counterfeits

Background

A large enterprise, ABC Company, has developed a system that is maintained by contract with an external integration company. The system requires a common telecommunications element that is no longer available from the Original Equipment Manufacturer (OEM). The OEM has offered a newer product as a replacement which would require modifications to the system at a cost of approximately $1 million. If the element is not upgraded, the agency and system integrator would have to rely on secondary market suppliers for replacements. The newer product provides no significant improvement on the element currently being used.

ABC Company has decided to perform a threat scenario analysis to determine whether to modify the system to accept the new product or accept the risk of continuing to use a product that is no longer in production.

Environment

The environment is characterized as follows:

- The system is expected to last ten more years without any major upgrades/modifications and has a 99.9% uptime requirement;
- Over 1000 of the $200 elements are used throughout the system and approximately 10% are replaced every year due to regular wear-and-tear, malfunctions, or other reasons. The integrator has an approximate three-month supply on hand at any given time;
- The element is continuously monitored for functionality, and efficient procedures exist to reroute traffic and replace the element should it unexpectedly fail;
- Outages resulting from unexpected failure of the element are rare, localized, and last only a few minutes. More frequently, when an element fails, the system's functionality is severely reduced for approximately one to four hours while the problem is diagnosed and fixed or the element replaced;
- Products such as the element in question have been a common target for counterfeiting;
- The integrator has policies restricting the purchase of counterfeit goods and a procedure to follow if a counterfeit is discovered [Ref. SR-11];
- The integrator and acquiring agency have limited testing procedures to ensure functionality of the element before acceptance [Ref. SR-5(2)].

Threat Event

To support the threat scenario, the agency created a fictitious threat source described as a group motivated by profit with vast experience creating counterfeit solutions. The counterfeiter is able to make a high profit margin by creating and selling as genuine products that are visually identical to their genuine counterparts, but which use lower-quality materials. They have the resources to copy most trademark and other identifying characteristics and insert counterfeits into a supply chain commonly used by the enterprise with little to no risk of detection. The counterfeit product is appealing to unaware purchasing authorities as it is generally offered at a discount, sold as excess inventory or as stockpile.

If an inferior quality element was inserted into the system, it would likely fail more often than expected, causing reduced functionality of the system. In the event of a large number of counterfeit products integrating with genuine parts into the system randomly, the number and severity of unexpected outages could grow significantly. The agency and integrator decided that the chances a counterfeit product could be purchased to maintain the system and the estimated potential impact of such an event were high enough to warrant further evaluation.

Threat Scenario Analysis

The person(s) purchasing the element from a supplier will be the first affected by a counterfeit product. Policy requires they attempt to purchase a genuine product from vetted suppliers. This individual would have to be led to believe that the product is genuine. As the counterfeit product in question is visually identical to the element desired, and at a discount, there is a high chance the counterfeit will be purchased. One will be tested to ensure functionality, and then the items will be placed into storage.

When one of the elements in the system needs replacing, an engineer will install a counterfeit, quickly test to ensure it is running properly, and record the change. It could take two years for the counterfeit product to fail, so up to 200 counterfeit elements could be inserted into the system before the first sign of failure. If all the regularly replaced elements are substituted for counterfeits and each counterfeit fails after two years, the cost of the system would increase by $160,000 in ten years. The requisite maintenance time would also cost the integration company in personnel and other expenses.

When a counterfeit fails, it will take approximately one to four hours to diagnose and replace the element. During this time, productivity is severely reduced. If more than one of the elements fails at the same time, the system could fail entirely. This could cause significant damage to agency operations and violate the 99.9% uptime requirements set forth in the contract. Plus, if it becomes determined that the element failed because it was counterfeit, additional costs associated with reporting the counterfeit would be incurred.

Mitigation Strategy

The following were identified as potential mitigating activities (from [NIST SP 800-161 Rev. 1]):

- Require developers to perform security testing/evaluation at all post-design phases of the SDLC [Ref. SA-11];
- Validate that the information system or system component received is genuine and has not been altered [Ref. SR-11];
- Incorporate security requirements into the design of information systems (security engineering) [Ref. PL-8, SC-36]; and
- Employ supplier diversity requirements [PL-8(2)].

Based on these controls, the agency was able to devise a strategy that would include:

- Acceptance testing: Examination of elements to ensure they are new, genuine, and that all associated licenses are valid. Testing methods include, where appropriate: physical inspection by trained personnel using digital imaging, digital signature verification, serial/part number verification, and sample electrical testing;
- Increasing security requirements into the design of the system by adding redundant elements along more critical paths (as determined by a criticality analysis) and to minimize the impact of an element failure; and
- Search for alternative vetted suppliers/trusted components.

It was determined that this strategy would cost less than accepting the risk of allowing counterfeits into the system or modifying the system to accept the upgraded element. The estimated cost for implementing a more rigorous acquisition and testing program was $80,000; the cost for increasing security engineering requirements was $100,000.

Table B-3: Scenario 2

Threat Scenario	**Threat Source**	Counterfeit telecommunications element introduced into supply chain
	Vulnerability	Element no longer produced by OEM Purchasing authorities unable / unwilling to identify and purchase only genuine elements
	Threat Event Description	Threat agent inserts their counterfeit element into a trusted distribution chain. → Purchasing authorities buy the counterfeit element. → Counterfeit elements installed into the system
	Threat Event Outcome	The element fails more frequently than before, increasing the number of outages
Enterprise units / processes/information/ assets/stakeholders affected		Acquisitions Maintenance OEM / supplier relations Mission-essential functions

Risk	**Impact**	Moderate: Element failure leads to 1-4-hour system downtime	
	Likelihood	High: Significant motivation by threat actor and high vulnerability due to agency's inability to detect counterfeits with 25% annualized probability of premature component failure	
	Risk Score (Impact x Likelihood)	Medium: Significant short-term disruptions that lead downtime to exceed uptime threshold by 0.5% (e.g., 99.4% < 99.9% requirement)	
	Acceptable Level of Risk	Low: System must have less than 10% annualized probability of missing 99% uptime thresholds	
Mitigation	**Potential Mitigating Strategies / C-SCRM Controls**	Increase acceptance testing capabilities [C-SCRM_SA-9; C-SCRM_SA-10], increase security requirements in design of systems [C-SCRM_PL-2, and employ supplier diversity requirements [C-SCRM_PL-8(2)]	Modify the system to accept element upgrade
	Estimated Cost of Mitigating Strategies	$180,000	$1 million
	Change in Likelihood	Low: 8% annualized probability of component failure	
	Change in Impact	Low: Element failure causes failover to redundant system component – cost limited to maintenance and replacement	
	Selected Strategies	Agency-level examination and testing Place elements in escrow until they pass defined acceptance testing criteria Increase security engineering Search for multiple suppliers of the element	
	Estimated Residual Risk	Low: 8% annualized probability of component failures leading to system downtime (i.e., less than 99.9% uptime)	

SCENARIO 3: Industrial Espionage

Background

ABC Company, a semiconductor (SC) company used by the enterprise to produce military and aerospace systems, is considering a partnership with a KXY Co. to leverage their fabrication facility. This would represent a significant change in the supply chain related to a critical system element. A committee was formed including representatives from the enterprise, ABC Company, and the integration company to help identify the impact the partnership would have on the enterprise and risk-appropriate mitigating practices to enact when the partnership is completed.

Environment

The systems of concern are vital to the safety of military and aerospace missions. While not classified, the element that KXY would be expected to manufacture is unique, patented, and critical to the operational

status of the systems. Loss of availability of the element while the system is operational could have significant, immediate impact across multiple agencies and the civilian populous, including loss of life and millions of dollars in damages. An initial Risk Assessment was accomplished using [NIST SP 800-30 Rev. 1], and the existing level of risk for this is was given a score of "Moderate."

KXY currently produces a state-of-the-art, low-cost wafer fabrication with a primarily commercial focus. The nation-state in which KXY operates has a history of conducting industrial espionage to gain IP/technology. They have shown interest in semiconductor technology and provided a significant grant to KXY to expand into the military and aerospace markets. While KXY does not currently have the testing infrastructure to meet U.S. industry compliance requirements, the nation-state's resources are significant, including the ability to provide both concessions as well as incentives to help KXY meet those requirements.

The key area of concern was that the nation-state in which KXY operates would be able to use its influence to gain access to the element or the element's design.

The committee reviewed current mitigation strategies in place and determined that ABC Company, the integration company, and the enterprise had several existing practices to ensure that the system and all critical elements, as determined by a criticality analysis, met specific functionality requirements. For example, the system and critical elements are determined compliant with relevant industry standards. As part of their requirements under [NIST SP 800-53 Rev.5], the agency had some information protection requirements (Ref. PM-11). In addition, ABC Company had a sophisticated inventory tracking system that required that most elements to be uniquely tagged using RFID technology or otherwise identified for traceability (Ref. SR-4)).

Threat Scenario

Based on past experience, the enterprise decided that KXY's host nation would likely perform one of two actions if given access to the technology: sell it to interested parties or insert/identify vulnerabilities for later exploitation. For either of these threat events to succeed, the host nation would have to understand the purpose of the element and be given significant access to the element or element's design. This could be done with cooperation of KXY's human resources department, through deception, or by physical or electronic theft. Physical theft would be difficult given existing physical control requirements and inventory control procedures. For a modified element to be purchased and integrated with the system, it would need to pass various testing procedures at both the integrator and agency levels. Testing methods currently utilized included radiographic examination, material analysis, electrical testing, and sample accelerated life testing. Modifications to identification labels/schemes would need to be undetectable in a basic examination. In addition, KXY would need to pass routine audits, which would check KXY's processes for ensuring the quality and functionality of the element.

The committee decided that, despite existing practices, there was a 30% chance that the host nation would have the motivation and ability to develop harmful modifications to the element without detection, exploit previously unknown vulnerabilities, or provide the means for one of their allies to do the same. This could result in a loss of availability or integrity of the system, causing significant harm. Using information from an initial Risk Assessment accomplished using [NIST SP 800-30 Rev. 1], the committee identified this as the worst-case scenario with an impact score of "High."

There is approximately a 40% chance that the host nation could and would sell the technology to interested parties, resulting in a loss of technological superiority. If this scenario occurred, friendly

military and civilian lives could be at risk, intelligence operations would be damaged, and more money would be required to invest in a new solution. The committee assigned an impact score for this scenario of "Moderate."

The committee determined that the overall combined risk score for the vulnerability of concern was "High."

Mitigating Strategies

Using [NIST SP 800-161 Rev. 1] as a base, three broad strategies were identified by the committee: (1) improve traceability capabilities, (2) increase provenance and information requirements, and (3) choose another supplier. These three options were analyzed in more detail to determine specific implementation strategies, their impact on the scenarios, and their estimated cost to implement. (Specific technologies and techniques are not described in this case but would be useful in an actual threat scenario evaluation).

Improve traceability and monitoring capabilities

- CM-8 - SYSTEM COMPONENT INVENTORY
- IA-1 - POLICY AND PROCEDURES
- SA-10 - DEVELOPER CONFIGURATION MANAGEMENT
- SR-8 - NOTIFICATION AGREEMENTS
- SR-4 - PROVENANCE

Cost = 20 % increase
Impact = 10 % decrease

Increase provenance and information control requirements

- AC-21 - INFORMATION SHARING
- SR-4 - PROVENANCE

Cost = 20 % increase
Impact = 20 % decrease

Choose another supplier

- SR-6- SUPPLIER ASSESSMENTS AND REVIEWS

Cost = 40 % increase
Impact = 80 % decrease

Based on this analysis, the committee decided to implement a combination of practices:

- Develop and require unique, difficult-to-copy labels or alter labels to discourage cloning or modification of the component [Ref. SR-3(2)];
- Minimize the amount of information that is shared to suppliers. Require that the information be secured [Ref. AC-21]; and
- Require provenance be kept and updated throughout the SDLC [Ref. SR-4].

With this combination of controls, the estimated residual risk was determined to be equivalent with the existing risk without the partnership at a cost increase that is less than if the enterprise had changed suppliers.

6437 **Table B-4: Scenario 3**
6438

Threat Scenario	**Threat Source**	Nation-state with significant resources looking to steal IP		
	Vulnerability	Supplier considering partnership with company that has relationship with threat source		
	Threat Event Description	Nation-state helps KXY meet industry compliance requirements. ABC Company partners with KXY to develop chips		
	Existing Practices	Strong contractual requirements as to the functionality of the system and elements Comprehensive inventory tracking system at ABC Company Industry compliance requirements		
	Threat Event Outcome	Nation-state extracts technology threat actor, modifies technology, or exploits previously unknown vulnerability		
Enterprise units / processes/information/ assets/stakeholders affected		KXY Supplier ABC Company integrator functionality testing Technology users Other federal agencies / customers		
Risk	**Impact**	Technology modified / vulnerabilities exploited – High	Technology sold to interested parties – Moderate	
	Likelihood	Moderate	Moderate	
	Risk Score (Impact x Likelihood)	High		
	Acceptable Level of Risk	Moderate		
Mitigation	**Potential Mitigating Strategies / C-SCRM Controls**	(1) Improve traceability and monitoring capabilities	(2) Increase provenance and information control requirements	(3) Choose another supplier
	Estimated Cost of Mitigating Strategies	20% increase	20% increase	40% increase
	Change in Likelihood	Moderate → Low		
	Change in Impact	High → Moderate		
	Selected Strategies	Develop and require unique, difficult-to-copy labels or alter labels to discourage cloning or modification of the component [C-SCRM_PE-3] Minimize the amount of information that is shared to suppliers. Require that the information be secured [C-SCRM AC-21] Require provenance be kept and updated throughout the SDLC [C-SCRM_SR-4]		
	Estimated Residual Risk	Moderate – The residual risk was determined to be equivalent with the existing risk without the partnership		

6439
6440

SCENARIO 4: Malicious Code Insertion

Background

ABC Company has decided to perform a threat scenario analysis on a traffic control system. The scenario is to focus on software vulnerabilities and should provide general recommendations regarding mitigating practices.

Environment

The system runs nearly automatically and uses computers running a commonly available operating system along with centralized servers. The software was created in-house and is regularly maintained and updated by an integration company on contract for the next five years. The integration company is large, frequently used by ABC Company in a variety of projects and has significant resources to ensure that the system maintains its high availability and integrity requirements.

Threats to the system could include loss of power to the system, loss of functionality, or loss of integrity causing incorrect commands to be processed. Some threat sources could include nature, malicious outsiders, and malicious insiders. The system is equipped with certain safety controls such as backup generator power, redundancy of design, and contingency plans if the system fails.

Threat Event

ABC Company decided that the most concerning threat event would result from a malicious insider compromising the integrity of the system. Possible attacks could include the threat actor inserting a worm or a virus into the system, reducing its ability to function, or they could manually control the system from one of the central servers or by creating a back-door in the server to be accessed remotely. Depending on the skillfulness of the attack, an insider could gain control of the system, override certain fail-safes, and cause significant damage.

Based on this information, ABC Company developed the following fictitious threat event for analysis:

> *John Poindexter, a disgruntled employee of the integration company, decides to insert some open source malware into a component of the system. He then resigns from the firm, leaving no traceability of his work. The malware has the ability to call home to John and provide him access to stop or allow network traffic at any or all 50 of the transportation stations. As a result, unpredictable, difficult-to-diagnose disruptions would occur, causing significant monetary losses and safety concerns.*

After a Risk Assessment was accomplished using [NIST SP 800-30 Rev. 1], management decided that the acceptable level of risk for this scenario was "Moderate."

Threat Scenario Analysis

If John were successful, a potential course of events could occur as follows:

> John conducts a trial run, shutting off the services of one station for a short time. It would be discounted as a fluke and have minimal impact. Later, John would create increasingly frequent disruptions at various stations. These disruptions would cause anger among employees and

customers and some safety concerns. The integration company would be made aware of the problem and begin to investigate the cause. They would create a workaround, and make the assumption there was a bug in the system. However, because the malicious code would be buried and difficult to identify, the integration company wouldn't discover it. John would then create a major disruption across several transportation systems at once. The workaround created by the integration company would fail due to the size of the attack, and all transportation services would be halted. Travelers would be severely impacted, and the media alerted. The method of attack would be identified, and the system modified to prevent John from accessing the system again. However, the underlying malicious code would remain. Revenue would decrease significantly for several months. Legal questions would arise. Resources would be invested in assuring the public that the system was safe.

Mitigating Practices

ABC Company identified the following potential areas for improvement:

- Establish and retain identification of supply chain elements, processes, and actors [SR-4];
- Control access and configuration changes within the SDLC and require periodic code reviews [AC-1, AC-2, CM-3];
- Require static code testing [RA-9]; and
- Incident Handling [IR-4].

Table B-5: Scenario 4

Threat Scenario	**Threat Source**	Integrator– Malicious Code Insertion
	Vulnerability	Minimal oversight of integrator activities - no checks and balances for any individual inserting a small piece of code
	Threat Event Description	Disgruntled employee of an Integrator company inserts malicious functionality into traffic navigation software, and then leaves the ABC Company
	Existing Practices	Integrator: peer-review process Acquirer: Contract that sets down time, cost, and functionality requirements
	Threat Event Outcome	50 large metro locations and 500 instances affected by malware. When activated, the malware causes major disruptions to traffic
Enterprise units / processes/information/ assets/stakeholders affected		Traffic Navigation System Implementation company Legal Public Affairs
Risk	**Impact**	High – Traffic disruptions are major and last for two weeks while a work-around is created. Malicious code is not discovered and remains a vulnerability
	Likelihood	High
	Risk Score (Impact x Likelihood)	High

	Acceptable Level of Risk	Moderate
Mitigation	**Potential Mitigating Strategies / C-SCRM Controls**	C-SCRM_AC-1; C-SCRM_AC-2; C-SCRM_CM-3; C-SCRM_IR-2; C-SCRM_SA-10; C-SCRM_SA-11
	Estimated Cost of Mitigating Strategies	$2.5 million
	Change in Likelihood	High → Low
	Change in Impact	High (no change)
	Selected Strategies	Combination of strategies using the mitigation noted
	Estimated Residual Risk	Moderate

SCENARIO 5: Unintentional Compromise

Background

Uninformed insiders replace components with more cost-efficient solutions without understanding the implications to performance, safety, and long-term costs.

ABC Company has concerns about its acquisition policies and has decided to conduct a threat scenario analysis to identify applicable mitigating practices. Any practices selected must be applicable to a variety of projects and have significant success within a year.

Environment

ABC Company acquires many different systems with varying degrees of requirements. Because of the complexity of the environment, ABC Company officials decide they should use a scenario based on an actual past event.

Threat Event

Using an actual event as a basis, the agency designs the following threat event narrative:

> Gill, a newly hired program manager, is tasked with reducing the cost of a $5 million system being purchased to support complex research applications in a unique physical environment. The system would be responsible for relaying information regarding temperature, humidity, and toxic chemical detection as well as storing and analyzing various data sets. There must not be any unscheduled outages more than 10 seconds long, or serious safety concerns and potential destruction of research will occur. ABC Company's threat assessment committee determined that the acceptable level of risk for this type of event has a score of 2/10.

Gill sees that a number of components in the system design are priced high compared with similar components he has purchased in the commercial acquisition space. Gill asks John, a junior engineer with the integration company, to replace several load balancer/routers in the system design to save costs.

Threat Scenario Analysis

ABC Company decides that there were three potential outcomes to the scenario:

1. It is determined that the modifications are inadequate before any are purchased (30 % chance, no impact);
2. It is determined that the modifications are inadequate during testing (40 % chance, low impact); or
3. The inadequacy of the modifications is undetected, the routers are installed in the system, begin to fail, and create denial of service incidents (30 % chance, high impact).

Mitigating Strategies

Three potential mitigating strategies were identified:

- Improve the existing training program [Ref. AT-1] and add configuration management controls to monitor all proposed changes to critical systems [Ref. CM-1];
- Improve the testing requirements [Ref. SA-11]; and
- Require redundancy and heterogeneity in the design of systems [Ref. SC-29, SC-36].

Adding configuration management controls would increase the likelihood that the modifications were rejected either at the initial stage or during testing, but it was determined that a $200,000 investment in training alone could not bring the level of risk to an acceptable level in the time required.

Improving the testing requirements would increase the likelihood of the modifications being rejected during testing, but it was determined that no amount of testing alone could bring the level of risk to an acceptable level.

Requiring redundancy and heterogeneity in the design of the system would significantly reduce the impact of this and other events of concern but could double the cost of a project. In this scenario, it was determined that an investment of $2 million would be required to bring the risk to an acceptable level.

As a result of this analysis, ABC Company decides to implement a combination of practices:

- A mandatory, day-long training program for those handling the acquisition of critical systems and adding configuration management controls requiring changes be approved by a configuration management board (CMB) ($80,000 initial investment);
- $60,000 investment in testing equipment and software for critical systems and elements; and
- Redundancy and diversity of design requirements as deemed appropriate for each project.

It was determined that this combination of practices would be most cost-effective for a variety of projects and help mitigate the risk from a variety of threats.

6592

Table B-6: Scenario 5

Threat Scenario	**Threat Source**	Internal Employee – Unintentional Compromise		
	Vulnerability	Lax training practices		
	Threat Event Description	A new acquisition officer (AO) with experience in commercial acquisition is tasked with reducing hardware costs. The AO sees that a number of components are priced high and works with an engineer to change the purchase order		
	Existing Practices	Minimal training program that is not considered mandatory Basic testing requirements for system components		
	Threat Event Outcome	Change is found unsuitable before purchase	Change is found unsuitable in testing	Change passes testing, routers installed and start to fail, causing denial of service
Enterprise units / processes/information/ assets/stakeholders affected		None	Acquisitions	Acquisitions, System, Users
Risk	**Impact**	None	Low	High
	Likelihood	Moderate: 30%	High: 40 %	Moderate: 30 %
	Risk Score (Impact x Likelihood)	None	Moderate	Moderate
	Acceptable Level of Risk	Low	Moderate	High
Mitigation	**Potential Mitigating Strategies / SCRM Controls**	Improve training program and require changes be approved by CMB.	Improve acquisition testing	Improve design of system
	Estimated Cost of Mitigating Strategies	$200,000	---	$2 million
	Change in Impact	None – No Change	Low – No Change	High → Low
	Change in Likelihood	30% →10%	40% →20%	30% -- No Change
	New Risk Score	None	Low	Moderate
	Selected Strategies	Require mandatory training for those working on critical systems and require approval of changes to critical systems by a configuration management board (Cost = $100,000)		
	Residual Risk	Low		

SCENARIO 6: Vulnerable Reused Components Within Systems

Background

As part of their standard development practices, ABC Company reuses internally-developed and open source system components in the development of their COTS solutions. Recent high-profile cyber attacks have capitalized on vulnerabilities present in reused system components and ABC Company's customers are demanding increased transparency as a means of mitigating their own risk exposure.

ABC Company has decided to perform a threat scenario analysis to determine which steps can be taken to improve the security of their software products and offer customers greater confidence that ABC Company is taking the necessary steps to protect them from these types of attacks.

Environment

ABC Company is a well-known, market-leader in the Financial Planning & Analysis (FP&A) software market. ABC Company's customers rely on Acme's FP&A solution to store, process, and analyze sensitive financial information (e.g., closing the books).

Threat Event

Apache Struts (a widely-used software component) is used as a component within ABC Company's COTS FP&A solution. A vulnerability present in Apache Struts was patched in March of 2021. Motivated by financial gain, opportunistic cyber-criminal organizations were hunting for opportunities to capitalize on vulnerabilities in COTS solutions.

ABC Company's provides frequent updates to mitigate software vulnerabilities in their COTS solutions. However, in this case the software component in question was not included as part of these updates.

The vulnerability in question is present and exploitable within ABC Company's FP&A solution.

Threat Scenario Analysis

If the attackers were to discover the vulnerability in ABC Company's product, a potential course of events could occur as follows:

> A well-resourced cyber-criminal organization could install rogue code in customer instances of the FP&A solution. Using this rogue code, the cyber criminals could extract and sell sensitive, undisclosed financial information of public companies which trade on global stock markets. Upon discovery of the attack, ABC Company could face significant reputational harm due to the negative publicity. ABC Company's customers may engage in legal action against ABC Company as a result of their failure to appropriately patch known-vulnerabilities in their software products.

Mitigating Strategies

ABC Company identified the following areas for improvement in order to enhance their secure software development practices and improve the confidence in their products:

- Ensure that developers receive training on secure development practices and are instructed on the use of vulnerability tooling to ensure developed software is secure
- Ensure that reused system components either internally or open source are evaluated as part of a standard process for known vulnerabilities (Ref. SA-15)
- Maintain a system component inventory to aid in maintenance of the software product throughout its life cycle (Ref. CM-8)
- Continuously monitor system components for vulnerabilities that arise and ensure appropriate processes are in place to remediate expeditiously once a fix is available. Automate this process where possible. (Ref. CA-7, RA-5)

Table B-7: Scenario 5

Threat Scenario	**Threat Source**	Cyber Criminal Organization – Vulnerable Software Components
	Vulnerability	Failure to understand and monitor the vulnerability state of reused components used in FP&A software products and provide timely updates to patch known vulnerabilities
	Threat Event Description	Cyber Criminal Organization exploits a known vulnerability in an FP&A software product to install rogue code and gain access to sensitive financial information contained within the application instances used by ABC Company customers
	Existing Practices	ABC Company has a comprehensive Secure SDLC which focuses on identifying and mitigating vulnerabilities within their in-house developed code. ABC Company releases frequent patches to close vulnerabilities in their products
	Threat Event Outcome	10+ major ABC Company customers are compromised as a result of the vulnerable software. Negative press surrounding the attack has lead to significant impact, a 5% drop, to ABC Company's share price. ABC Company's competitors are capitalizing on the attack and using their own security practices to differentiate themselves and gain market share. ABC company faces significant legal costs due to action taken by affected customers. ABC Company has seen a 5% abnormal customer churn in the year following the attack.
Enterprise units / processes/information/ assets/stakeholders affected		FP&A Software Products Divison
Risk	**Impact**	High – $350M in aggregate cost. substantial reputational impact, loss of market share, share price, and customers.
	Likelihood	High – 20% annual probability of occurrence
	Risk Score (Impact x Likelihood)	High: $70M loss exposure
	Acceptable Level of Risk	Moderate - $20M: ABC Company's Risk Committee has stated that it is unwilling to lose more than $20 million due to a single cybersecurity event affecting customer products

Mitigation	**Potential Mitigating Strategies / SCRM Controls**	• Ensure that developers receive training on secure development practices and are instructed on the use of vulnerability tooling to ensure developed software is secure • Ensure that reused system components either internally or open source are evaluated as part of a standard process for known vulnerabilities (Ref. SA-15) • Maintain a system component inventor to aid in maintenance of the software product throughout its life cycle (Ref. CM-8) • Continuously monitor system components for vulnerabilities that arise and ensure appropriate processes are in place to remediate expeditiously once a fix is available. Automate this process where possible. (Ref. CA-7, RA-5)
	Estimated Cost of Mitigating Strategies	• Developer training: $500-$800K • System Component Inventory Process: $1.2-1.5M • Continuous Monitoring of System Component Vulnerabilities: $800K – $1.2M
	Change in Impact	High $350M (no change based on identified controls)
	Change in Likelihood	Low 5% annual probability of occurrence
	New Risk Score	Moderate: $17.5M

6658

6659

APPENDIX D: C-SCRM TEMPLATES

1. C-SCRM STRATEGY & IMPLEMENTATION PLAN

To address supply chain risks, enterprises develop a C-SCRM strategy. The C-SCRM strategy, accompanied by an implementation plan, is at the enterprise level (Level 1), though different mission/business areas (Level 2) may further tailor the C-SCRM strategy to address specific mission/business needs as outlined at the enterprise level. The C-SCRM strategy and implementation plan should anchor to the overarching enterprise risk management strategy and comply with applicable laws, executive orders, directives, and regulations.

Typical components of the strategy and implementation plan, as outlined in the below template, include strategic approaches to reducing an enterprise's supply chain risk exposure via enterprise-wide risk management requirements, ownership, risk tolerance, roles and responsibilities, and escalation criteria. Note that the strategy and implementation plan may be developed as a single document or split apart into multiple documents. In any case, these C-SCRM outputs should be closely related in nature.

1.1. C-SCRM Strategy & Implementation Plan Template

1.1.1. Purpose

Outline the enterprise's high-level purpose for the strategy and implementation document, aligning that purpose to enterprise mission, vision, and values. Describe where the strategy and implementation document reside relative to other C-SCRM documentation that must be maintained at various tiers. Provide clear direction around the enterprise's C-SCRM priorities and its general approach for achieving those priorities.

Sample Text

The purpose of this strategy and implementation document is to provide a strategic roadmap for implementing effective C-SCRM capabilities, practices, processes, and tools within the enterprise and in support of its vision, mission, and values.

The strategic approach is organized around a set of objectives that span the scope of the enterprise's mission and reflect a phased, achievable, strategic approach to ensure successful implementation and effectiveness of C-SCRM efforts across the enterprise.

This strategy and implementation document discusses the necessary core functions, roles, and responsibilities, and the approach the enterprise will take to implement C-SCRM capabilities within the enterprise. As mission/business policies and system plans are developed and completed, they will be incorporated as attachments to this document. All three tiers of documentation should be periodically reviewed together to ensure cohesion and consistency.

The focus of this strategy and implementation plan is intentionally targeted toward establishing a core foundational capability. These baseline functions, such as defining policies, ownership, and dedicated resources will ensure the enterprise can expand and mature its C-SCRM capabilities over time. This plan also acknowledges and emphasizes the need to raise awareness among staff

and ensure proper training in order to understand C-SCRM and grow the competencies necessary to be able to perform C-SCRM functions.

This initial strategy and implementation plan also recognizes the dependencies on industry-wide coordination efforts, processes, and decisions. As government and industry-wide direction, process guidance, and requirements are clarified and communicated, the enterprise will update and refine its strategy and operational implementation plans and actions.

1.1.2. Authority & Compliance

List of the laws, executive orders, directives, regulations, policies, standards, and guidelines that govern C-SCRM Strategy and Implementation.

Sample Text

- Legislation
  - Strengthening and Enhancing Cyber-capabilities by Utilizing Risk Exposure Technology Act (SECURE) Technology of 2018
  - Federal Information Security Modernization Act of 2014
  - Section 889 of the 2019 National Defense Authorization Act - "Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment"
  - Gramm-Leach-Bliley Act
  - Health Insurance Portability and Accountability Act
  - Executive Order 14028 of May 12, 2021, Improving the Nation's Cybersecurity
- Regulations
  - NYDFS 23 NYCRR 500: Section 500.11 Third Party Service Provider Security Policy
  - CIP-013-1: Cyber Security - Supply Chain Risk Management
  - FFIEC Information Security Handbook II.C.20: Oversight of Third-Party Service Providers
- Guidelines
  - NIST 800-53 Revision 5: CA-5, SR-1, SR-2, SR-3
  - NIST 800-37 Revision 2
  - NIST 800-161 Revision 1: Appendix C
  - ISO 28000:2007

1.1.3. Strategic Objectives

Strategic objectives establish the foundation for determining enterprise-level C-SCRM controls and requirements. Each objective supports achievement of the enterprise's stated purpose in pursuing sound C-SCRM practices and risk-reducing outcomes. Together, the objectives provide the enterprise with the essential elements needed to bring C-SCRM capabilities to life, and effectively pursue the enterprise's purpose.

In aggregate, strategic objectives should address essential C-SCRM capabilities and enablers, such as:

- Implementing a risk management hierarchy and risk management approach;

- Establishing an enterprise governance structure that integrates C-SCRM requirements and incorporates these requirements into enterprise policies;
- Defining a supplier risk assessment approach;
- Implementing a quality and reliability program that includes quality assurance and quality control process and practices;
- Establishing explicit collaborative roles, structures, and processes for supply chain, cybersecurity, product security, and physical security (and other relevant) functions;
- Ensuring that adequate resources are dedicated and allocated to information security and C-SCRM to ensure proper implementation of policy, guidance, and controls;
- Implementing a robust incident management program to successfully identify, respond to, and mitigate security incidents; and
- Including critical suppliers in contingency planning, incident response, and disaster recovery planning and testing.

Sample Text

Objective 1: Effectively manage cybersecurity risk in the supply chain

This objective addresses the primary intent of the enterprise's pursuit of C-SCRM. Establishing and sustaining an enterprise-wide C-SCRM program will enable the enterprise's risk owners to identify, assess, and mitigate supply chain risk to the enterprise's assets, functions, and associated services. Implementing an initial capability that can sustain and grow in scope of focus and breadth and depth of function will be done in phases and will incorporate holistic "people, process, and technology" needs to ensure the enterprise is able to achieve desired C-SCRM goals in areas such as improving enterprise awareness, protection, and resilience.

Objective 2: Serve as a trusted source of supply for customers

Addressing customer supply chain risks at scale and across the enterprise's diverse portfolio demands a prioritization approach, structure, improved processes, and ongoing governance. C-SCRM practices and controls need to be tailored to address the distinct and varied supply chain threats and vulnerabilities that are applicable to the enterprise's customers. This objective can be achieved by:

- Strengthening vetting processes, C-SCRM requirements, and oversight of external providers;
- Ensuring customer needs are met in line with their cybersecurity risk in the supply chain appetite, tolerance, and environment.

Objective 3: Position as an industry leader in C-SCRM

The enterprise is well-positioned to enable and drive forward improvements that address how cybersecurity risk is managed in the supply chains across the industry. Therefore, we must use this position to advocate with industry stakeholders about communication, incentivization, and education of industry players about our requirements and expectations related to addressing supply chain risk.

1.1.4. Implementation Plan & Progress Tracking

Outline the methodology and milestones by which progress against the enterprise's C-SCRM strategic objectives will be tracked. Though enterprise context heavily informs this process, enterprises should define prioritized time horizons to encourage execution of tasks critical or foundational in nature. Common nomenclature for defining such time horizons includes "crawl, walk, run" or "do now, do next, do later." Regardless of the time horizon designated, implementation of practical, prioritized plans is essential to building momentum in the establishment or enhancement of C-SCRM capabilities.

Once the implementation plan is baselined, an issue escalation process and feedback mechanism are included to drive change to the implementation plan and progress tracking.

Sample Text

[Enterprise's] execution of its C-SCRM strategic objectives and sustained operational effectiveness of underlying activities requires a formal approach and commitment to progress tracking. [Enterprise] will track and assess implementation of its strategic objectives by defining subsidiary milestones and implementation dates in an implementation plan. Monitoring and reporting against implementation plan require shared responsibility across multiple disciplines and a cross-enterprise, team-based approach.

The following implementation plan will be continuously maintained by mission/business owners and reviewed by the Senior Leadership team as a part of regular oversight activities.

Risks and issues impacting the implementation plan should be raised proactively by mission/business owners, or their team, to the Senior Leadership Team. The implementation plan may then be revised in accordance with Senior Leadership Team's discretion.

Objective 1: Effectively manage cybersecurity risk in the supply chains				
Implementation Plan Milestone	Status	Owner	Priority	Target Date
Establish policy and authority	Planned	J. Doe	Do Now	XX/XX/XX
Establish and provide executive oversight and direction	Complete	…	Do Next	…
Integrate C-SCRM into enterprise risk management (ERM) framework	Delayed	…	Do Later	…
Establish C-SCRM PMO capability and enterprise	Cancelled	…	…	…
Establish roles, responsibilities, and assign accountability	…	…	…	…
Develop C-SCRM plans	…	…	…	…
Stand up internal awareness function	…	…	…	…

Identify, prioritize, and implement supply chain risk assessment capabilities	…	…	…	…
Establish, document, and implement enterprise-level C-SCRM controls	…	…	…	…
Identify C-SCRM resource requirements and secure sustained funding	…	…	…	…
Establish C-SCRM program performance monitoring	…	…	…	…

6818

Objective 2: Serve as a trusted source of supply for customers				
Implementation Plan Milestone	Status	Owner	Priority	Target Date
Incorporate C-SCRM activities, customer-facing business lines, programs, and solution offerings	Planned	J. Doe	Do Now	XX/XX/XX
Ensure customer support personnel are well versed in cybersecurity risk in the supply chains and management requirements	Complete	…	Do Next	…
Establish minimum baseline levels of cybersecurity supply chain assurance	Delayed	…	Do Later	…
Establish processes to respond to identified risks and to monitor for impacts to the enterprise's supply chain	Cancelled	…	…	…

6819

Objective 3: Position as an industry leader in C-SCRM				
Implementation Plan Milestone	Status	Owner	Priority	Target Date
Coordinate and engage with national security and law enforcement to ensure rapid access to mission-critical supply chain threats	Planned	J. Doe	Do Now	XX/XX/XX
Evaluate C-SCRM improvement opportunities and strengthen requirements and oversight for industry-wide common solutions / shared services	Complete	…	Do Next	…
Advocate for C-SCRM awareness and competency through training and workforce development – to include secure coding training for developers	Delayed	…	Do Later	…

Release whitepapers and public guidance related to C-SCRM	Cancelled	…	…	…

1.1.5. Roles & Responsibilities

Designate those responsible for the Strategy & Implementation template, as well as its key contributors. Include the role and name of each individual or group, as well contact information where necessary (e.g., enterprise affiliation, address, email address, and phone number).

Sample Text

- Senior Leadership Team shall:
  - endorse the enterprise's C-SCRM strategic objectives and implementation plan;
  - provide oversight of C-SCRM implementation and effectiveness;
  - communicate C-SCRM direction and decisions for priorities and resourcing needs;
  - determine the enterprise's risk appetite and risk tolerance; and
  - respond to high-risk C-SCRM issue escalations that could impact the enterprise's risk posture in a timely manner.

- Mission/Business Owners shall:
  - determine mission-level risk appetite and tolerance, ensuring they are in line with enterprise expectations;
  - define supply chain risk management requirements and implementation of controls that support enterprise objectives;
  - maintain criticality analyses of mission functions and assets; and
  - perform risk assessments for mission/business-related procurements.

1.1.6. Definitions

List the key definitions described within the Strategy & Implementation template, providing enterprise-specific context and examples where needed.

Sample Text

- Enterprise: An enterprise with a defined mission/goal and a defined boundary, using information systems to execute that mission, and with responsibility for managing its own risks and performance. An enterprise may consist of all or some of the following business aspects: acquisition, program management, financial management (e.g., budgets), human resources, security, and information systems, information, and mission management.

- Objective: An enterprise's broad expression of goals. Specified target outcome for operations.

1.1.7. Revision & Maintenance

Define the required frequency of Strategy & Implementation template revisions. Maintain a table of revisions to enforce version control. Strategy & Implementation templates are living documents that must be updated and communicated to all appropriate individuals (e.g., staff, contractors, and suppliers).

Sample Text

[Enterprise's] Strategy & Implementation template must be reviewed at a minimum every 3-5 years (within the federal environment) since changes to laws, policies, standards, guidelines, and controls are dynamic and evolving. Additional criteria that may trigger interim revisions include:

- change of policies that impact the Strategy & Implementation template;
- significant Strategy & Implementation events;
- introduction of new technologies;
- discovery of new vulnerabilities;
- operational or environmental changes;
- shortcomings in the Strategy & Implementation template;
- change of scope; and
- other enterprise-specific criteria.

Sample Version Management Table

Version Number	Date	Description of Change/Revision	Section/Pages Affected	Changes made by Name/Title/Enterprise

2. C-SCRM POLICY

The C-SCRM policies direct the implementation of the C-SCRM strategy. C-SCRM policies can be developed at Level 1 and/or at Level 2 and are informed by the mission/business specific factors, including risk context, risk decisions and risk activities from the C-SCRM strategy. The C-SCRM policies support applicable enterprise policies (e.g., acquisition and procurement, information security and privacy, logistics, quality, and supply chain). The C-SCRM policies address the goals and objectives outlined in the enterprise's C-SCRM strategy, which in turn is informed by the enterprise's strategic plan. The C-SCRM policies should also address missions and business functions, and the internal and external customer requirements. C-SCRM policies also define the integration points for C-SCRM with the risk management and processes for the enterprise. Finally, the C-SCRM policies define at a more specific and granular level the C-SCRM roles and responsibilities within the enterprise, any interdependencies among those roles, and the interaction between the roles; the C-SCRM policies at Level 1 are more broad-based, whereas the C-SCRM policies at Level 2 are specific to the mission/business function. C-SCRM roles specify the responsibilities for procurement, conducting risk assessments, collecting supply chain threat intelligence, identifying and implementing risk-based mitigations, performing monitoring, and other C-SCRM functions.

2.1. C-SCRM Policy Template

2.1.1. Authority & Compliance

List of the laws, executive orders, directives, regulations, policies, standards, and guidelines that govern the C-SCRM policy.

Sample Level 1 Text

- Policies
  - [Enterprise Name] Enterprise Risk Management Policy
  - [Enterprise Name] Information Security Policy
- Legislation
  - Strengthening and Enhancing Cyber-capabilities by Utilizing Risk Exposure Technology Act (SECURE) Technology of 2018
- Regulations
  - NYDFS 23 NYCRR 500: Section 500.11 Third Party Service Provider Security Policy
  - CIP-013-1: Cyber Security - Supply Chain Risk Management
  - FFIEC Information Security Handbook II.C.20: Oversight of Third-Party Service Providers

Sample Level 2 Text

- Policies
  - [Enterprise Name] C-SCRM Policy

- [Mission and Business Process Name] Information Security Policy
- Regulations
  - NYDFS 23 NYCRR 500: Section 500.11 Third Party Service Provider Security Policy
- Guidelines
  - NIST 800-53 Revision 5: SR-1, PM-9, PM-30, PS-8, SI-12
  - NIST 800-161 Revision 1: Appendix C

2.1.2. Description

Describe the purpose and scope of the C-SCRM policy, outlining the enterprise leadership's intent to adhere to the plan, enforce its controls, and ensure it remains current. Define the tier(s) at which the policy applies. C-SCRM policies may need to be derived in whole or in part from existing policies or other guidance.

For Level 2, C-SCRM policies should list all Level 1 policies and plans that inform the Level 2 policies, provide a brief explanation of what this mission/business encompasses, and briefly describe the scope of applicability (e.g. plans, systems, type of procurements, etc.) for these Level 2 C-SCRM policies.

Sample Level 1 Text

[Enterprise] is concerned about the risks in the products, services, and solutions bought, used, and offered to customers.

The policy objective of the [Enterprise's] C-SCRM Program is to successfully implement and sustain the capability of providing improved assurance that the products, services, and solutions used and offered by [Enterprise] are trustworthy, appropriately secure and resilient, and able to perform to the required quality standard.

C-SCRM is a systematic process for identifying and assessing susceptibilities, vulnerabilities, and threats throughout the supply chain and implementing strategies and mitigation controls to reduce risk exposure and combat threats. The establishment and sustainment of an enterprise-wide C-SCRM Program will enable [Enterprise's] risk owner(s) to identify, assess, and mitigate supply chain risk to [Enterprise's] mission assets, functions, and associated services.

Sample Level 2 Text

[Mission and Business Process] recognizes its criticality to [Enterprise Objective]. A key component of producing products involves coordinating among multiple suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. [Mission and Business Process] understands the realization of cybersecurity risk in the supply chain may disrupt or completely inhibit [Mission and Business Process]'s ability to generate products in a timely manner and in accordance with the required quality standard.

Based on the C-SCRM objectives set forth by [Enterprise Level 1 Policy Name], [Mission and Business Process]'s policy objective is to implement C-SCRM capabilities allowing for the assessment, response, and monitoring of cybersecurity risk in the supply chain. C-SCRM capabilities that align with the policy and requirements set forth by the enterprise-wide C-SCRM program will provide the boundaries within which [Mission and Business Process Name] will tailor C-SCRM processes and practices to meet the unique requirements associated with sourcing components and assembling key products.

2.1.3. Policy

Outline the mandatory high-level policy statements that underpin the goals and objectives of the enterprise's C-SCRM strategic plan, missions and business functions, and the internal and external customer requirements.

Sample Level 1 Text

[Enterprise's] enterprise-level C-SCRM Program is established to implement and sustain the capability to:

- assess and provide appropriate risk response to cybersecurity risk in the supply chain posed by the acquisition and use of covered articles;
- prioritize assessments of cybersecurity risk in the supply chain and risk response actions based on criticality assessment of mission, system, component, service, or asset;
- develop an overall C-SCRM strategy and high-level implementation plan and policies and processes;
- integrate supply chain risk management practices throughout the acquisition and asset management life cycle of covered articles;
- share C-SCRM information in accordance with industry-wide criteria and guidelines; and
- guide and oversee implementation progress and program effectiveness.

The C-SCRM Program shall:

- be centrally led and coordinated by a designated senior leadership who shall function as the [Enterprise's] C-SCRM Program Executive and chair the C-SCRM Program Management Office (PMO);
- leverage and be appropriately integrated into existing [Enterprise's] risk-management and decision-making governance processes and structures;
- reflect a team-based approach and be collaborative, interdisciplinary, and intra-enterprise in nature and composition;
- incorporate a Leveled risk management approach, consistent with the NIST Risk Management Framework and NIST's supply chain risk management Special Publication 800-161 Revision 1; and
- implement codified and regulatory C-SCRM requirements and industry-wide and [Enterprise]-specific policy direction, guidance, and processes.

Sample Level 2 Text

[Mission and Business Process]'s C-SCRM Program shall:

- operate in accordance with requirements and guidance set forth by [Enterprise] C-SCRM Program;
- collaborate with the C-SCRM Program Management Office (PMO) to apply C-SCRM practices and capabilities needed to assess, respond to, and monitor cybersecurity risk in the supply chain arising from pursuit of [Mission and Business Process]'s core objectives;
- integrate C-SCRM activities into applicable activities to support [Enterprise]'s objective to manage cybersecurity risk in the supply chain;
- assign and dedicate resources responsible for coordinating C-SCRM activities within [Mission and Business Process];
- identify [Mission and Business Process]'s critical suppliers and assess level of risk exposure arising from that relationship;
- implement risk response efforts to reduce exposure to cybersecurity risk in the supply chain; and
- monitor [Mission and Business Process]'s ongoing cybersecurity risk exposure in the supply chain profile and provide periodic reporting to identified [Enterprise] enterprise risk management and C-SCRM stakeholders.

2.1.4. Roles & Responsibilities

State those responsible for the C-SCRM policies, as well as its key contributors. Include the role and name of each individual or group, as well contact information where necessary (e.g., enterprise affiliation, address, email address, and phone number).

Sample Level 1 Text

- The C-SCRM Program Executive shall be responsible for:
  - leading the establishment, development, and oversight of the C-SCRM Program, in coordination and consultation with designated C-SCRM Leads;
  - establishing and serving as the Chair of the C-SCRM PMO. This Team will be comprised of the chair and the designated C-SCRM Leads and will be responsible for developing and coordinating C-SCRM strategy and implementation plans and actions, addressing C-SCRM-related issues, program reporting and oversight, and identifying and making program resource recommendations; and
  - escalating and/or reporting C-SCRM issues to Senior Officials, as may be appropriate.

- Each C-SCRM Security Officer shall be responsible for:
  - identify C-SCRM Leads (the Lead will be responsible for participating as a collaborative and core member of the C-SCRM PMO);
  - incorporate relevant C-SCRM functions into enterprise and position-level functions; and
  - implement and conform to C-SCRM Program requirements.

Sample Level 2 Text

- C-SCRM Leads shall be responsible for:
  - representing the interests and needs of C-SCRM PMO members; and
  - leading and/or coordinating the development and execution of program or business-line C-SCRM plan(s). This shall include ensuring such plan(s) are appropriately aligned to and integrated with the enterprise-level C-SCRM plan.

- Mission and Business Process C-SCRM Staff shall be responsible for:
  - Primary execution of C-SCRM activities (e.g., supplier or product assessments); and
  - Support mission and business-specific C-SCRM activities driven by non-C-SCRM staff.

2.1.5. Definitions

List the key definitions described within the policy, providing enterprise-specific context and examples where needed.

Sample Text (Applies to Level 1 and/or Level 2)

- Covered Articles: Information technology, including cloud computing services of all types; Telecommunications equipment or telecommunications service; the processing of information on a Federal or non-Federal information system, subject to the requirements of the Controlled Unclassified Information program; all IoT/OT (hardware, systems, devices, software, or services that include embedded or incidental information technology).

- Cybersecurity Supply Chain Risk Assessment: Cybersecurity Supply Chain Risk Assessment is a systematic examination of cybersecurity risk in the supply chain, likelihoods of their occurrence, and potential impacts.

- Risk Owner: A person or entity with the accountability and authority to manage a risk.

2.1.6. Revision & Maintenance

Define the required frequency for the C-SCRM policy. Maintain a table of revisions to enforce version control. C-SCRM policies are living documents that must be updated and communicated to all appropriate individuals (e.g., staff, contractors, and suppliers).

Sample Text (Applies to Level 1 and/or Level 2)

[Enterprise's] C-SCRM policy must be reviewed at minimum on an annual basis since changes to laws, policies, standards, guidelines, and controls are dynamic and evolving. Additional criteria that may trigger interim revisions include:

- change of policies that impact the C-SCRM policy;
- significant C-SCRM events;

- introduction of new technologies;
- discovery of new vulnerabilities;
- operational or environmental changes;
- shortcomings in the C-SCRM policy;
- change of scope; and
- other enterprise-specific criteria.

Sample Version Management Table

Version Number	Date	Description of Change/Revision	Section/Pages Affected	Changes made by Name/Title/Enterprise

3. C-SCRM PLAN

The C-SCRM plan is developed at Tier 3 and is implementation specific, providing policy implementation, requirements, constraints, and implications. It can either be stand-alone or components may be incorporated into system security and privacy plans. If incorporated, the C-SCRM components must be clearly discernable. The C-SCRM plan addresses managing, implementation, and monitoring of C-SCRM controls and the development/sustainment of systems across the SDLC to support mission and business functions. The C-SCRM Plan applies to High and Moderate Impact systems per [FIPS 199].

Given supply chains can differ significantly across and within enterprises, C-SCRM plans should be tailored to individual program, enterprise, and operational contexts. Tailored C-SCRM plans provide the basis for determining whether a technology, service, system component, or system is fit for purpose, and as such, the controls need to be tailored accordingly. Tailored C-SCRM plans help enterprises focus their resources on the most critical mission and business functions based on mission and business requirements and their risk environment.

The following C-SCRM Plan template is provided only as an example. Enterprises have the flexibility to develop and implement various approaches for the development and presentation of the C-SCRM plan. Enterprises can leverage automated tools to ensure all relevant sections of the C-SCRM plan are captured. Automated tools can help document C-SCRM plan information such as component inventories, individuals filling roles, security control implementation information, system diagrams, supply chain component criticality, and interdependencies.

3.1. C-SCRM Plan Template

3.1.1. System Name & Identifier

Designate a unique identifier and/or name for the system. Include any applicable historical names and relevant Tier 1 and Tier 2 document titles.

Sample Text

This C-SCRM Plan provides an overview of the security requirements for the [SYSTEM NAME] [UNIQUE IDENTIFIER] and describes the supply chain cybersecurity controls in place or planned for implementation to provide fit for purpose C-SCRM controls appropriate for the information to be transmitted, processed or stored by the system.

The security safeguards implemented for the [UNIQUE IDENTIFIER] meet the requirements set forth in the enterprise's C-SCRM strategy and policy guidance.

3.1.2. System Description

Describe the function, purpose, and scope of the system and include a description of the information processed. Provide a general description of the system's approach to managing supply chain risks associated with the research and development, design, manufacturing,

acquisition, delivery, integration, operations and maintenance, and disposal of the following systems, system components or system services.

Ensure the C-SCRM plan describes the system in the context of the enterprise's supply chain risk tolerance, acceptable supply chain risk mitigation strategies or controls, a process for consistently evaluating and monitoring supply chain risk, approaches for implementing and communicating the plan, and a description of and justification for supply chain risk mitigation measures taken. Descriptions must be consistent with the high-level mission/business function of the system, the authorization boundary of the system, overall system architecture, including any supporting systems and relationships, how the system supports enterprise missions, and the system environment (e.g., standalone, managed/enterprise, custom/specialized security-limited functionality, cloud) established in Level 1 and 2.

Sample Text

The [Enterprise's] document management system (DMS) serves to provide dynamic information repositories, file hierarchies, and collaboration functionality to streamline internal team communication and coordination. The data managed within the system contains personally identifiable information (PII). The DMS is a commercial off-the-shelf (COTS) solution that was purchased directly from a verified supplier [Insert Supplier's name] within the United States. It has been functionally configured to meet the enterprise's needs; no third-party code libraries are utilized to deploy or maintain the system. It is hosted within the management layer of the enterprise's primary virtual private cloud provider.

The DMS is a Category 1 system, mandating a recovery time objective (RTO) of one hour in the event of downtime. The enterprise maintains a disaster recovery environment with a second private cloud provider to which the enterprise can cutover if the Category 1 RTO is not likely to be met on the primary platform.

3.1.3. System Information Type & Categorization

The following tables specify the information types that are processed, stored, or transmitted by the system and/or its in-boundary supply chain. Enterprises utilize NIST [SP 800-60 v2], [NARA CUI], or other enterprise-specific information types to identify information types and provisional impact levels. Using guidance regarding the categorization of federal information and systems in [FIPS 199], the enterprise determines the security impact levels for each information type. For each security objective (i.e., confidentiality, integrity, availability), articulate the impact level (i.e., low, moderate, high).

Sample Text

Information Type	Security Objectives		
	Confidentiality (Low, Moderate, High)	Integrity (Low, Moderate, High)	Availability (Low, Moderate, High)

Based on the table above, indicate the high-water mark for each of the security impacts (i.e., low, moderate, high). Determine the overall system categorization.

Security Objective	Security Impact Level
Confidentiality	☐ Low ☐ Moderate ☐ High
Integrity	☐ Low ☐ Moderate ☐ High
Availability	☐ Low ☐ Moderate ☐ High
Overall System Security Categorization	☐ Low ☐ Moderate ☐ High

3.1.4. System Operational Status

Sample Text

Indicate the operational status of the system. If more than one status is selected, list which part of the system is covered under each status

System Status		
☐	Operational	The system is currently operating and is in production.
☐	Under Development	The system is being designed, developed, or implemented
☐	Major Modification	The system is undergoing a major change, development, or transition.
☐	Disposition	The system is no longer operational.

3.1.5. System/Network Diagrams, Inventory, & Life Cycle Activities

Include a current and detailed system and network diagram including a system component inventory or reference to where diagrams and inventory information can be found.

Contextualize the above components against the system's SDLC to ensure activities are mapped and tracked. This ensures full coverage of C-SCRM activities since these activities may require repeating and reintegrating (using spiral or agile techniques) throughout the life cycle. C-SCRM plan activities are required from concept, all the way through development, production, utilization, support, and retirement steps.

Sample Text

[SYSTEM NAME] components may include:

- Component description
- Version number
- License number
- License holder
- License type (e.g., single user, public license, freeware)
- Barcode/property number
- Hostname (i.e., the name used to identify the component on a network)
- Component type (e.g., server, router, workstation, switch)
- Manufacturer
- Model
- Serial number
- Component revision number (e.g., firmware version)
- Physical location: (include specific rack location for components in computer/server rooms)
- Vendor name(s)

3.1.6. Information Exchange & System Connections

List any information exchange agreements (e.g., Interconnection Security Agreements (ISA), Memoranda of Understanding (MOU), Memoranda of Agreement (MOA)) between the system and another system, date of the agreement, security authorization status of the other system(s), the name of the authorizing official, a description of the connection, and any diagrams showing the flow of any information exchange.

Sample Text

Agreement Date	Name of System	Enterprise	Type of Connection or Information Exchange Method	FIPS 199 Categorization	Authorization Status	Authorization Official Name and Title

3.1.7. Security Control Details

Document C-SCRM controls to ensure the plan addresses requirements for developing trustworthy, secure, privacy-protective, and resilient system components and systems, including the application of the security design principles implemented as part of life cycle-based systems security engineering processes. Consider relevant topic areas such as assessments, standard operating procedures, responsibilities, software, hardware, product, service, and DevSecOps considerations.

For each control, provide a thorough description of how the security controls in the applicable baseline are implemented. Include any relevant artifacts for control implementation. Incorporate any control-tailoring justification, as needed. Reference applicable Level 1 and/or Level 2 C-SCRM policies that provide inherited controls where applicable. There may be multiple Level 1 policies that come from the CIO, CAO, or PMO.

Sample Text

SR-6 SUPPLIER ASSESSMENTS AND REVIEWS

Implementation: As a part of a comprehensive, defense-in-breadth information security strategy, the enterprise established a C-SCRM program to address the management of cybersecurity risk in the supply chain. The C-SCRM PMO is responsible for conducting assessments of cybersecurity risk in the supply chain for business partners seeking to integrate with [SYSTEM NAME] in accordance with enterprise-wide C-SCRM Level 2 policy requirements. C-SCRM training and awareness materials must also be provided for all individuals prior to receiving access to [SYSTEM NAME].

Control Enhancements: Control enhancements 2, 7 and 8 from [NIST 800-161] are applicable.

(2) SUPPLIER REVIEWS
Implementation: C-SCRM PMO provides supplier reviews to business partners in the form of SCRAs before entering into a contractual agreement to acquire information systems, components, or services in relation to [SYSTEM NAME]. The Level 1 strategy and Level 2 policy documents place SCRA requirements on business partners seeking to acquire IT systems,

components, and/or services. The SCRA provides a step-by-step guide for business partners to follow in preparation for an assessment of suppliers by the C-SCRM PMO.

(7) ASSESSMENT PRIOR TO SELECTION/ACCEPTANCE/UPDATE
Implementation: The Level 2 policy defines what [SYSTEM NAME] integration activities require an SCRA. The process and requirements are defined in the SCRA Standard Operating Procedure.

(8) USE OF ALL-SOURCE INTELLIGENCE
Implementation: The C-SCRM PMO utilizes all-source intelligence when conducting supply chain risk assessments for [SYSTEM NAME].

3.1.8. Role Identification

Identify the role, name, department/division, primary and alternate phone number, email address of key cybersecurity supply chain personnel or designate contacts (e.g., vendor contacts, acquisitions subject matter experts (SME), engineering leads, business partners, service providers), with role, name, address, primary and alternate phone numbers, and email address.

Sample Text

Role	Name	Department/ Division	Primary Phone Number	Alternate Phone Number	Email Address
Vendor Contact					
Acquisitions SME					
Engineering Lead					
Business Partner					
Service Provider					

3.1.9. Contingencies & Emergencies

For organizations that choose to do this in the event of contingency or emergency operations, enterprises may need to bypass normal C-SCRM acquisition processes to allow for mission continuity. Contracting activities that are not vetted using approved C-SCRM plan processes introduce operational risks to the enterprise.

Where appropriate, describe abbreviated acquisition procedures to follow during contingencies and emergencies, such as the contact information for C-SCRM, acquisitions, and legal subject matter experts who can provide advice absent a formal tasking and approval chain of command.

Sample Text

In the event of an emergency where equipment is urgently needed, the C-SCRM PMO will offer its assistance through C-SCRM Subject Matter Experts (SMEs) to provide help in the absence of the formal tasking and chain of command approval. The CIO has the authority to provide such waivers to bypass normal procedures. The current contact information for C-SCRM SMEs is provided below:

- C-SCRM SME POC
  - Name
  - Email
  - Phone
- Acquisitions SME POC
  - Name
  - Email
  - Phone
- Legal SME POC
  - Name
  - Email
  - Phone

3.1.10. Related Laws, Regulations, & Policies

List any applicable laws, executive orders, directives, policies, and regulations that are applicable to the system, for example: Executive Order 14028, FAR, FERC, etc. For Level 3, include applicable Level 1 C-SCRM Strategy and Implementation Plans and Level 2 C-SCRM Policy titles.

Sample Text

The enterprise shall ensure that C-SCRM plan controls are consistent with applicable statutory authority, including the Federal Information Security Modernization Act (FISMA); with regulatory requirements and external guidance, including Office of Management and Budget (OMB) policy and Federal Information Processing Standards (FIPS) publications promulgated by the National Institute of Standards and Technology (NIST); and with internal C-SCRM policies and strategy documents.

The following references apply:

- Committee on National Security Systems. CNSSD No. 505. *(U) Supply Chain Risk Management (SCRM)*
- NIST SP 800-53 Revisions 5 *Security and Privacy Controls for Information Systems and Enterprises*
- NIST SP 800-161 Revision 1 *Supply Chain Risk Management Practices for Information Systems and Enterprises*
- OMB Circular A-130 *Managing Information as a Strategic Resource*
- Federal Acquisition Supply Chain Security Act of 2018

- Executive Order 14028 of May 12, 2021, *Improving the Nation's Cybersecurity*

3.1.11. Revision & Maintenance

Include a table identifying the date of the change, a description of the modification, and the name of the individual who made the change. At a minimum, review and update Level 3 C-SCRM plans at life cycle milestones, gate reviews, and significant contracting activities, and verify for compliance with upper tier plans as appropriate. Ensure the plan adapts to shifting impacts of exogenous factors, such as threats, enterprise, and environmental changes.

Sample Text

Version Number	Date	Description of Change/Revision	Section/Pages Affected	Changes made by Name/Title/Enterprise

3.1.12. C-SCRM Plan Approval

Include a signature (either electronic or handwritten) and date when the system security plan is reviewed and approved.

Sample Text

Authorizing Official:

X_____

Name

Date

3.1.13. Acronym List

Include and detail any acronyms utilized in the C-SCRM plan.

Sample Text

Acronym	Detail
AO	Authorizing Official
C-SCRM	Cybersecurity Supply Chain Risk Management

SDLC	System Development Life Cycle

3.1.14. Attachments

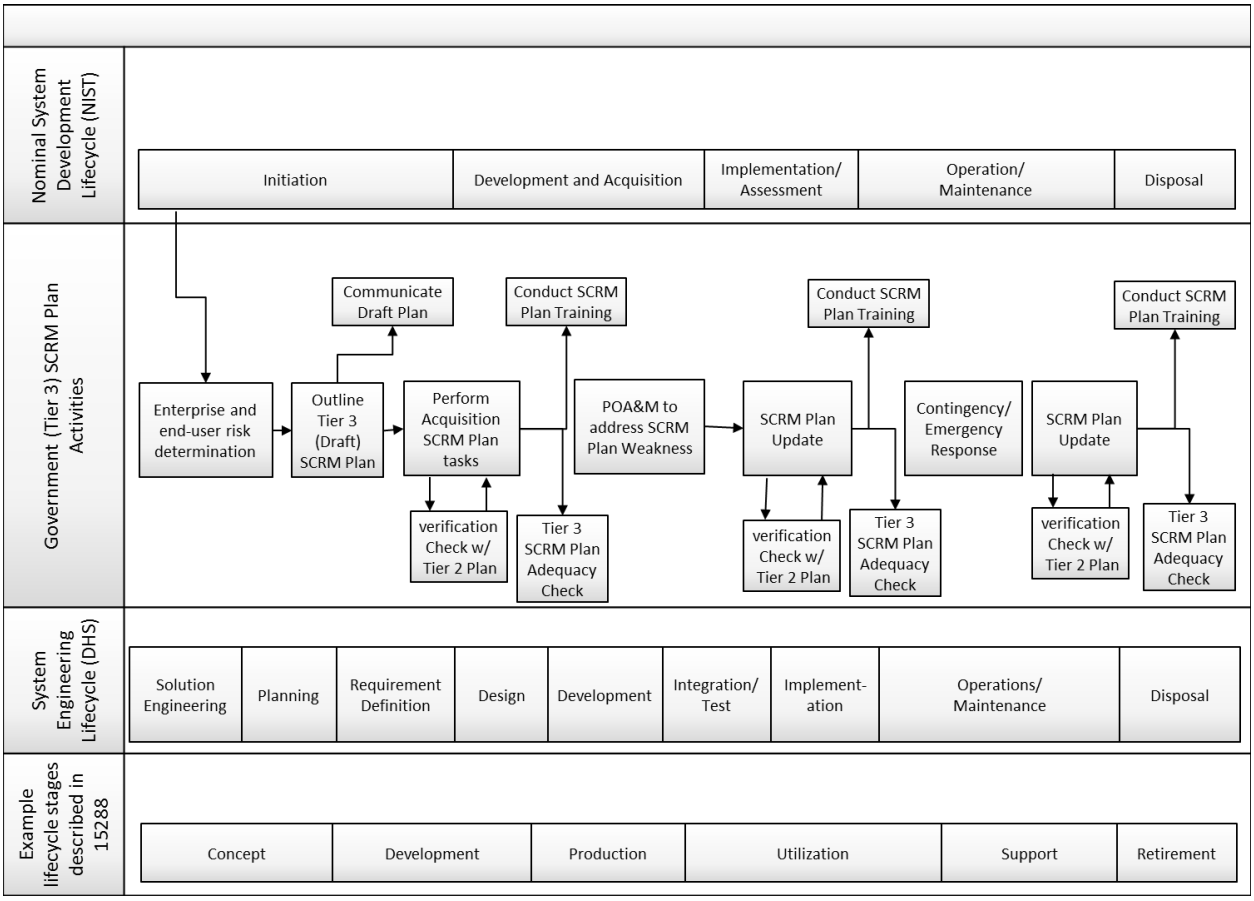
Attach any relevant artifacts that can be included to support the C-SCRM plan.

Sample Text

- Contractual agreements
- Contractors' or suppliers' C-SCRM plans

3.1.15. C-SCRM Plan and Life Cycles

C-SCRM plans should cover the full SDLC of systems and programs, including research and development, design, manufacturing, acquisition, delivery, integration, operations, and disposal/retirement. The C-SCRM plan activities should be integrated into the enterprise's system and software life cycle processes to ensure that C-SCRM activities are integrated into those processes. Similar controls in the C-SCRM plan can be applied in more than one life cycle process. The figure below shows how the C-SCRM plan activities can be integrated into various example life cycles.


Nominal System Development Lifecycle (NIST)
Initiation
Development and Acquisition
Implementation/ Assessment
Operation/ Maintenance
Disposal
Government (Tier 3) SCRM Plan Activities
Enterprise and end-user risk determination
Outline Tier 3 (Draft) SCRM Plan
Communicate Draft Plan
Perform Acquisition SCRM Plan tasks
verification Check w/ Tier 2 Plan
Conduct SCRM Plan Training
Tier 3 SCRM Plan Adequacy Check
POA&M to address SCRM Plan Weakness
SCRM Plan Update
verification Check w/ Tier 2 Plan
Conduct SCRM Plan Training
Tier 3 SCRM Plan Adequacy Check
Contingency/ Emergency Response
SCRM Plan Update
verification Check w/ Tier 2 Plan
Conduct SCRM Plan Training
Tier 3 SCRM Plan Adequacy Check
System Engineering Lifecycle (DHS)
Solution Engineering
Planning
Requirement Definition
Design
Development
Integration/ Test
Implement-ation
Operations/ Maintenance
Disposal
Example lifecycle stages described in 15288
Concept
Development
Production
Utilization
Support
Retirement

7374

4. SUPPLY CHAIN CYBERSECURITY RISK ASSESSMENT TEMPLATE

The Supply Chain Cybersecurity Risk Assessment (S-CSRA) guides the review of any third-party product, service, or supplier[22] that could present a cybersecurity risk in the supply chain to a procurer. The objective of the S-CSRA template is to provide a toolbox of questions that an acquirer can choose to use or not use depending on the controls selected. Typically executed by C-SCRM PMOs at the operational level (Level 3), the S-CSRA takes into account available public and private information to perform a holistic assessment, including known cybersecurity risk in the supply chain, likelihoods of their occurrence, and potential impacts to an enterprise and its information and systems. As enterprises may be inundated with S-CSRAs, and suppliers inundated with S-CSRA requests, the enterprise should evaluate the relative priority of its S-CSRAs as an influencing factor on the rigor of the S-CSRA.

As with the other featured templates, the below S-CSRA is provided only as an example. Enterprises must tailor the below content to align with their Level 1 and 2 risk postures. The execution of S-CSRAs is perhaps the most visible and time-consuming component of C-SCRM operations and must therefore be designed for efficient execution at scale with dedicated support resources, templated workflows, and automation wherever possible. Federal agencies should refer to Appendix E for additional guidance concerning supply chain risk assessments.

4.1. C-SCRM Template

4.1.1. Authority & Compliance

List of the laws, executive orders, directives, regulations, policies, standards, and guidelines that govern S-CSRA execution.

Sample Text

- Legislation
  - Strengthening and Enhancing Cyber-capabilities by Utilizing Risk Exposure Technology Act (SECURE) Technology of 2018
- Policies
  - [Enterprise Name] S-CSRA Standard Operating Procedures
  - [Enterprise Name] S-CSRA Risk Assessment Factors
  - [Enterprise Name] S-CSRA Criticality Assessment Criteria
- Guidelines
  - NIST 800-53 Revision 5: PM-30, RA-3, SA-15, SR-5
  - NIST 800-37 Revision 2
  - NIST 800-161 Revision 1: Appendix C
  - ISO 28001:2007

[22] A supplier may also refer to a source, as defined in the Strengthening and Enhancing Cyber-capabilities by Utilizing Risk Exposure Technology Act (SECURE) Technology of 2018

4.1.2. Description

Describe the purpose and scope of the S-CSRA template, referencing the enterprise commitment to C-SCRM and mandate to perform S-CSRAs as an extension of that commitment. Outline the templates relationship to enterprise risk management principles, frameworks, practices. This may include providing an overview of the enterprise's S-CSRA processes, standard operating procedures, and/or criticality designations that govern usage of this template.

Reinforce the business case for executing S-CSRAs by highlighting the benefits of reducing expected loss from adverse supply chain cybersecurity events, as well as the C-SCRM PMOs role in executing these assessments efficiently at scale.

Provide an overview of the enterprise boundaries, systems, and services within the scope of the S-CSRAs.

List the contact information and other resources that readers may access in order to further engage with the S-CSRA process.

Sample Text

This S-CSRA is intended to evaluate risks, in a fair and consistent manner, posed to the [Enterprise] via third parties that hold the potential for harm or compromise arising as a result of cybersecurity risks. Cybersecurity risk in the supply chain include exposures, threats, and vulnerabilities associated with the products and services traversing the supply chain as well as the exposures, threats, and vulnerabilities to the supply chain and its suppliers.

The S-CSRA template provides tactical guidelines for the [Enterprise's C-SCRM PMO] to review cybersecurity risk in the supply chain and ensure that S-CSRAs are appropriately carried out in line with enterprise mandates efficiently and effectively.

Requestors seeking to introduce third-party products, services, or suppliers into enterprise boundaries should familiarize themselves with the following template. This will ensure that requestors can provide the requisite information to the C-SCRM PMO to ensure timely execution of S-CSRAs and are otherwise aligned with adherence to the steps of the S-CSRA.

The S-CSRA process contains five primary steps, as outlined in the below template:[23]

1. Information Gathering & Scoping Analysis
2. Threat Analysis
3. Vulnerability Analysis
4. Impact Analysis
5. Risk Response Analysis

To learn more about the S-CSRA process and/or submit an assessment request to the C-SCRM PMO, please go to [Enterprise intranet page] or contact [C-SCRM PMO email].

[23] See Appendix D's "Assess" section for the methodological principles and guidance that underpin these steps.

4.1.3. Information Gathering & Scoping Analysis

Define the purpose and objectives for the requested S-CSRA, outlining the key information required to appropriately define the system, operations, supporting architecture, and boundaries. Provide key questions to requestors to facilitate collection and analysis of this information. The C-SCRM PMO will then use this information as a baseline for subsequent analyses and data requests.

Sample Text

Supply Chain Risk Management Assessment Scoping Questionnaire Section 1: Request Overview	Provide Response:	Response Provided by:
Requestor Name		Acquirer
S-CSRA Purpose and Objective		Acquirer
System Description		Acquirer
Architecture Overview		Acquirer
Boundary Definition		Acquirer
Date of Assessment		Acquirer
Assessor Name		Acquirer
Section 2: Product/Service Internal Risk Overview		
What is the suppliers market share for this particular product/service		Acquirer
What % of this supplier's sales of this product/service does your enterprise consume?		Acquirer
How widely used will the product or service be in your enterprise?		Acquirer
Is the product/service manufactured in a geographic location that is considered an area of geopolitical risk for your enterprise based on its primary area of operation (e.g., in the United States).		Acquirer
Would switching to an alternative supplier for this product or service constitute significant cost or effort for your enterprise?		Acquirer
Does your enterprise have an existing relationship with another supplier for this product/service?		Acquirer
How confident is your enterprise that they will be able to obtain quality products/services regardless of major supply chain disruptions, both manmade and natural		Acquirer

Does your enterprise maintain a reserve of this product/service?		Acquirer
Is the product/service fit for purpose? (i.e., capable of meeting is objectives or service levels)		Acquirer
Does the product/service perform an essential security function? Please describe		Acquirer
Does the product/service have root access to IT networks, OT systems or sensitive platforms?		Acquirer
Can compromise of the product/service lead to system failure or severe degradation?		Acquirer
Is there a known independent reliable mitigation for compromise leading to system failure or severe degradation?		Acquirer
Does the product/service connect to a platform that is provided by your enterprise to customers?		Acquirer
Does the product/service transmit, generate, maintain, or process high value data?		Acquirer
Does the product/service have access to systems that transmit, generate, maintain or process high value data (e.g., PII, PHI, PCI)		Acquirer
Does the supplier require physical access to the companies facilities as a result of its provision of the product/service?		Acquirer
Based on holistic consideration of the above responses, how critical is this product/service to your enterprise (e.g., Critical, High, Moderate, Low)		Acquirer
Section 2: Supplier Overview		
Have you identified the supplier's critical suppliers?		Supplier
Did you verify the supplier ownership, both foreign and domestic?		Supplier
If the supplier uses distributors, did you investigate them for potential threats?		Supplier
Is the supplier located in the United States?		Supplier
Has the supplier declared where replacement components will be purchased from?		Supplier
Have all of the suppliers', subcontractors', and suppliers' owners and locations been validated?		Supplier
Does the supplier vet suppliers for threat scenarios?		Supplier

Does the supplier have documents which track part numbers to manufacturers?		Supplier
Can the supplier provide a list of who they procure COTS software from?		Supplier
Does the supplier have counterfeit controls in place?		Supplier
Does the supplier safeguard key program information that may be exposed through interactions with suppliers?		Supplier
Does the supplier perform reviews, inspections, and have safeguards to detect/avoid counterfeit equipment, tampered hardware/software (HW/SW), vulnerable HW/SW, and/or operations security leaks?		Supplier
Does the supplier use industry standards baselines (e.g., CIS, NES) when purchasing software?		Supplier
Does the supplier comply with regulatory and legislation mandates?		Supplier
Does the supplier have procedures for secure maintenance and upgrades following deployment?		Supplier
Section 3: Policies & Procedures		
Does the supplier have definitive policies and procedures that help minimize supply chain risk, including subsidiary sourcing needs?		Supplier
Does the supplier define and manage system criticality and capability?		Supplier
Does everyone associated with the procurement (e.g., supplier, C-SCRM PMO) understand the threats and risks in the subject supply chain?		Supplier
Are all engaged personnel US citizens?		Supplier
Does the supplier have "insider threat" controls in place?		Supplier
Does the supplier verify and monitor all personnel that interact with the subject product, system, or service to know if they pose a threat?		Supplier
Does the supplier use, record, and track risk mitigation activities throughout the life cycle of the product, system, or service?		Supplier

Have all of the supplier's personnel signed non-disclosure agreements?		Supplier
Does the supplier allow its personnel or suppliers to access environments remotely (i.e. from an out of boundary)?		Supplier
Section 4: Logistics (if applicable)		
Does the supplier have documented tracking and version controls in place?		Supplier
Does the supplier analyze events (environmental or man-made) that could interrupt their supply chain?		Supplier
Are the supplier's completed parts controlled, so they are never left unattended or exposed to tampering?		Supplier
Are the supplier's completed parts locked up?		Supplier
Does the C-SCRM PMO have a process that ensures integrity when ordering inventory from the supplier?		Supplier
Does the C-SCRM PMO periodically inspect the supplier's inventory for exposure or tampering?		Supplier
Does the C-SCRM PMO have secure material destruction procedures for unused and scrap parts procured from the supplier?		Supplier
Is there a documented chain of custody for the deployment of products and systems?		Supplier
Section 5: Software Design & Development (if applicable)		
Is the C-SCRM PMO familiar with all the suppliers that will work on the design of the product/system?		Supplier and Manufacturer
Does the supplier align its SDLC to a secure software development standard (e.g., Microsoft Security Development Life Cycle)		Supplier and Manufacturer
Does the supplier perform all development onshore?		Supplier and Manufacturer
Do only United States citizens have access to development environments?		Supplier and Manufacturer
Does the supplier provide cybersecurity training to its developers?		Supplier and Manufacturer
Does the supplier use trusted software development tools?		Supplier and Manufacturer
Is the supplier using trusted information assurance controls to safeguard the development environment (e.g., secure		Supplier and Manufacturer

network configurations, strict access controls, dynamic/static vulnerability management tools, penetration testing)?		
Does the supplier validate open source software prior to use?		Supplier and Manufacturer
Are the supplier's software compilers continuously monitored?		Supplier and Manufacturer
Does the supplier have codified software test and configuration standards?		Supplier and Manufacturer
Section 6: Product/Service Specific Security (if applicable, one questionnaire per product/service)		
Product / Service Name		Manufacturer
Product Type (s) (Hardware, Software, Service)		Manufacturer
Product / Service Description		Manufacturer
Part Number (if applicable)		Manufacturer
Does the manufacturer implement formal enterprise roles and governance responsible for the implementation and oversight of Secure Engineering across the development or manufacturing process for product offerings?		Manufacturer
Does the manufacturer have processes for product integrity conform to any of the following standards (e.g., ISO 27036, SAE AS6171, etc.)?		Manufacturer
Is the product Federal Information Processing Standards (FIPS) compliant? If yes, please provide the FIPS level		Manufacturer
Does the manufacturer document and communicate security control requirements for your hardware, software, or solution offering?		Manufacturer
Has the manufacturer received fines or sanctions from any governmental entity or regulatory body in the past year related to the delivery of the product or service? If yes, please describe.		Manufacturer
Has the manufacturer experienced litigation claims over the past year related to the delivery of the product or service? If yes, please describe		Manufacturer
Does the manufacturer provide a bill of materials (BOM) for the products or service, and components which includes all logic-		Manufacturer

bearing (e.g., readable/writable/programmable) hardware, firmware, and software?		
For hardware components included in the product or service offering, does the supplier only buy from original equipment manufacturers or licensed resellers?		Supplier
Does the manufacturer have a policy or process to ensure that none of your suppliers or third-party components are on any banned list?		Manufacturer
How does the manufacturer prevent malicious and/or counterfeit IP components within their product offering or solution?		Manufacturer
Does the manufacturer manage the integrity of IP for its product or service offering?		Manufacturer
How does the manufacturer assess, prioritize, and remediate reported product or service vulnerabilities?		Manufacturer
How does the manufacturer ensure that product or service vulnerabilities are remediated in a timely period, reducing the window of opportunity for attackers?		Manufacturer
Does the manufacturer maintain and manage a Product Security Incident Reporting and Response program (PSRT)?		Manufacturer
What is the manufacturer's process to ensure customers and external entities (such as government agencies) are notified of an incident when their product or service is impacted?		Manufacturer

4.1.4. Threat Analysis

Define threat analysis as well as the criteria that will be utilized to assess the threat of the product, service, or supplier. Include a rubric with categorical definitions to encourage transparency behind assessment results.

Sample Text

The S-CSRA threat analysis evaluates and characterizes the level of threat to the integrity, trustworthiness, and authenticity of the product, service, or supplier as described below. This analysis is based on a threat actor's capability and intent to compromise or exploit the product, service, or supplier being introduced into the supply chain. Following completion of the analysis, one of the following threat levels is assigned:

- **Critical:** Information indicates adversaries are engaged in subversion, exploitation, or sabotage of the product, service, or supplier.
- **High:** Information indicates adversaries have established an overt or clandestine relationship with the product, service, or supplier, with the capability and intent to engage in subversion, exploitation or sabotage of the supply chain; however, there are no known indications of subversion, exploitation, or sabotage.
- **Moderate:** Information indicates adversaries have the capability but *not* the intent to engage in subversion, exploitation or sabotage of the product, service, or supplier. Conversely, they may have the intent but *not* the capability.
- **Low:** Information indicates adversaries have neither the capability nor the intent to engage in subversion, exploitation, or sabotage of the product, service, or supplier.

To appropriately assign the above threat analysis designation, C-SCRM PMOs and requestors should leverage the Information Gathering & Scoping questionnaire to coordinate collection of information related to the product, service, or supplier's operational details, ownership structure, key management personnel, financial information, business ventures, government restrictions, and potential threats. Additional investigations should be performed against the aforementioned topics if red flags are observed during initial data collection.

4.1.5. Vulnerability Analysis

Define vulnerability analysis as well as the criteria that will be utilized to assess the vulnerability of the product, service, or supplier being assessed. Include a rubric with categorical definitions to encourage transparency behind assessment results.

Sample Text

The S-CSRA vulnerability analysis evaluates and then characterizes the vulnerability of the product, service, or supplier throughout its life cycle and/or engagement. The analysis includes an assessment of the ease of exploitation by a threat actor with moderate capabilities. This analysis is based on a threat actor's capability and intent to compromise or exploit the product, service, or supplier being introduced into the supply chain. Following completion of the analysis, one of the following threat levels is assigned:

- **Critical:** The product, service, or supplier contains vulnerabilities that are wholly exposed (physically or logically) and are easily exploitable.
- **High:** The product, service, or supplier contains vulnerabilities that are highly exposed and are reasonably exploitable.
- **Moderate:** The product, service, or supplier contains vulnerabilities that are moderately exposed and would be difficult to exploit.
- **Low:** The product, service, or supplier is not exposed and would be unlikely to be exploited.

To appropriately assign the above vulnerability analysis designation, C-SCRM PMOs and requestors should coordinate the collection of information related to the product, service, or supplier's operational details, exploitability, service details, attributes of known vulnerabilities,

and mitigation techniques.

4.1.6. Impact Analysis

Define impact analysis as well as the criteria that will be utilized to assess the criticality of the product, service, or supplier being assessed. Include a rubric with categorical definitions to encourage transparency behind assessment results.

Sample Text

The S-CSRA impact analysis evaluates and then characterizes the impact of the product, service, or supplier throughout its life cycle and/or engagement. The analysis includes an end-to-end functional review to identify critical functions and components based on an assessment of the potential harm caused by the probable loss, damage, or compromise of a product, material, or service to an [Enterprise's] operations or mission. Following completion of the analysis, one of the following impact levels is assigned:

- **Critical:** The product, service, or supplier's failure to perform as designed would result in a total enterprise failure or a significant and/or unacceptable level of degradation of operations that could only be recovered with exceptional time and resources.
- **High:** The product, service, or supplier's failure to perform as designed would result in severe enterprise failure or a significant and/or unacceptable level of degradation of operations that could only be recovered with significant time and resources.
- **Moderate:** The product, service, or supplier's failure to perform as designed would result in serious enterprise failure that could readily and quickly managed with no long-term consequences.
- **Low:** The product, service, or supplier's failure to perform as designed would result in very little adverse effects on the enterprise that could readily and quickly managed with no long-term consequences.

To appropriately assign the above impact analysis designation, C-SCRM PMOs and requestors should coordinate the collection of information related to [Enterprise's] critical functions and components, identification of the intended user environment for the product or service, and supplier information.

4.1.7. Risk Response Analysis

Define risk analysis as well as the criteria that will be utilized to assess the scoring of the product or service being assessed. Include a rubric with categorical definitions to encourage transparency behind assessment results.

Sample Text

The S-CSRA risk score reflects a combined judgement based on likelihood and impact analyses. The likelihood analysis is scored via a combination of the aforementioned threat and vulnerability analysis score, as outlined in the figure below.

Likelihood Level					
Threat	**Vulnerability**				
		Low	Moderate	High	Critical
	Very Likely	Moderately Likely	Highly Likely	Very Likely	Very Likely
	Highly Likely	Moderately Likely	Highly Likely	Highly Likely	Very Likely
	Moderately Likely	Unlikely	Moderately Likely	Highly Likely	Highly Likely
	Unlikely	Unlikely	Unlikely	Moderately Likely	Moderately Likely

The S-CSRA risk score is then aggregated based upon that likelihood score and the impact score. If multiple vulnerabilities are identified for a given product or service, each vulnerability shall be assigned a risk level based upon its likelihood and impact.

Overall Risk Score					
Likelihood (threat and vulnerability)	**Impact**				
		Low	Moderate	High	Critical
	Very Likely	Moderate	High	Critical	Critical
	Highly Likely	Moderate	Moderate	High	Critical
	Moderately Likely	Low	Moderate	High	High
	Unlikely	Low	Low	Moderate	High

The aforementioned risk analyses and scoring provide measures by which [Enterprise] determines whether or not to proceed with procurement of the product, service, or supplier. Decisions to proceed must be weighed against the risk appetite and tolerance across the tiers of the enterprise, as well as the mitigation strategy that may be put in place to manage the risks as a result of procuring the product, service, or supplier.

4.1.8. Roles & Responsibilities

State those responsible for the S-CSRA policies, as well as its key contributors. Include the role and name of each individual or group, as well contact information where necessary (e.g., enterprise affiliation, address, email address, and phone number).

Sample Text

- C-SCRM PMO shall:
  - maintaining S-CSRA policies, procedures, and scoring methodologies
  - performing S-CSRA standard operating procedures
  - liaising with requestors seeking to procure a product, service or supplier
  - reporting S-CSRA results to leadership to help inform enterprise risk posture

- Each requestor shall:
  - complete S-CSRA request forms and provide all required information
  - address any information follow-up requests from the C-SCRM PMO resource completing the S-CSRA
  - adhering to any stipulations or mitigations mandated by the C-SCRM PMO following approval of a S-CSRA request.

4.1.9. Definitions

List the key definitions described within the policy, providing enterprise-specific context and examples where needed.

Sample Text

- Procurement: Process of obtaining a system, product, or service.

4.1.10. Revision & Maintenance

Define the required frequency for the S-CSRA template. Maintain a table of revisions to enforce version control. S-CSRA templates are living documents that must be updated and communicated to all appropriate individuals (e.g., staff, contractors, and suppliers).

Sample Text

[Enterprise's] S-CSRA template must be reviewed at a minimum on an annual basis since changes to laws, policies, standards, guidelines, and controls are dynamic and evolving. Additional criteria that may trigger interim revisions include:

- change of policies that impact the S-CSRA template;
- significant C-SCRM events;
- introduction of new technologies;
- discovery of new vulnerabilities;
- operational or environmental changes

- shortcomings in the S-CSRA template;
- change of scope; and
- other enterprise-specific criteria.

Sample Version Management Table

Version Number	Date	Description of Change/Revision	Section/Pages Affected	Changes made by Name/Title/Enterprise

APPENDIX E: FASCSA

INTRODUCTION

Purpose, Audience, and Background

This Appendix augments the current content in NIST SP 800-161 Revision 1 and provides additional guidance specific to federal executive agencies (agencies) related to supply chain risk assessment factors, assessment documentation, risk severity levels, and risk response.

As discussed in the introductory section of the main body of SP 800-161 Rev 1., *The Federal Acquisition Supply Chain Security Act of 2018* (FASCSA), Title II of the *SECURE Technology Act* (P. L. 115-390) was enacted to improve executive branch coordination, supply chain information sharing, and actions to address supply chain risks. The law established the Federal Acquisition Security Council (FASC)[24], an interagency executive body at the federal enterprise level. This Council is authorized to perform a range of functions intended to reduce the federal government's supply chain risk exposure and risk impact.

The FASCSA also provides the FASC and executive agencies with authorities relating to mitigating supply chain risks, to include exclusion and/or removal of sources and covered articles[25]. The law also mandates agencies conduct and prioritize supply chain risk assessments (SCRAs). The guidance in this appendix is specific to this FASCSA requirement, as described below, and addresses the need for a baseline level of consistency and alignment between agency-level C-SCRM risk assessment and response functions and those SCRM functions occurring at the government-wide level by authorized bodies such as the FASC.

[24] For additional information about the FASC authorities, membership, functions, and processes, readers should refer to the Federal Acquisition Security Council Final Rule, 41 CFR Parts 201 and 201-1.
See: https://www.govinfo.gov/content/pkg/FR-2021-08-26/pdf/2021-17532.pdf

[25] As defined by FASCSA, a covered article means: Information technology, including cloud computing services of all types; Telecommunications equipment or telecommunications service; the processing of information on a Federal or non-Federal information system, subject to the requirements of the Controlled Unclassified Information program; all IoT/OT - (hardware, systems, devices, software, or services that include embedded or incidental information technology.

Scope

IN SCOPE

This appendix is primarily focused on providing agencies with additional guidance concerning Section 1326 (a) (1) of the FASCSA, which requires executive agencies to assess the supply chain risk posed by the acquisition and use of covered articles and respond to that risk as appropriate. The law directs agencies to perform this activity, and other SCRM activities described therein, consistent with NIST standards, guidelines, and practices.[26]

OUT OF SCOPE

Section 4713 of the FASCA pertains to executive agencies' covered procurement actions and specific guidance concerning those actions is outside the scope of this Appendix. The FASCSA requires the Federal Acquisition Regulatory (FAR) Council to prescribe such regulations as may be necessary to carry out this section. NIST does and will continue to work closely with our interagency colleagues, within the FASC, and the federal acquisition community to help ensure harmonized guidance.

This appendix does not provide guidance about how to conduct an assessment. This is best addressed through role-based training, education, and work experience. Agencies should take steps to ensure personnel with current and prospective responsibility for performing SCRAs have adequate skills, knowledge, and depth and breadth of experience sufficient to identify and discern indications of cybersecurity risk in the supply chain and the assessment of those risks. Agencies are strongly encouraged to invest in training to grow and sustain competencies in analytic skills and SCRM knowledge. Counter-intelligence and security training is also strongly recommended for C-SCRM PMO staff or those personnel with responsibility dedicated to performing SCRAs to help ensure there is sufficient understanding and awareness of adversarial-related supply chain risks and provide advice and support for risk response decisions and actions.

Relationship to SP 800-161 Revision 1, Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations

The practices and processes to assess, respond to, and otherwise manage cyber-supply chain risks are discussed at length throughout the main body and appendices of SP 800-161 Rev. 1. This appendix provides supplemental and expanded guidance and is tailored and applicable to federal agencies. This guidance describes the scope and type of supply chain risk assessment information and documentation to support recommendations and decisions concerning an escalation of risk response decisions and actions, internally to senior agency officials or to external bodies such as the FASC.

This augmented guidance is also intended to ensure a baseline consistency and sufficiency of processes and supply chain risk information utilized for assessment and documentation and to facilitate information sharing and referrals to applicable decision makers, whether at a given

.

agency or at the government-wide level. Within the constraints of requisite support for federal enterprise-level analysis and decision-making, agencies continue to have the flexibility to assess and manage their supply risk in a manner consistent with the broader guidance outlined in the main body and other appendices of NIST SP 800-161 Rev.1, and their policies, mission and priority needs, and existing practices (assuming these are sufficient).

FASCSA Supply Chain Risk vs. NIST SP 800-161 Revision 1 Cybersecurity-Supply Chain Risk

Agencies should take note that the FASCSA definition of supply chain risk is narrowly focused on risk that arises from an adversarial threat actor. In contrast, NIST's definition and scope of cybersecurity-supply chain risk is otherwise consistent with the FASCSA definition but broader in scope as it includes both adversarial and non-adversarial-related risks. Consistent with the FASCA's direction that agencies rely upon NIST standards and guidance, agencies need to ensure their assessment and risk response activities address all applicable cyber-supply chain risks.

SUPPLY CHAIN RISK ASSESSMENTS (SCRAs)

General Information

The FASCA requires agencies to conduct and prioritize supply chain risk assessments when acquiring a covered article as well during its use or performance. In most cases, this also compels the need to assess the source associated with the covered article. Supply chain cybersecurity risk assessments conducted by agencies are highly dependent on the operating environment and use case associated with a covered article. Agencies have flexibility in how they apply NIST guidelines to their operations and there is not, nor should there be, a one-size-fits-all approach to conducting a SCRA. However, to facilitate assessments that may need to take place at the government-wide level to evaluate risk that may impact national security or multiple agency missions; for example: there is a need to ensure agencies' SCRA information and documentation reflects an acceptable baseline level of due diligence and standardization.

In general, information used for an assessment will be comprised of up to three categories of inputs:

1) Purpose and context information (i.e., use-case specific) used to understand the risk environment and to inform and establish risk tolerance relative to the use case;
2) Data/information obtained from the source;
3) All-source information, which may come from publicly available data, government sources (which may include classified sources), and/or commercial fee-based sources.

The purpose and context, as well as when in the SDLC or procurement life cycle a given assessment of a supplier and/or covered article is performed, will necessarily drive variations in terms of focus, degree of rigor, and scope with regard to what type, how much, and from what source(s) information used in an assessment is obtained.

The FASCSA recognizes that agencies have constrained resources, and it is necessary to prioritize the conduct of SCRAs[27]. Prioritization is not meant to be understood to mean that only a subset of sources or covered articles should be assessed; rather, agencies should establish a tiered set of priority levels, commensurate with the criticality and potential for risk impact. This tiering can then be used to guide or compel the timing of, order, level of rigor, scope, and frequency of SCRAs.

In addition to externally driven priorities (e.g. government-wide policy direction, regulatory requirement, etc.) and agency-defined prioritization factors, NIST SP 800-161 Rev 1. instructs agencies to prioritize assessments concerning critical suppliers (i.e., sources) and critical systems and services, as compromise of these sources and covered articles are likely to result in greater harm than something determined to be non-critical. For these assessments, agencies should address all baseline risk factors described in the Baseline Risk Factors (Common, Minimal) section below (augmenting and weighting the factors, as appropriate to the use case, to ensure appropriate consideration of both adversarial and non-adversarial-related risks). For a given non-critical source or non-critical covered article, agencies have discretion, consistent with their own internal policies and practices and absent other mandate, as to whether all, some, and to what extent, the baseline risk factors described in this Appendix should be considered when assessing supply chain risk. However, if and when there are one or more credible findings that indicates that a substantial supply chain risk may exist (see Supply Chain Risk Severity Schema, described below) it may require that a more robust assessment be completed, inclusive of all the baseline risk factors, or more robust research and analysis of the baseline risk factors. See also, the risk response guidance described in Risk Response Section below.

Responsibility and accountability for determining the priority level(s) for SCRAs, evaluating impact, making risk response decisions and taking actions based upon the findings in a SCRA is an inherently governmental function and cannot be outsourced. However, some agencies may rely upon a qualified third-party for support in conducting research, documenting findings, and reviewing relevant information. To aid in their research and assessment activities, agencies may also acquire access to commercially-available data or tools. Appropriate requirements should be included in solicitations and contracts to address access to, handling, and safeguarding of supply chain risk information. Failure to do this, in and of itself, reflects a security control gap and creates an unmitigated supply chain risk. Additionally, agency personnel should follow the guidance and direction of their ethics officials and legal counsel to ensure protections are in place to guard against conflicts of interest and inappropriate or unauthorized access to or disclosure of information, as supply chain risk information may be sensitive, proprietary, or in certain instances classified. For the latter category of information, agencies must ensure adherence to policies and procedures governing classified information and must limit access to only those personnel who are cleared and authorized access.

In all instances, those personnel who directly or support the conduct of an assessment have a duty and responsibility to act prudently, objectively, and exercise reasonable care in researching and analyzing a source or covered article as this supply chain risk information underpins subsequent risk response decisions and actions.

[27] See Section 1326 (a)(2) of the FASCSA

Baseline Risk Factors (Common, Minimal)

This section describes the baseline (common, non-exclusive) supply chain risk factors and guidance agencies should incorporate into (or map to the factors included in) their agency-defined SCRA methodology. These factors are to be used as a guide to research, identify, and assess risk for those SCRAs pertaining to critical sources or critical covered articles, at a minimum. A common baseline of risk factors also helps to ensure due diligence is consistently conducted as part of the analysis that informs risk-response decisions and actions, whether these occur at various levels within an agency or at the Federal enterprise-level. Agencies should assess additional factors beyond the baseline factors, as deemed relevant and appropriate to a given assessment use case.

Objectives for establishing his baseline set of factors include:

- ensuring a level of even treatment of evaluated sources or covered articles;
- ensuring minimum necessary information is available to the FASC, when required;
- promoting consistency and comparability across agencies;
- aiding the conduct of more sophisticated analyses such as trend analysis or causal or correlation relationships between found indicators of risk and realized risks; and
- having a base of information sufficient to identify and understand potential mitigation options, to inform prioritization or risk response trade-off analysis/decisions, etc.

Table E-1 that follows includes a list of the baseline risk factors, and their corresponding definition or description. These factors also are consistent with and align to the factors included in the FASC rule. The right-most column includes a listing of the type of information that may be identified and found to be an indicator of risk; this listing is intended to be used as a reference aid and is not all-inclusive of the universe of possible indicators of risk. Information pertaining to the context-based risk factors should be known by the agency and is often already documented, e.g. in a system security plan or acquisition plan. An assessment of these context-based factors helps to understand inherent risk, guides identification and selection of needed cybersecurity and SCRM controls and procurement requirements, and aids in determining the risk tolerance threshold for a covered article associated with a given use case. The vulnerability and threat risk factors are focused on risk that may be inherited from the covered article itself or the associated source or supply chain. Agencies will assess the findings associated with these baseline (and any additional) factors to provide an informed judgment about the likelihood for compromise or harm and resultant impact and whether a source or covered article is within or exceeds their acceptable risk tolerance level.

Table E-1: Baseline Risk Factors

BASELINE RISK FACTOR	DEFINITION OR GUIDANCE	NON-EXCLUSIVE INDICATORS OF RISK (As applicable)
CONTEXT (Inherent Risk)		

Criticality	Identify if the product, service, or source is deemed a critical system, system component, service, or supplier. Refer to main body and glossary of NIST SP 800-161 Rev. 1 for additional guidance. Also, see definition for EO-critical software.	• Supplier or Covered article (or component therein) performs or is essential to or, if compromised, could result in harm to, a mission critical function, life-safety, homeland security, critical infrastructure, or national security function; or, has an interdependency with another covered article performing, or essential to, such functions.
Information and Data	Understand and document the type, amount, purpose, and flow of federal data/information used by, or accessible by, the product, service, and/or source.	• Requirement or ability to access CUI or classified information • Federal information will be managed and/or be able to be accessed by external persons or entities other than the prime contractor or supplier • Product or service data inputs or outputs can affect life safety, if compromised
Reliance on the covered article or source	Understand the degree to which an agency is reliant on a covered article and/or source, and why.	• Prevalence of use of the product or service by the agency • Single source of supply • Product or service availability in the marketplace • Availability of or acceptable alternatives to product, service, or source
User/operational environment in which the covered article is used or installed, or service performed	For products included in systems or as a system component the user environment should be described in the System Security Plan and/or C-SCRM System Plan. For labor-based services, understand and document relevant information about the user environment (i.e. place of performance) that may expose the agency to risk	• The System and/or C-SCRM Security Plan should identify and document risks and describe the applicable, selected security controls required to be implemented to mitigate those risks • Relevant environment considerations that give rise to risk concerns should be documented in procurement plans and applicable controls addressed in solicitations and contracts
External Agency Interdependencies	Understand and identify interdependencies related to data, systems, and mission functions	• Covered article performs a function in support of a government-wide shared service • Covered article exchanges data with another agency's mission critical system • Contractor maintains an analytic tool that stores government-wide CUI data.
VULNERABILITIES or THREATS (Inherited Risk)		

Purpose Functionality, features, and components of the covered article	Research and assessment should result in a determination as to whether the product or service is "fit for purpose" and the extent to which there is assurance that the applicable C-SCRM dimensions (see Section 1.4 of main body) are satisfied.	• Ability of the source to produce and deliver the product or service as expected • Built-in security features and capabilities or lack thereof. • Secure configuration options and constraints. • Network/Internet Connectivity capability or requirements and method(s) of connection • Software and/or Hardware Bill of Material • Any transmission of information or data by a covered article to a country outside of the United States.
Company Information	Information about the company, to include size, structure, key leadership, and its financial health.	• Stability or high turnover/firings at senior leadership level • Corporate family tree • Years in business • Merger and acquisition activity (past and present) • Customer base and trends • Number of employees at specific location and company-wide, • Investors/Investments • Patent sales to foreign entities • Financial metrics and trends • Financial reports/audits
Quality/Past Performance	Assess ability of the source to produce and deliver covered articles as expected; Includes an understanding of the quality assurance practices associated with preventing mistakes or defects in manufactured/ developed products and avoiding problems when delivering solutions or services to customers.	• Past performance information • Relevant customer ratings or complaints • Recalls • Quality metrics • Evidence of a quality program and/or certification
Personnel	Risks associated with personnel affiliated with or employed by the source or an entity within the supply chain of the product or service.	• The supplier's program to vet its personnel, to include an insider threat program, and/or whether the supplier performs background checks and prior employment verification. • Hiring history from a foreign country's or foreign adversary's intelligence, military, law enforcement or other security services • Turnover rate • Staffing level and competencies • Evidence of questionable loyalties, unethical or illicit behavior and activity
Physical	Risks of harm or damage (such as espionage, theft, natural events, or terrorist attacks). associated with the physical environment, structures, or facilities, or other assets.	• Evidence of effectiveness of physical security controls such as procedures and practices that ensure or assist in the support of physical security. • Proximity to critical infrastructure or sensitive government assets or mission functions • Natural Disaster, Seismic, and Climate concerns

Geo-Political	Risks associated with a geographic location/region.	• Location-based political upheaval or corruption • Trade route disruptions • Jurisdictional legal requirements • Country or Regional instability

Foreign Ownership, Control, Influence (FOCI)	Ownership of, control of, or influence over the source or covered article(s) by a foreign interest (foreign government or parties owned or controlled by a foreign government, or other ties between the source and a foreign government) has the power, direct or indirect, whether or not exercised, to direct or decide matters affecting the management or operations of the company.	• Country is identified as a foreign adversary or country of special concern; • Source or its component suppliers have headquarters, research, development, manufacturing, testing, packaging, distribution, or service facilities or other operations in a foreign country, including a country of special concern or a foreign adversary • Identified personal and/or professional ties between the source—including its officers, directors or similar officials, employees, consultants, or contractors—and any foreign government • Laws and regulations of any foreign country in which the source has headquarters, research development, manufacturing, testing, packaging, distribution, or service facilities or other operations • Extent or amount of FOCI on a supplier • FOCI of any business entities involved in the covered article's supply chain, to include subsidiaries and sub-contractors, and whether that ownership or influence is from a foreign adversary of the United States or country of concern • Any indications the supplier may be partly or wholly acquired by a foreign entity or a foreign adversary • Supplier domiciled in a country where the law mandates cooperation, to include the sharing of PII and other sensitive information, with the country's security services • Indications demonstrating a foreign interest's capability to control or influence the supplier's operations or management or that of an entity within the covered article's supply chain • Key management personnel in the supply chain with foreign influence from or with a connection to a foreign government official or entities, such as members of the board of directors, officers, general partners, and senior management official • Foreign nationals or key management personnel from a foreign country involved with the design, development, manufacture or distribution of the covered article • Supplier's known connections to a foreign country's or foreign adversary's intelligence, law enforcement or other security service • Supplier is domiciled in or influenced/ controlled by a country that is known to conduct intellectual property theft against the United States.

Compliance/Legal	Risks arising from non-compliance, litigation, criminal acts, or other relevant legal requirements.	• Record of compliance with pertinent U.S. laws, regulations and contracts or agreements • Judgments/Fines
Fraud, Corruption, Sanctions, and Alignment with Government Interests	Risks arising from past or present fraudulent activity, corruption and being subject to suspension, debarment, exclusion, or sanctions (See also, Table J-2 and discussion immediately above table)	• Civil or criminal litigation; • Past history or current evidence of fraudulent activity • Source's history of committing intellectual property theft • Supplier's dealings in the sale of military goods, equipment or technology to countries that support terrorism or proliferate missile technology or chemical or biological weapons, and transactions identified by the Secretary of Defense as "posing a regional military threat" to the interests of the United States. • Source's history regarding unauthorized technology transfers
Cybersecurity	Cybersecurity risks associated with the source, the product or service, or the supply chain. posture of the source and the accessibility, availability, authenticity and integrity of products and services and associated supply and compilation chains	• Evidence of effective cybersecurity policies and practices • Supplier's history as a victim of computer network intrusions • Supplier's history as a victim of intellectual property theft • Information about whether a foreign intelligence entity unlawfully collected or attempted to acquire an acquisition item, technology or intellectual property. • Existence of unmitigated cybersecurity vulnerabilities • Indication of malicious activity including subversion, exploitation or sabotage associated with the supplier or the covered article.
*Counterfeit and Non-Conforming Products (include in baseline if relevant to the covered article; If in doubt, include).	Risks associated with the purchase and use of a counterfeit, suspected counterfeit, grey market, or non-conforming product.	• Evidence or history of counterfeits or non-conforming products associated with the supplier • Suppliers' anti-counterfeit practices and controls • Sourcing of components from the grey market
Supply Chain Relationships, Visibility, and Controls	Risks stemming from the supply chain associated with the source and/or covered article.	• Evidence of effective C-SCRM and Supplier Relationship Management practices • Components or materials (relevant to covered article) originate from single source in upstream supply chain • Reliance on single trade route • Provenance of the covered article

Information about these baseline risk factors should be generally available from open sources, although the type, quality, and extent of information is likely to vary broadly. In some instances, no information may be discovered for a given factor and should be noted accordingly. Research should be tailored toward attaining credible information of most relevance to the purpose and

context for which the assessment is being conducted (See also, discussion about information quality in the Assessment Documentation and Records Management section below). Because of these variables, it is not possible nor desirable to attempt to standardize below the risk factor level.

Findings associated with these factors may reflect a mix of information about threats, vulnerabilities, or general "exposures" that can indicate risk being possible or present. The findings may also be positive, neutral, or negative in nature. Positive findings are those that are indicative of the source or covered article having desired or required assurance attributes while on the other end of the spectrum, negative findings indicate there is or may be a risk that presents concern.

Caution! The existence of one or more risk indicators, associated with the above factors, does not necessarily indicate whether a source, product, or service poses a viable or an unacceptable risk, or the severity of the risk. Also, care should be taken to analyze what combination of factors and findings may give rise to risk, or conversely mitigate risk concerns. Uncertainty about a risk determination may prompt the need to conduct additional due diligence research and analysis, escalate internally or externally, or to seek advice as to whether the risk is such that mitigation is not possible.

Separate from, or as part of the assessment, agencies should examine whether there are any laws or federal restrictions prohibiting the use of certain suppliers and the acquisition or use of certain items, services or materials. The list below, while not inclusive of all applicable laws and restrictions, is focused on foreign ownership and control, other types of foreign influence, foreign adversaries and foreign investment concerns that may pose risks to the U.S. supply chain.

Use of such suppliers or the acquisition of such an item, service or material from an individual or entity on any of the lists below is a violation of law absent an exception or waiver, and therefore should likely be excluded from the federal procurement process. If an item has already been obtained prior to the below prohibitions going into effect, agencies should conduct an assessment to determine whether they are permitted to keep the prohibited items or services, and if so, whether any adversarial threats posed by continued use can be mitigated.

1.	**The Specially Designated Nationals (SDN) and Blocked Persons List**: The Treasury Department, Office of Assets Control (OFAC), through EO 13694 and as amended by EO 13757, provided for the designation on the Specially Designated Nationals and Blocked Persons List (SDN List) of parties determined to be responsible for or complicit in, or to have engaged in, directly or indirectly, malicious cyber-enabled activities. Any entity in which one or more blocked persons directly or indirectly holds a fifty percent or greater ownership interest in the aggregate is itself considered blocked by operation of law. U.S. persons may not engage in any dealings, directly or indirectly, with blocked persons.
2.	**The Sectoral Sanctions Identifications (SSI) List**: The sectoral sanctions imposed on specified persons operating in sectors of the Russian economy identified by the Secretary of the Treasury were done under EO 13662 through Directives issued by OFAC pursuant to its delegated authorities. It identifies individuals operating in the sectors of the Russian economy

	with whom U.S. persons are prohibited from transacting in, providing financing for, or dealing in debt with a maturity of longer ninety days.
3.	**The Foreign Sanctions Evaders (FSE) List**: OFAC publishes a list of foreign individuals and entities determined to have violated, attempted to violate, conspired to violate, or caused a violation of U.S. sanctions on Syria or Iran pursuant to EO 13608. It also lists foreign persons who have facilitated deceptive transactions for or on behalf of persons subject to U.S. sanctions. Collectively, such individuals and companies are called "Foreign Sanctions Evaders" or "FSEs." Transactions by U.S. persons or within the United States involving FSEs are prohibited.
4.	**The System for Award Management (SAM) Exclusions:** The SAM contains the electronic roster of debarred companies excluded from Federal procurement and non-procurement programs throughout the U.S. Government (unless otherwise noted) and from receiving federal contracts or certain subcontracts and from certain types of federal financial and nonfinancial assistance and benefits. The SAM system combines data from the Central Contractor Registration, Federal Register, Online Representations and Certification Applications, and the Excluded Parties List System. It also reflects data from the Office of the Inspector General's exclusion list (GSA). CFR Title 2, Part 180.
5.	**The List of Foreign Financial Institutions Subject to Correspondent Account Payable-Through Account Sanctions (the "CAPTA List").** The CAPTA List replaced the list of Foreign Financial Institutions Subject to Part 561. It includes names of foreign financial institutions subject to sanctions, certain prohibitions, or strict conditions before a U.S. company may do business with them.
6.	**The Persons Identified as Blocked.** Pursuant to 31 CFR 560 and 31 CFR 560.304, property and persons included on this list must be blocked if they are in or come within the possession or control of a U.S. person.
7.	**The BIS Unverified List:** Parties listed on the Unverified List (UVL) are ineligible to receive items subject to the Export Administration Regulations (EAR) by means of a license exception.
8.	**The 2019 National Defense Authorization Act, Section 889:** Unless a waiver is granted, NDAA Section 889 prohibits the federal government, government contractors, and grant and loan recipients from procuring or *using* certain "covered telecommunication equipment or services" that are produced by Huawei, ZTE, Hytera, Hikvision, and Dahua and their subsidiaries as a "substantial or essential component of any system, or as critical technology as part of any system."
9.	Any other federal restriction or law that would restrict the acquisition of goods, services, or materials from a supplier.

Risk Severity Schema

A common framework is needed as a reference to aid agencies in determining and appropriate risk response from the results of a supply chain risk assessment. This schema indicates whether an identified risk associated with a given source or covered article can be managed within agency-established C-SCRM processes or requires internal or external escalation for a risk-response decision or action.

There is benefit in adopting and tailoring an existing government-wide severity schema as this creates a degree of alignment and consistency with other related processes and guidance that are already in use. The Supply Chain Risk Severity Schema (SCRSS) introduced and described below mirrors the intent and structure of the Cyber Incident Severity Schema (CISS), which was

developed in coordination with departments and agencies with a cybersecurity or cyber operations mission.

Similar to the CISS, but focused on and tailored to supply chain risks versus cyber incidents, the SCRSS is intended to ensure a common view of:

- The severity of assessed supply chain risk associated with a given source or covered article;
- The urgency required for risk response;
- The seniority level necessary for coordinating or making a risk response decision; and
- The information, documentation, and processes required to inform and support risk response efforts.

Table E-2: Risk Severity Schema

Level	Type	Description
5	Urgent National Security Interest Risk	Adversarial-related significant risk with imminent or present impact to National Security Interest
4	National Security Interest Risk	Adversarial-related significant risk with potential to impact National Security Interest
3	Significant Risk	Adversarial-related significant risk assessed, with potential or known multi-agency/ mission(s) or Government-wide impact
2	Agency High Risk	Adversarial or non-adversarial-related risk associated with a critical supplier (i.e., source), critical system or asset, or critical system component, and assessed to have a risk that is high, per agency-established risk level assessment. Assessed risk impact does not extend outside of the agency.
1	Agency Low or Moderate Risk	Adversarial or non-adversarial risk is assessed which falls within agency's risk tolerance/appetite thresholds. Assessed risk impact does not extend outside of the agency.

The schema in Table E-2 is not intended to replace existing agency-established methodologies that describe and assign various risk levels or scores but rather, it is to be used as a mapping reference that associates an agency risk assessment result to the schema level that most closely describes that result. Mapping allows agencies to continue to have the flexibility they need to assess and describe risk levels in a manner applicable to their purpose and context while at the same time, creates the ability to have a normalized lexicon to be able to commonly describe supply risk severity across the Federal enterprise. This schema framework also helps to communicate expectations about risk response coordination, information sharing, and decision-making responsibilities associated with each level.

7907

7908 **Risk Response Guidance**

7909

7910 Depending upon the SCRSS level of an assessed supply chain risk, agencies may need to
7911 escalate and share SCRA information with others within their internal organization for further
7912 research, analysis, or risk response decision or engage with external officials, such as the FASC.

7913

7914 **Information Sharing**

7915

7916 Supply chain risks assessed at Levels 3 and above are characterized as "substantial risk," per the
7917 FASC rule, requiring mandatory information sharing with the FASC, via the Information Sharing
7918 Agency[28] (ISA), for subsequent review and potential additional analysis and action. At their
7919 discretion, agencies may choose to voluntarily share with the FASC supply chain information
7920 concerning identified Level 2 or 1 risks, in accordance with ISA information-sharing processes.

7921

7922 All information sharing that occurs between an agency and the FASC, whether mandatory or
7923 voluntary, is to be done in accordance with FASC-established information sharing requirements
7924 and processes. Additionally, agencies will designate a senior agency official(s) who will be the
7925 liaison for sharing information with the FASC. Agencies should establish processes to be able to
7926 share (send and receive) information between the agency and the FASC and establish
7927 commensurate requirements and processes, tailored to their organization, for sharing of supply
7928 chain risk information, within their own organization.

7929

7930 **Risk Response Escalation and Triaging**

7931

7932 Agencies are reminded of the importance of integrating SCRM into enterprise risk management
7933 activities and governance, as covered extensively in the main body and appendices of NIST SP
7934 800-161 Revision 1. For risk that is determined to be at a SCRSS substantial level, it is
7935 necessary to escalate the risk assessment information to applicable senior level officials within
7936 the agency, including legal counsel. Agencies should also ensure appropriate officials have
7937 security clearances, sufficient to allow them to access classified information, as needed and
7938 appropriate, to inform or support risk response coordination, decisions, or actions.

7939

7940 Also, because a risk deemed to be substantial is adversarial in nature, there may be law
7941 enforcement or counter-intelligence equities or existing activities that need to be considered prior
7942 to responding to the assessed risk. Agencies notifying and referring of substantial risks to the
7943 FASC standardizes and streamlines the process that agencies should follow to ensure these risks
7944 are "triaged" appropriately.

7945

7946

7947

[28] The Department of Homeland Security (DHS), acting primarily through the Cybersecurity and Infrastructure Security Agency, has been designated to serve as the FASC's ISA. The ISA performs administrative information sharing functions on behalf of the FASC, as provided at 41 U.S.C. 1323 (a) (3).kk

ASSESSMENT DOCUMENTATION AND RECORDS MANAGEMENT

Content Documentation Guidance

Agencies need to ensure their assessment record satisfies the minimal documentation requirements described in this section for referrals of sources and/or covered articles to the FASC or when escalating internally for risk-response decision that may implicate the use of an agencies' Section 4713 authority. This documentation baseline standard helps to ensure a robust and defensible record is established that can be used to support well-informed risk-response decisions and actions. It also helps to promote consistency in the scope and organization of documented content to facilitate comparability, re-usability, and information sharing.

The documentation requirements extend beyond capturing risk factor assessment information and includes general facts about who conducted the assessment and when, identifier and descriptive information about the source and covered article, citation of the data source(s) used to attain assessment information, an assignment of a confidence level to discrete findings and aggregate analysis of findings, as well as noting assumptions and constraints.

Agencies should also have, and follow, a defined assessment and risk scoring methodology. This methodology should be documented and referenced in the assessment record concerning a given source and/or covered article. Any deviations from the agency-defined methodology should be described in the general information section of the assessment record.

As information is researched and compiled, it needs to be organized and synthesized to cull out and document relevant findings that align to the varying risk factor categories. Sourced information, especially concerning notable findings of risk of concern, should be retained or be retrievable in a form that retains its evidentiary integrity and considered as supplemental content that may be required to support and defend a risk response decision or action. As such, the sources for, and the quality of and confidence in, the sourced information needs to be considered as part of the assessment activity and documented accordingly. Broadly, quality information should be understood to be information that is timely, relevant, unbiased, sufficiently complete or provided in-context, and attained from credible sources.

Documentation requirements should be incorporated into existing, relevant supply chain risk assessment policies, processes, and procedures. These requirements should be informed by consultation with, and direction from, officials within the agency to include legal counsel and personnel with responsibility for records management, CUI and classified information management, and privacy.

While a format is not specified, the minimal scope of content and documentation for a given assessment record should include the content described in Table E-3 below:

7990 **Table E-3: Assessment Record – Minimal Scope of Content and Documentation**
7991
7992

General Information	Additional Comments
Agency responsible for the assessment.	Agencies should be able to identify points of contact and retain information about any non-Federal personnel who supported the assessment and/or tools, data sources (inclusive of commercially obtained) used in support of the assessment.
Date of assessment or Timeframe in which the assessment was conducted.	Agencies should note which of their findings are temporal in nature and subject to change over time.
Source Profile: Identifier and Descriptive Information about Assessed Supplier	Document (as knowable and applicable): Legal Name, DBA Name, Domicile, Physical Address, (if different, physical Location of HQ); DUNS number, CAGE Code; Contact Phone Number; Registered as Foreign or Domestic Company; Company Website URL, Company Family Tree Structure and location in Company Family Tree (if known); Company Size; Years in Business; Market Segment
Identifier and Descriptive Information about Assessed Covered Article	Document: Product Name; Unique Identifier (e.g., Model Number/Version Number/Serial Number); Relevant NAICS and PSC; Brief Description
Summary of Purpose and Context of Assessment	Briefly summarize. Identify applicable life cycle phase indicated when assessment occurred (e.g., market research, procurement action, operational use)
Assessment Methodology	Provide reference to documented methodology. Describe any deviations from documented methodology.
Source/Covered Article Research, Findings, and Risk Assessment Results	Documented analysis of findings and identification and assessment of risk. Minimally, there needs to be a summation of the key findings and analysis of those findings and rationale for risk level determination. Specifically, this summary should address potential or existing threats to or vulnerabilities of Federal systems, programs or facilities, including the potential for exploitability. Include notes about relevant assumptions and constraints.
Impact Assessment	Relative to the purpose and context of the assessment, describe the assessed potential for impact, given the type, scope, and severity of the risk. identified.
Mitigation of Unresolved or Unacceptable Risk(s)	Include a discussion about the capability, capacity, and willingness of the source to mitigate risks to a satisfactory level and/or the capability and capacity of the agency to mitigate risks. Identify viable mitigation options, if known, to address any unresolved or unacceptable risks.
Assessment of Risk Severity level in accordance with Supply Chain Risk Severity Schema.	Include SCRSS level number and summary of explanation as to why this level was assigned. Address identified implications for government missions or assets, national security, homeland security, or critical functions associated with use of the source or covered article.

Risk Response	Describe risk response decision or actions taken (e.g., avoid, mitigate, escalate to FASC for coordination and triaging; referral to FASC, other (describe)).
Any other information, as specified and directed to provide by the FASC or is included, per agency discretion.	Describe or provide information that would factor into an assessment of supply chain risk, including any impact to agency functions, and other information as the FASC deems appropriate.
Review and Clearance	Ensure the credibility of and confidence in sources and available information used for assessment of risk associated with proceeding, with using alternatives, and/or with enacting mitigation efforts is addressed. Confirm the assessment record was reviewed and cleared by applicable officials, to include applicable Senior Leadership and legal counsel, for risk assessed as being substantial. Review and clearance are also intended to ensure that assessment record and supporting information is appropriately safeguarded, marked, and access-controlled.

Assessment Record

Agencies should ensure records management requirements are adhered to with regard to SCRAs. Policies and procedures should be in place that address the requisite safeguarding, marking, handling, retention, and dissemination requirements and restrictions associated with an assessment record and its associated content.

If and when assessment services (e.g., analytic support) or commercially-provided information is obtained to support the development of an assessment record, an agreement (e.g., contract, interagency agreement) should specify appropriate requirements and restrictions about scope and purpose of data use or limitations, access, and retention rights.

APPENDIX F: RESPONSE TO EXECUTIVE ORDER 14028's CALL TO PUBLISH PRELIMINARY GUIDELINES FOR ENHANCING SOFTWARE SUPPLY CHAIN SECURITY

INTRODUCTION

The Executive Order (EO) on Improving the Nation's Cybersecurity, released on May 12, 2021, acknowledges growing risks across the cybersecurity landscape and seeks to correspondingly enhance the federal government's cybersecurity posture. The enhancements contained within are multi-faceted, mandating changes from incident response procedures to the establishment of a Cyber Safety Review Board.

Federal departments and agencies are increasingly exposed to cybersecurity risk in the supply chain as a result of software they acquire, deploy, use and manage from their supply chain (which includes open sources). Software acquired through the supply chain may contain both known and unknown vulnerabilities as a result of the build process used by the developer. For example, commercially-developed software may include open source code and software components which were subjected to varying levels of due diligence by developers. The obscurity that Federal departments and agencies face within their supply chains present a unique challenge when it comes to managing cybersecurity risk in the supply chain.

Mitigating these types of risks to the supply chain is a cornerstone of the EO, with Section 4 focusing exclusively on the critical sub-discipline of software supply chain security. The implications of Section 4 to C-SCRM activities within the federal government and those in the private sector that supply the federal government are substantial enough to require explicit consideration within this publication. Additionally, the EO identifies NIST as an authoritative source in the collection and dissemination of recommended guidance for securing the software supply chain.

Section 4

Referential Text from EO Section 4:
(b) Within 30 days of the date of this order, the Secretary of Commerce acting through the Director of NIST shall solicit input from the Federal Government, private sector, academia, and other appropriate actors to **identify existing or develop new standards, tools, and best practices** for complying with the standards, procedures, or criteria in subsection (e) of this section. The guidelines shall include **criteria that can be used to evaluate software security, include criteria to evaluate the security practices of the developers and suppliers themselves**, and identify innovative tools or methods to demonstrate conformance with secure practices.

Relevant directive to this appendix:
(c) Within 180 days of the date of this order, the Director of NIST shall publish **preliminary guidelines, based on the consultations described in subsection (b) of this section and drawing on existing documents as practicable, for enhancing software supply chain security and meeting the requirements of this section.**

This appendix therefore seeks to provide a response to the directives outlined within Section 4(c) of the EO by outlining existing industry standards, tools, and recommended[29] practices within the context of SP 800-161 Rev. 1, as well as any new standards, tools, and recommended practices stemming from the EO and recent developments in the discipline.

Existing industry standards, tools, and recommended practices are sourced from the main body of SP 800-161 Rev. 1, as well as subsequent guidance published by NIST as a result of the EO, including:

- Definition of Critical Software Under Executive Order (EO) 14028; June 25, 2021
- Security Measures for "EO-Critical Software" Use Under Executive Order (EO) 14028; July 9, 2021
- Guidelines on Minimum Standards for Developer Verification of Software; July 2021

New standards, tools, and recommended practices are sourced from over 150 position papers submitted in advance NIST's June 2021 Enhancing Software Supply Chain Security Workshop, federal software supply chain security working groups, as well as an array of public and private industry partnerships.

To facilitate prioritization and practical implementation of new software supply chain security recommendations, the corresponding guidance in Section 1.3 is presented in the Foundational, Sustaining, and Enhancing practices paradigm first presented in the main body of SP 800-161 Rev. 1.

[29] NIST interprets the intent of "best" practices within the context of the EO as "recommended" practices to align with its typical mandate as an authoritative body providing recommendations to both public and private organizations.

Following the release of these preliminary guidelines and pursuant to section 4(e) of the EO, NIST will issue guidance which includes the Secure Software Development Framework (SSDF) captured in NIST SP 800-218 (currently in draft for public comment). The SSDF provides a core set of high-level secure software development practices that can be integrated into each SDLC implementation. In addition, this guidance identifies practices that enhance software supply chain security, with references to standards, procedures, and criteria. Initial work on this guidance is scheduled to be released by February 6th, 2022. This publication will include references to practices and standards available prior to the release of the final publication of NIST SP 800-161.

Purpose

The purpose of this Appendix is to provide guidance to IT, C-SCRM PMO, acquisition/procurement and other functions to facilitate compliance with the relevant EO. This guidance includes applying existing SP 800-161 Rev. 1 controls to suppliers, and, where feasible, adopting new software supply chain security recommendations that previously fell outside of the explicit scope of SP 800-161 Rev. 1.

Scope

The EO's broad-based directives are being addressed across numerous public and private sector forums, working groups, and publications. This appendix focuses exclusively on software supply chain security guidance related to acquisition, use, and maintenance of third-party software and services as they relate to Section 4(c) of the EO. This appendix does not include contractual language for departments and agencies and cybersecurity concepts and disciplines beyond core software supply chain security use cases.

Audience

The primary audience for this appendix is federal departments and agencies that acquire, deploy, use and manage software from open sources, third party suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers and must comply with Section 4 of the EO. This guidance also applies to software developed in-house by federal departments and agencies which commonly relies on reuse of open source and third-party developed code. Given the significant downstream impacts of the EO on the private sector, however, the guidance contained herein may also be of use to non-federal organizations seeking to understand and/or align with federal C-SCRM and software supply chain security recommended requirements and practices.

Relationship to SP 800-161 Rev. 1

The initial public draft of SP 800-161 Rev. 1 was published in April 2021 and preceded the release of the EO. This appendix responds to the bulk of required updates resulting from Section 4(c)'s directives, though additional changes have been cascaded throughout the main body of NIST SP 800-161, Rev.1 as required by Section 4(c) and adjudicated public comments. The

intent of this approach is to provide clear and direct guidance for federal departments and agencies seeking to comply with Section 4 of the EO, while ensuring that the main body of this document is aligned with the rapidly changing C-SCRM and software supply chain disciplines. The impact of Section 4's directives will continue to evolve through 2022 and beyond. Concepts introduced within this appendix will similarly continue to evolve, in particular those related to new standards, tools, and recommended practices. As with any NIST guidance, organizations referencing these materials should ascertain that no subsequent publication, guidance, or EO supersedes the concepts discussed here.

THE EO THROUGH THE LENS OF SP 800-161 Rev. 1

Software supply chain security concepts are a critical sub-discipline within C-SCRM, and as such are well represented throughout SP 800-161 Rev. 1. The main body of SP-800-161 is therefore a fitting lens through which NIST's efforts to gather existing industry standards, tools, and recommended practices in software supply chain security can be organized and operationalized by federal departments and agencies.

NIST has translated the EO's Section 4 software supply chain directives into three targeted initiatives[30]. Those initiatives encompass:

- Critical Software Definition and Security Measures
- Recommended Minimum Standard for Vendor or Developer Verification of Code
- Cybersecurity Labeling for Consumers: Internet of Things (IoT) Devices and Software

SP 800-161 Rev. 1's coverage of, and contribution to, existing industry standards, tools, and recommended practices across each of these initiatives is outlined in this section. NIST looks to these other standards, tools, and recommended practices as a mean of establishing preliminary guidelines, for enhancing software supply chain security, and will include information available at the time of publication of the final version of NIST SP 800-161, Rev.1. Those efforts include

- National Telecommunications and Information Administration (NTIA) developing and establishing minimum elements for a Software Bill of Materials (SBOM)
- NIST in consultation with the Department of Defense, NSA, CISA, OMB, and National Intelligence publishing a definition for EO-critical software
- NIST efforts to develop and publish guidance outlining security measures for critical software

EO-Critical Software

The EO's Section 4 directives outline two actions for NIST in relation to critical software. The first is to publish a definition based on the parameters set out in the EO for critical software that "reflect[s] the level of privilege or access required to function, integration, and dependencies

[30] For more information, see NIST's "Improving the Nation's Cybersecurity: NIST's Responsibilities under the Executive Order"

with other software." The second is to "publish guidance outlining security measures" that should be utilized to protect that revised set of critical software designations.

Definition

NIST's response to the EO, titled a "Definition of Critical Software Under Executive Order (EO) 14028", was released on June 25, 2021. The publication revisits traditional notions of context-based criticality definitions and enhances them with additional function-based definitions, as summarized below[31].

To aid in the application of this enhanced assessment of software criticality and facilitate their efforts to comply with Section 4 of the EO, Table F-1 identifies the points at which existing criticality considerations in SP 800-161 Rev. 1 adopted by Federal departments and agencies may be enhanced by the new EO-critical software definition.

Table F-1: Impacts of EO-critical software definition on SP 800-161 Rev. 1 guidance for Federal Departments and Agencies

Section Identifier	Section Title	EO-critical Definition Impact
1.4	**C-SCRM Key Practices**	• Integrate context-based criticality concepts within the Foundational Practices' measurement of supplier criticality and utilization of supplier risk assessments • Expand Sustaining Practices assessment and certification activities to all net new critical suppliers under the expanded EO-criticality definition (e.g., suppliers who develop a software component that performs a function critical to trust, regardless of where that component is used within the organization)
2	**Integration of C-SCR in Enterprise-wide Risk Management**	• Enhance SP 800-39's Assess risk step with EO-critical risk definitions when considering software supply chain components and suppliers
2.1	**Multi-level Risk Management**	• Augment C-SCRM Strategy and Implementation Plans, Policies, and Plans focus on mission/business critical requirements to include EO-critical software supply chain security considerations, where applicable
3.1	**C-SCRM in Acquisition**	• Ensure groupings accommodate EO-critical software supply chain suppliers when segmenting the organization's supplier relationships and contracts • Codify function-based software criticality definitions during the 'plan procurement' step and incorporate EO-critical concepts when justifying the level of criticality
4.3	**Applying C-SCRM Controls to Acquiring Products and Services**	• Extend EO-critical definition considerations to ICT/OT related service providers, where applicable
Appendix C	**Risk Exposure Framework**	• Incorporate EO-critical definition components when determining the organizational acceptable level of risk,

[31] NIST's Definition of Critical Software Under Executive Order (EO) 14028

		particularly within the context of system criticality assessments
Appendix D	**C-SCRM Templates**	• Account for EO-critical definitions when considering automated generation of C-SCRM plan elements, such as supply chain component criticality
Appendix E	**FASCSA**	• Account for risk factors associated with EO-critical definitions when identifying, assessing, and responding to supply chain risk
Appendix G	**C-SCRM Activities in the Risk management Process**	• Incorporate EO-critical component definitions when performing risk management activities that include a reference to criticality as part of (i) frame risk, (ii) assess risk, (iii) respond to risk once determined, and (iv) monitor risk (i.e., FARM process)

Security Measures (SM) for "EO-Critical Software" Use

Following the release of the "Definition of Critical Software Under Executive Order (EO) 14028," NIST subsequently published "Security Measures for 'EO-Critical Software' Use Under Executive Order (EO) 14028" on July 9, 2021.

The security measures contained within this publication are designed to guide the secure use of EO-critical software. Its contents demonstrate two key concepts for federal department and agencies seeking to comply with the EO:

(1) SP 800-161 Rev. 1's C-SCRM controls, control enhancements, and supplemental guidance remain an effective vehicle through which EO-driven software supply chain security controls can be operationalized across the SDLC; and
(2) Software supply chain security measures are essential both internally and for supplier oversight; departments and agencies must recognize that they are critical players in the software supply chain and should, at a minimum, implement the same security controls internally that they impose upon their software suppliers.

The table below outlines the mappings and coverage of the EO's security measures across SP 800-161 Rev. 1's controls, control enhancements, and supplemental guidance outlined in the main body of this document, many of which are included in the C-SCRM controls baseline.

EO Security Measures and their associated [NIST SP 800-53] controls are considered flow-down in that enterprises should require their prime contractors to implement this control and flow down this requirement to relevant sub-tier contractors as part of procurement. These control and security measures are foundational to cybersecurity in every organization.

Federal departments and agencies aligned to SP 800-161 Rev. 1 controls should use the below table to aid conformance with EO Security Measures and ensure their effective application across the software supply chain.

8214
8215
8216 **Table F-2: C-SCRM Control and Security Measure Crosswalk**
8217

Control Identifier	Control Name	C-SCRM Baseline	EO Security Measure
AC-2	**Account Management**	x	1.1, 1.2, 1.3, 2.2
AC-3	**Access Enforcement**	x	2.2
AC-4	**Information Flow Enforcement**		2.4
AC-5	**Separation of Duties**		3.3
AC-6	**Least Privilege**[32]	x[37]	2.2, 3.3
AC-17	**Remote Access**	x	2.4
AT-2	**Literacy Training and Awareness**[37]	x[37]	5.1
AT-3	**Role-based Training**	x	4.5, 5.1, 5.2, 5.3
AU-2	**Event Logging**	x	4.1
AU-3	**Content of Audit Records**	x	4.1
AU-12	**Audit Record Generation**	x	4.1
AU-13	**Monitoring for Information Disclosure**		4.4
AU-14	**Session Audit**		4.4
CA-7	**Continuous Monitoring**[37]	x[37]	3.2, 3.3, 4.1
CM-2	**Baseline Configuration**	x	3.3
CM-3	**Configuration Change Control**		3.3
CM-6	**Configuration Settings**	x	3.3
CM-7	**Least Functionality**	x	3.3
CM-8	**System Component Inventory**	x	2.1, 3.1
CP-3	**Contingency Training**	x	5.2
IA-2	**Identification and Authentication (organizational Users)**	x	1.1, 1.2
IA-4	**Identifier Management**	x	1.1
IA-5	**Authenticator Management**	x	1.1
IA-9	**Service Identification and Authentication**		1.2
IR-2	**Incident Response Training**	x	4.5
PM-5	**System Inventory**		2.1, 3.1
RA-5	**Vulnerability Monitoring and Scanning**	x	3.2, 3.3
RA-9	**Criticality Analysis**		3.1
SC-7	**Boundary Protection**	x	1.4, 4.4
SC-8	**Transmission Confidentiality and Integrity**		2.4
SC-28	**Protection of Information at Rest**		2.3
SI-2	**Flaw Remediation**	x	3.2
SI-3	**Malicious Code Protection**	x	4.3, 4.4
SI-4	**System Monitoring**	x	4.2, 4.3
SI-5	**Security Alerts, Advisories, and Directives**	x	3.2, 3.3, 4.3
SR-8	**Notification Agreements**	x	

8218

8219 The security measures are intended to protect the use of deployed EO-critical software in
8220 agencies' operational environments. Security measures for EO Critical Software are not intended
8221 to be comprehensive, nor are they intended to eliminate the need for other security measures that
8222 federal agencies implement as part of their existing requirements and cybersecurity programs.

[32] While the base control is not addressed within SP 800-161 Rev. 1, the topic at large is addressed through supplemental guidance provided for control enhancements to the base control within SP 800-161 Rev.1

8223 One security measure outlined within the "Security Measures for 'EO-Critical Software' Use
8224 Under Executive Order (EO) 14028" falls outside the scope of SP 800-161 Rev. 1**.** Security
8225 Measure 2.5 outlines a requirement to "back up data, exercise backup restoration, and be
8226 prepared to recover data used by EO-critical software and EO-critical software platforms at any
8227 time from backups". Though relevant to sound C-SCRM practices, controls related to Security
8228 Measure 2.5 are out of scope and therefore not present in SP 800-161 Rev. 1. These controls are
8229 considered out of scope because they are not third-party risk related, and rather focus on
8230 managing the software within a system. That security measure, and any other partial security
8231 measure mappings outside the scope of this document are outlined in the table below.
8232
8233 Departments and agencies seeking to fully conform with all mapped controls across all EO
8234 security measures, regardless of whether they are C-SCRM specific in nature, should use this
8235 table to accelerate conformance.
8236

8237 **Table F-3: C-SCRM Control and Security Measure Crosswalk**
8238

Control Identifier	Control (or Control Enhancement) Name	C-SCRM Baseline	EO Security Measure
AU-4	**Audit Log Storage Capacity**	N/A	4.1
AU-5	**Response to Audit Logging Process Failures**	N/A	4.1
AU-8	**Time Stamps**	N/A	4.1
AU-11	**Audit Record Retention**	N/A	4.1
CA-7	**Continuous Monitoring**	N/A	3.2, 3.3, 4.1
CP-9	**System Backup**	N/A	2.5
CP-10	**System Recovery and Reconstitution**	N/A	2.5
SC-2	**Separation of System and User Functionality**	N/A	1.3
SC-7(15)	**Boundary Protection | Networked Privileged Accesses**	N/A	1.3

8239
8240

Software Verification

The second initiative launched by NIST in response to EO 14028 encompasses the aggregation and codification of recommended minimum practices for software verification. As the name implies, the resulting "Guidelines on Minimum Standards for Developer Verification of Software" released in July 2021 focuses primarily on the perspective of developers supplying secure products and services to organizations within the Federal Government. Those recommended minimum software verifications techniques for developers are listed below[33]:

- Threat modeling to look for design-level security issues
- Automated testing for consistency and to minimize human effort
- Static code scanning to look for top bugs
- Heuristic tools to look for possible hardcoded secrets
- Use of built-in checks and protections
- "Black box" test cases
- Code-based structural test cases
- Historical test cases
- Fuzzing
- Web app scanners, if applicable
- Address included code (libraries, packages, services)

At a minimum, federal department and agencies should familiarize themselves with these guidelines and take action to ensure applicable recommended baseline practices are being performed by their suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Federal departments and agencies should ensure that roles and responsibilities for software verification are made explicit within solicitations and agreements. Suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers who have direct or indirect responsibilities for software development may be held responsible by Federal departments and agencies for the verification of software. In the case of resellers, they should be held responsible for demonstrating that the software is verified. At times, agencies may determine a need for performing software verification activities for example, in cases where the contract should address corrective actions and ongoing maintenance and update requirements.

As with the security measures for critical software use, these recommended baseline practices can be operationalized by departments and agencies through the lens of SP 800-161 Rev. 1. Table F-4 outlines where the minimum software verification techniques can be used by Federal departments and agencies to enhance existing C-SCRM controls, control enhancements, and supplemental guidance:

[33] NIST's Guidelines on Minimum Standards for Developer Verification of Software

8283

8284 **Table F-4: C-SCRM Control and Security Measure Crosswalk**
8285

Control Identifier	Control Name	EO Minimum Software Verification Technique Impact
AU-12	**Audit Record Generation**	• Expand examples of "supply chain auditable events" to include supplier attestation (or third-party validation) that all relevant minimum software verification techniques were performed and passed. Attestation should accompany each installation, deployment, and/or upgrade of software.
SA-3	**System Development Life Cycle**	• Integrate all applicable minimum software verification techniques into a supplier's "traditional SDLC activities"
SA-4	**Acquisition Process**	• Include all applicable minimum software verification techniques into a supplier's "requirements for functional properties, configuration, and implementation information, as well as any development methods, techniques, or practices which may be relevant". To differentiate between assurance activities and their effectiveness, evaluation factors should include means for weighting inclusion of each applicable minimum software verification technique, monitoring, and remediation of resultant findings.
SA-8	**Security Engineering Principles**	• Incorporate threat modelling, fuzzing, and automation to determine "maximum possible ways that the ICT/OT product or service can be misused and abused" by a supplier • Expand supplier's "security mechanisms" to include the built-in checks and protections verification technique • Use address included code verification techniques to enhance supplier "design information system components and elements"
SA-9	**External System Services**	• Ensure minimum software verification techniques and results are documented alongside a supplier's "cyber-supply chain threats, vulnerabilities, and associated risks"
SA-10	**Developer Configuration Management**	• Mandate supplier "developer configuration management activities" incorporates checking included software for known vulnerabilities and application of remediations and/or compensating controls to resolve or mitigate identified vulnerabilities.
SA-11	**Developer Testing and Evaluation**	• Supplement suggested "C-SCRM-relevant testing" with all applicable minimum software verification techniques
SA-15	**Development Process, Standards, and Tools**	• Enhance "threat modelling and vulnerability analysis" activities to include the minimum software verification techniques, where applicable
SA-22	**Unsupported System Components**	• Incorporate automated testing, built-in checks, and address included code (libraries, packages, services) verification techniques to proactively identify unsupported systems or system subcomponents
SR-6	**Supplier Assessment and Reviews**	• Augment "baseline factors and assessment criteria" to include a supplier's minimum software verification techniques, where applicable
SR-9	**Tamper Resistance and Detection**	• Augment "tamper resistance and detection control" to include a supplier's minimum software verification techniques, where applicable

SR-11	**Component Authenticity**	• Use automated scanning and check included software techniques to continuously monitor "configuration control for component service and repair" activities as well as "anti-counterfeit scanning"
SI-7	**Software, Firmware, and Information Integrity**	• Expound on "applicable verification tools" to include all minimum software verification techniques, where applicable
CM-3	**Configuration Change Control**	• Incorporate automated scanning, fuzzing, and other built-in checks and protections into "testing and validation, and documentation of changes" activities to control for supplier misconfiguration risks
CM-6	**Configuration Settings**	• Codify "automated management, application, and verification" activities to include all applicable minimum software verification techniques
CM-10	**Software Usage Restrictions**	• Mandate use of all applicable software verification techniques when utilizing open source software or licensed software (which may also apply to some open source software)

Cybersecurity Labeling for Consumers: Internet of Things (IoT) Devices and Software

The third and final initiative undertaken by NIST in response to EO 14028 is to define cybersecurity IoT labeling criteria and secure software development practices or criteria for a consumer software labeling program. While this initiative remains in its early stages at time of publication, SP 800-161 Rev. 1 does provide tangential guidance on the topic. Federal departments and agencies should consider FISMA as applicable to IoT, and as such, should already be ensuring that applicable security requirements are being addressed when acquiring, configuring and using IoT within their environments. Organizations should refer to the body of existing work on IoT that can be taken into consideration until such a time that new guidance is released as a result of the ongoing efforts.

CISA's *Internet of Things Acquisition Guidance* provides recommendations to the acquisition function on how to apply cybersecurity and C-SCRM principles throughout the acquisition life cycle of IoT devices. This work emphasizes the importance of comprehensively evaluating the supply chains of IoT technologies before buying and deploying them. Guidance is provided within the context of each phase of the acquisition life cycle and covers purchasing, deployment and implementation, and integration with legacy systems.

In addition to the work of CISA, NIST has published an extensive set of guidance which includes NISTIR 8259 *Recommendations for IoT Device Manufacturers: Foundational Activities* as well as NISTIR 8259A *Core Device Cybersecurity Capability Baseline* which address IoT security activities and baseline security capabilities for IoT device manufactures. This work provides specific recommendations for improving how securable manufactured IoT devices are. IoT device manufactures should look to for recommendations on designing secure devices with embedded cybersecurity capabilities, providing customer services to support the cybersecurity of the device across the device life cycle, and generally enhancing the cybersecurity risk management capabilities of customers through their devices.

In general, this publication provides broadly applicable guidance in the form of C-SCRM activities and controls which Federal departments and agencies should consider within the context of IoT. Example areas where activities and controls in this publication can be applied to IoT include the handling and processing of sensitive information, provenance and anti-tampering of IoT devices, and due-diligence on and assessment of IoT suppliers, manufacturers, and their supplied IoT devices.

Emerging software supply chain concepts

Both C-SCRM and software supply chain security disciplines have evolved rapidly in recent years. The release of EO 14028, subsequent roundtables, and cross-industry publications have brought many of these evolutions to the fore. This section seeks to introduce those emerging concepts for departments and agencies looking to adopt industry leading practices, while simultaneously responding to the EO's Section 4 mandate to gather and define new industry standards, tools, and recommended practices in software supply chain security

As with the existing standards, tools, and recommended practices provided above, these emerging concepts are tailored to the context of departments and agencies within the federal space. Given the varying levels of complexity and technical capabilities required to implement these capabilities, they are presented in the Foundational, Sustaining, and Enhancing practices paradigm first introduced in the main body of SP 800-161 Rev. 1. Departments and agencies should use these designations to assist in prioritizing the implementation of these leading software supply chain security capabilities as well as a source of reference when imposing requirements.

As mentioned in the introduction of this appendix, the new standards, tools, and recommended practices are sourced from over 150 position papers submitted in advance NIST's June 2021 Enhancing Software Supply Chain Security Workshop, federal software supply chain security working groups, as well as an array of public and private industry partnerships.

Software Bill of Materials (SBOM)

The US Department of Commerce's National Telecommunications and Information Administration (NTIA) is the designated lead for producing SBOM guidance featured prominently within the EO. An SBOM is defined as a "formal record containing the details and supply chain relationships of various components used in building software," similar to food ingredient labels on packaging. The intent of SBOMs is to provide increased transparency, provenance, and speed at which vulnerabilities can be identified and remediated by departments and agencies. SBOMs as well as their currency can be indicative of a developer or suppliers' application of secure software development practices across the SDLC. Figure F-1 illustrates how an SBOM may be assembled across the SDLC.

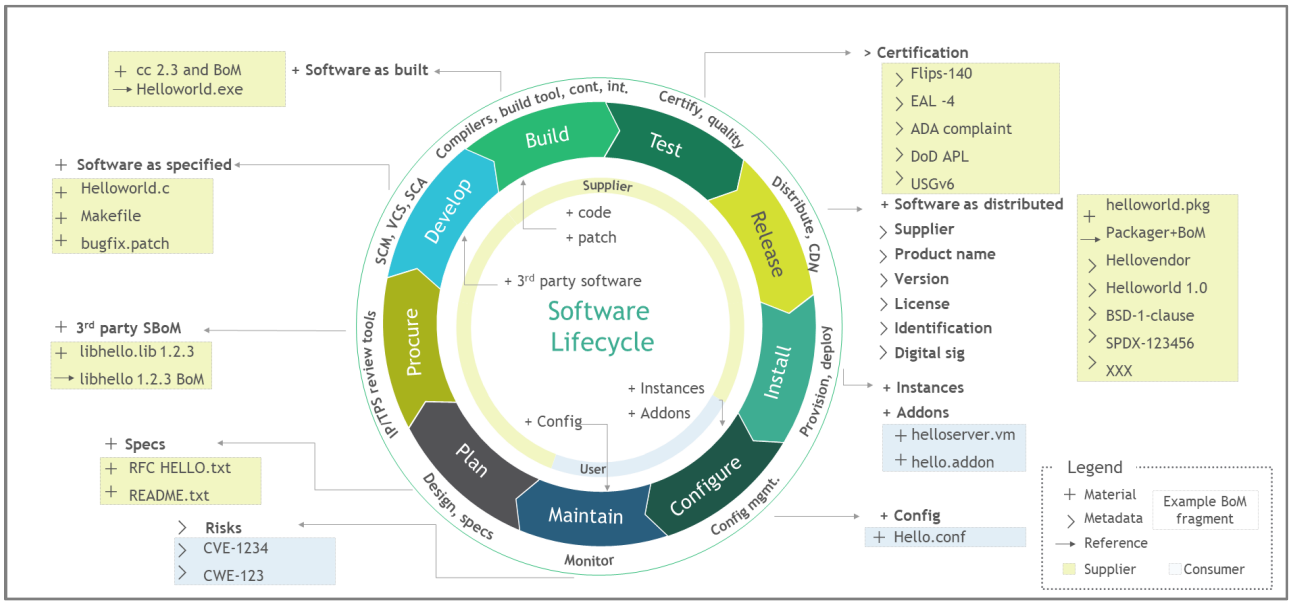


Fig. F-1: Software Life Cycle & Bill of Materials Assembly Line

Departments and agencies should ensure that their suppliers of software products and services are able to produce SBOMs in conformance with the EO and NTIA's published guidelines by containing:

- **Data Fields:** Documenting baseline information about each component that should be tracked
- **Automation Support:** Allowing for scaling across the software ecosystem through automatic generation and machine-readability
- **Practices and Processes:** Defining the operations of SBOM requests, generation, and use

Departments and agencies, where possible and applicable, should require their suppliers to demonstrate they are implementing, or have implemented, these foundational SBOM components and functionality along with the following capabilities:

Foundational Capabilities

- Ensure SBOMs conform to industry standards formats to enable automated ingestions and monitoring of versions. Acceptable standard formats currently include SPDX, Cyclone DX, and SWID[34].
- Ensure that comprehensive and current SBOMs are available for all classes of software including purchased software, open source software, and in-house software, by requiring subtier software suppliers to produce, maintain, and provide SBOMs

[34] NTIA's Minimum Elements for a Software Bill of Materials. For additional information on the graphic, see https://www.ntia.gov/

- Maintain readily accessible SBOM repositories, posting publicly when required

Sustaining Capabilities

- Contextualize SBOM data with additional data elements that inform the risk posture of the acquiring entity. Additional data elements include plug-ins, hardware components, organizational controls, and other community-provided components[35]
- Integrate vulnerability detection with SBOM repositories to enable automated alerting of any cybersecurity risk in the supply chain[36]

Enhancing Capabilities

- Incorporate artificial intelligence and machine learning (AI/ML) considerations into SBOMs to monitor risks relating to the testing and training of datasets for ML models[37]
- Develop risk monitoring and scoring components to dynamically monitor the impact of SBOMs' vulnerability disclosures to the acquiring organization. Align with asset inventories for further risk exposure and criticality calculations.[38]

Enhanced vendor risk assessments

With the EO raising the bar for software verifications techniques and other software supply chain controls, additional scrutiny is being paid upon not just the software the vendors produce, but the business entities within a given software supply chain that may sell, distribute, store, or otherwise have access to the software code themselves. Departments and agencies looking to further enhance assessment of supplier software supply chain controls can perform additional scrutiny on vendor SDLC capabilities, security posture, and risks associated with foreign ownership, control, or influence (FOCI).

The following capabilities provide additional vendor risk assessment controls outlined within the main body of 800-161 Rev. 1 and its corresponding supplier assessment template:

Foundational Capabilities

- Perform outside-in analyses of vendors utilizing open source data and, as resources permit, commercially available third-party assessment and security ratings platforms. Acquirers with access to confidential information may further supplement these outside-in analyses.
- Require vendors' describe and, at a minimum, self-attest to their commitment and capabilities for securing software throughout the SDLC

[35] GitLab's NIST Position Paper: Area #5
[36] VigilantOps NIST Position Paper: Section 4 Enhancing Software Supply Chain Security
[37] Accenture NIST Position Paper: Minimum Secure Software Development Testing Requirements at Scale and Pace
[38] Synopsis NIST Position Paper: Guidelines for software integrity chains and provenance

Sustaining Capabilities

- Extend foundational capability details to subsidiary suppliers designated within an SBOM, to the extent feasible.
- Include flow-down requirements to sub-tier suppliers in agreements pertaining to the secure development, delivery, operational support, and maintenance of software.
- Preference or mandate the use of suppliers that provide a software security label or data sheet which should include information about the software itself, the tools and technologies used to build the software, security tools and processes governing the software, and the people involved in building the software for all provided products[1]

Enhancing Capabilities

- Automatically verify hashes/signatures infrastructure for all vendor-supplied software installation and updates[2]
- Ensure suppliers attest to and provide evidence of utilizing automated build deployments, including pre-production testing, automatic rollbacks, and staggered production deployments[3]
- Enforce just-in-time credentials for supplier build systems[39]
- Ensure suppliers attest to utilizing automated build deployments, including pre-production testing, automatic rollbacks, and staggered production deployments[40]

Open source software controls

As stated in the EO, "ensuring and attesting, to the extent practicable, to the integrity and provenance of open source software used within any portion of a product" is a central driver behind many of flagship initiatives like the SBOM. Though organizations should enforce formal baseline software supply chain security controls regardless of where and how code is developed, the risks of using open source or community developed software are unique. Open source projects are diverse, numerous, and use a wide range of operating models. Many of these projects' provenance, integrity, support maintenance, and other underlying functions are not well understood or easy to discover and vary from one project to the next.

Open source components are pervasive and as such, Federal departments and agencies should seek to better understand their suppliers' usage of open source components by considering the below capabilities:

[1] Contrast Security NIST Position Paper Initial list of secure software development life cycle standards
[2] Enduring Security Framework User Subgroup Working Paper
[3] Amazon Web Services NIST Position Paper
[39] Enduring Security Framework User Subgroup Working Paper
[40] Amazon Web Services NIST Position Paper

Foundational Capabilities

- Utilize Software Composition Analysis (SCA) tools to identify any publicly known vulnerabilities of supplied source code. SCA tools can also be utilized to determine whether in-house developed codebases leverage vulnerable open source code components.
- Apply procedural and technical controls to ensure that open source code is acquired via secure channels from well-known and trustworthy repositories[41]

Sustaining Capabilities

- Supplement SCA source code-based reviews with binary software composition analyses to identify vulnerable components that could have been introduced during build and run activities[42]
- Set up a centralized repository and/or library of open source code that developers may utilize as a part of a robust continuous integration continuous delivery (CI/CD) pipeline

Enhancing Capabilities

- Exclude the use of inherently vulnerable programming languages and frameworks that do not have built in guardrails to proactively mitigate common types of vulnerabilities[43]
- Automate the open source pipeline of collection, storage, and scanning of codebases to designated, hardened internal repositories and/or sandboxes prior to introduction into development environments

Vulnerability management practices

Vulnerabilities are discovered by a variety of sources. Developers of software may find security bugs in already deployed code. Security researchers and penetration testers may find vulnerabilities by scanning or manually testing software and accessible systems (following published rules of behavior) [DRAFT NIST SP 800-216]. As such, effectively identifying, triaging, remediating, and reporting on vulnerabilities is a central pillar of the EO. In its discussion of Zero Trust architecture, the EO recognizes that discovering vulnerabilities are inevitable and departments and agencies' strategies should therefore focus on how to manage those vulnerabilities once discovered efficiently and comprehensively.

Aside from adhering to NIST's existing Vulnerability Disclosure Program guidance documented within NIST SP 800-216, which addresses reporting, coordinating, publishing, and receiving information about security vulnerabilities, departments and agencies can impose a range of activities and capabilities from its suppliers that will enable comprehensive and timely management of vulnerabilities:

[41] Broadcom and Symantec NIST Position Paper
[42] BlackBerry NIST Position Paper
[43] Google NIST Position Paper

Foundational Capabilities

- Demonstrate utilization of effective change control, automation, robust CI/CD, and DevSecOps practices to mitigate common vulnerabilities
- Integrate SBOMs, vulnerability databases, and reporting mechanisms to ensure departments and agencies rapidly receive notification of recently released vulnerabilities

Sustaining Capabilities

- Adhere to a coordinated vulnerability disclosure (CVD) practice to ensure that departments and agencies are able to remediate vulnerabilities in a timely manner [44]
- Establish a formal, publicly available means by which the public can notify the supplier of uncovered vulnerabilities[45]

Enhancing Capabilities

- Engage suppliers that are staff defined product security incident response teams (PSIRT) and/or internal research team dedicated to the identification, triage, and remediation across the supplier's product/service suite[46]
- Suppliers should have a formalized bug bounty program that incentivizes discovery and proactive remediation of vulnerabilities before adversaries are able to utilize them

Key Takeaways

- **Using this appendix.** Federal departments and agencies should utilize this appendix to contextualize their application of any existing SP 800-161 Rev. 1 controls upon their suppliers, and, where feasible should adopt new software supply chain security recommendations that previously fell outside of the explicit scope of SP 800-161 Rev. 1.

- **Relationship of SP 800-161 Rev. 1 to the EO.** This publication serves as a lens for understanding the targeted EO directives which include 1) Critical Software, 2) Minimum Standard for Vendor or Developer Verification of Code, and 3) Cybersecurity Labeling for Consumers: Internet of Things (IoT) Devices and Software. This publication serves as a complement to tangential workstreams by NIST, NTIA, NSA, DOD, CISA, and OMB.

- **Emerging Software Supply Chain Concepts.** This publication offers recommended practices against emerging software supply chain concepts which include Software Bill of Materials (SBOM), Enhanced vendor risk assessments, Open source software Controls, and Vulnerability Management practices. Organizations should prioritize, tailor, and implement these practices and capabilities by applying this publication's Foundational, Sustaining, and Enhancing practices paradigm as a source of reference.

[44] CERT/CC NIST Position Paper
[45] GitLab NIST Position Paper
[46] Synopsis NIST Position Paper

Additional existing industry standards, tools, and recommended practices

Though the existing industry standards, tools, and recommended practices have been presented through the lens of SP 800-161 Rev. 1, additional conversation on software supply chain security extends far beyond this document. Federal departments and agencies looking for additional industry standards, tools, and recommended practices on software supply chain security should reference the following cross-industry publications listed in Table F-5.

Table F-5: Existing Industry Standards, Tools, and Recommended Practices

Source	Description
The BSA Framework for Secure Software: A New Approach to Securing the Software Lifecycle, Version 1.1	The Framework offers an outcome-focused, standards-based risk management tool to help stakeholders in the software industry – developers, vendors, customers, policymakers, and others – communicate and evaluate security outcomes associated with specific software products and services
Building Security in Maturity Model (BSIMM) Version 11.	A study of existing software security initiatives across 100+ different organizations that provides organizations a baseline of activities for software security
CISA's Defending Against Software Supply Chain Attacks	Provides an overview of software supply chain risks and recommendations on how software customers and vendors can use the NIST Cybersecurity Supply Chain Risk Management (C-SCRM) framework and the Secure Software Development Framework (SSDF) to identify, assess, and mitigate risks.
CISA's Internet of Things Security Acquisition Guidance	Provides recommendations to the acquisition function of an organization about how to apply cybersecurity and supply chain risk management (C-SCRM) principles and practices throughout the acquisition life cycle when purchasing, deploying, operating, and maintaining Internet of Things (IoT) devices, systems, and services
Cyber Security & Information Systems Information Analysis Center (CSIAC) Software Assurance (SWA)	Explores different aspects of software assurance competencies that can be used to improve software assurance functions and how to develop/deploy assured software throughout the life cycle acquisition process

IDASOAR: Institute for Defense Analyses (IDA), State-of-the-Art Resources (SOAR) for Software Vulnerability Detection, Test, and Evaluation 2016	Written to enable DoD program managers (PMs), and their staff, to make effective software assurance and software supply chain risk management (SCRM) decisions, particularly when they are developing and executing their program protection plan and inform DoD policymakers who are developing software policies
ISO/IEC 27036 Information security for supplier relationships	A multi-part standard offering guidance on the evaluation and treatment of information risks involved in the acquisition of goods and services from suppliers.
ISO/IEC 27034-1:2011 Information technology – Security techniques – Application security – Part 1: Overview and concepts	Presents an overview of application security. It introduces definitions, concepts, principles and processes involved in application security.
ISO/IEC 20243-1:2018 Information technology — Open Trusted Technology ProviderTM Standard (O-TTPS) — Mitigating maliciously tainted and counterfeit products — Part 1: Requirements and recommendations	A set of guidelines, requirements, and recommendations that address specific threats to the integrity of hardware and software COTS ICT products throughout the product life cycle
MSSDL: Microsoft, Security Development Life Cycle	Introduces security and privacy considerations throughout all phases of the development process, helping developers build highly secure software, address security compliance requirements, and reduce development costs
National Defense Industrial Association (NDIA) Engineering for System Assurance	Provides guidance on how to build assurance into a system throughout its life cycle as well as identifies and discusses systems engineering activities, processes, tools, and considerations to address system assurance
NIST CSF: NIST, Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1	Voluntary guidance, based on existing standards, guidelines, and practices for organizations to better manage and reduce cybersecurity risk. In addition to helping organizations manage and reduce risks, it was designed to foster risk and cybersecurity management

	communications amongst both internal and external organizational stakeholders
NISTIR 8259 Foundational Cybersecurity Activities for IoT Device Manufacturers	Describes recommended activities related to cybersecurity that manufacturers should consider performing before their IoT devices are sold to customers
NISTIR 8259A Core Device Cybersecurity Capability Baseline	Defines a baseline set of device cybersecurity capabilities that organizations should consider when confronting the challenge of the Internet of Things (IoT)
OWASP DevSecOps Maturity Model (DSOMM)	Shows security measures which are applied when using DevOps strategies and how these can be prioritized
Open Web Application Security Project (2020) *OWASP Application Security Verification Standard 4.0.2*.	Provides a basis for testing web application technical security controls and also provides developers with a list of requirements for secure development
Payment Card Industry (PCI) Security Standards Council (2021) *Secure Software Lifecycle (Secure SLC) Requirements and Assessment Procedures Version 1.1*	Provides a baseline of security requirements with corresponding assessment procedures and guidance to help software vendors design, develop, and maintain secure software throughout the software lifecycle
SAMM15: OWASP, Software Assurance Maturity Model Version 1.5	An open framework to help organizations formulate and implement a strategy for software security that is tailored to the specific risks facing the organization

SCAGILE: Software Assurance Forum for Excellence in Code (SAFECode), Practical Security Stories and Security Tasks for Agile Development Environments	Translates secure development practices into a language and format that Agile practitioners can more readily act upon as part of a standard Agile methodology
SCFPSSD: SAFECode, Fundamental Practices for Secure Software Development: Essential Elements of a Secure Development Life Cycle Program, Third Edition	Authoritative best practices guide written by SAFECode members to help software developers, development organizations and technology users initiate or improve their software assurance programs and encourage the industry-wide adoption of fundamental secure development practices
SCSIC: SAFECode, Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain	Focuses on examining the software integrity element of software assurance and provides insight into the controls that SAFECode members have identified as effective for minimizing the risks that intentional and unintentional vulnerabilities could be inserted into the software supply chain
SCTPC: SAFECode, Managing Security Risks Inherent in the Use of Third-Party Components	Provides a blueprint for how to identify, assess, and manage the security risks associated with the use of third-party components
SCTTM: SAFECode, Tactical Threat Modeling	Provides guidance about the process of threat modeling as well as the "generic" framework in which a successful threat-modeling effort can be conducted
SP 800-181: NIST, National Initiative for Cybersecurity Education (NICE) Cybersecurity Workforce Framework	A fundamental reference for describing and sharing information about cybersecurity work. It expresses that work as Task statements and describes Knowledge and Skill statements that provide a foundation for learners including students, job seekers, and employees
SP 800-53 Revision 5: Joint Task Force Transformation Initiative, Security and Privacy Controls for Federal Information Systems and Organizations	Provides a catalog of security and privacy controls for information systems and organizations to protect organizational operations and assets, individuals, other organizations, and the Nation from a diverse set of threats and risks, including hostile attacks, human errors, natural disasters, structural failures, foreign intelligence entities, and privacy risks;

SP 800-53A Rev. 4, Assessing Security and Privacy Controls in Federal Information Systems and Organizations: Building Effective Assessment Plans	Provides a set of procedures for conducting assessments of security controls and privacy controls employed within federal information systems and organizations.
SP 800-53 B, Control Baselines for Information Systems and Organizations	Provides security and privacy control baselines for the Federal Government. There are three security control baselines (one for each system impact level—low-impact, moderate-impact, and high-impact), as well as a privacy baseline that is applied to systems irrespective of impact level
SP 800-160 Volume 1: NIST, Systems Security Engineering: Considerations for a Multidisciplinary Approach in the Engineering of Trustworthy Secure Systems	Addresses the engineering-driven perspective and actions necessary to develop more defensible and survivable systems, inclusive of the machine, physical, and human components that compose the systems and the capabilities and services delivered by those systems;
Draft NIST SP 800-216 Recommendations for Federal Vulnerability Disclosure Guidelines	Recommends guidance for establishing a federal vulnerability disclosure framework and highlights the importance of proper handling of vulnerability reports and communicating the minimization or elimination of vulnerabilities

8551

8552

APPENDIX G: C-SCRM ACTIVITIES IN THE RISK MANAGEMENT PROCESS

Risk management is a comprehensive process that requires enterprises to: (i) frame risk (i.e., establish the context for risk-based decisions); (ii) assess risk; (iii) respond to risk once determined; and (iv) monitor risk on an ongoing basis using effective enterprise communications and a feedback loop for continuous improvement in the risk-related activities of enterprises. Figure G-1 depicts interrelationships among the risk management process steps, including the order in which each analysis may be executed, and the interactions required to ensure that the analysis is inclusive of the various inputs at the enterprise, mission, and operations levels.

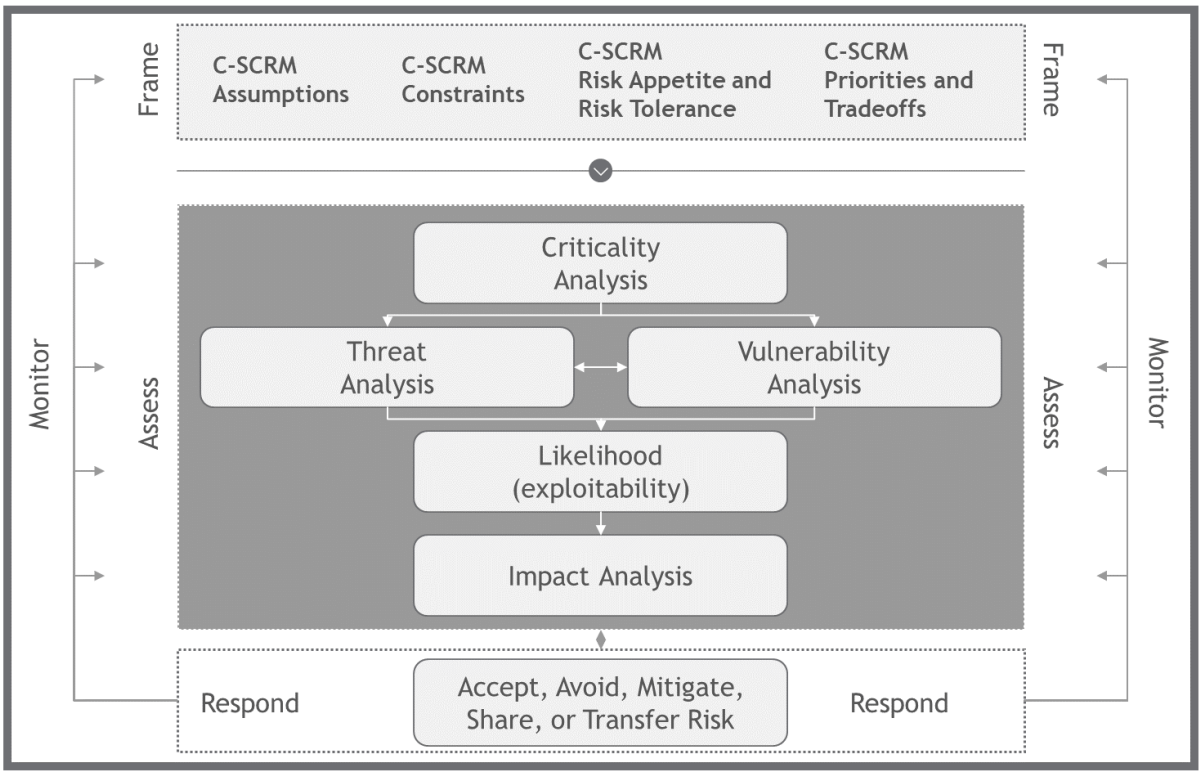


Fig. G-1: Cybersecurity Supply Chain Risk Management (C-SCRM)

The steps in the risk management process (Frame, Assess, Respond, and Monitor) are iterative and not inherently sequential in nature. Different individuals may be required to perform the steps at the same time depending on a particular need or situation. Enterprises have significant flexibility in how the risk management steps are performed (e.g., sequence, degree of rigor, formality, and thoroughness of application) and in how the results of each step are captured and shared—both internally and externally. The outputs from a particular risk management step will directly impact one or more of the other risk management steps in the risk management process.

Figure G-2 summarizes C-SCRM activities throughout the risk management process as they are performed within the three risk framework levels. The arrows between different steps of the risk management process depict simultaneous flow of information and guidance among the steps. Together the arrows indicate that the inputs, activities, and outputs are continuously interacting and influencing one another. More details are provided in the forthcoming subsections.

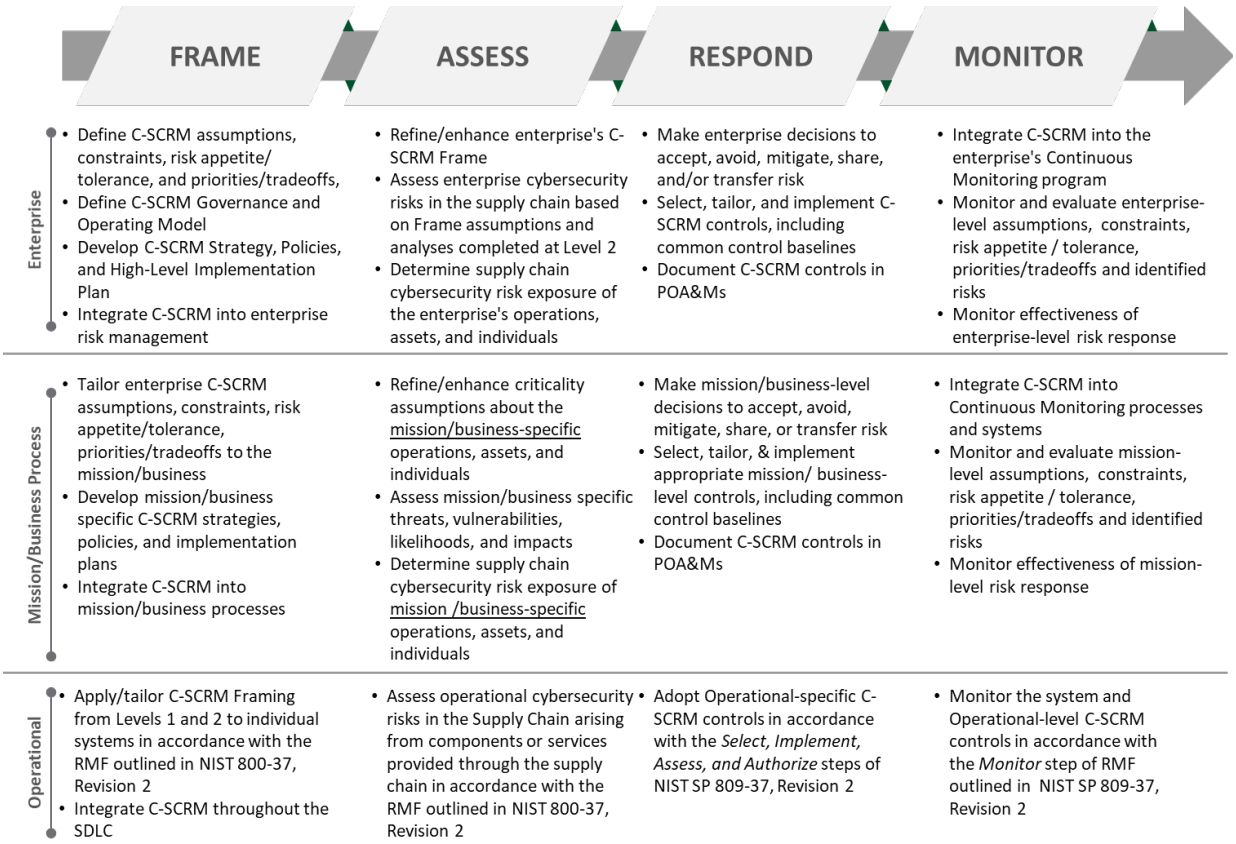


Fig. G-2: C-SCRM Activities in the Risk Management Process[47]

Figure G-2 depicts interrelationships among the risk management process steps including the order in which each analysis is executed, and the interactions required to ensure the analysis is inclusive of the various inputs at the enterprise, mission and business process, and operational levels.

The remainder of this section provides a detailed description of C-SCRM activities within the Frame, Assess, Respond, and Monitor steps of the Risk Management Process. The structure of subsections *Frame* through *Monitor* mirrors the structure of [NIST SP 800-39], Sections 3.1-3.4. For each step of the Risk Management Process (i.e., Frame, Assess, Respond, Monitor), the structure includes Inputs and Preconditions, Activities, and Outputs and Post-Conditions. Activities are further organized into Tasks according to [NIST SP 800-39]. [NIST SP 800-161 Rev 1.] cites the steps and tasks of the risk management process but rather than repeating any other content of [NIST SP 800-39], it provides C-SCRM-specific guidance for each step with its Inputs and Preconditions, Activities with corresponding Tasks, and Outputs and Post-Conditions. [NIST SP 800-161 Rev. 1] adds one task to the tasks provided in [NIST SP 800-39], under the Assess step: Task 2-0, *Criticality Analysis*.

[47] More detailed information on the Risk Management Process can be found in Appendix C

TARGET AUDIENCE

The target audience for this appendix is those individuals with specific C-SCRM responsibilities for performing the supply chain risk management process across and at each level. Examples include those process/functional staff responsible for defining the frameworks and methodologies used by the rest of the enterprise (e.g., C-SCRM PMO Processes, Enterprise Risk Management, Mission/Business Process Risk Managers, etc.). Other personnel or entities are free to make use of the guidance as appropriate to their situation.

ENTERPRISE-WIDE RISK MANAGEMENT & THE RMF

Managing cybersecurity risk in the supply chain requires a concerted and purposeful effort by enterprises across enterprise, mission/business process, and operational-levels. This document describes two different but complementary risk management approaches which are iteratively combined to facilitate effective risk management across the 3 levels.

The first approach known as FARM consists of 4 steps: Frame, Assess, Respond, Monitor. FARM is primarily used at Levels 1 and 2 to establish the enterprise's risk context and inherent exposure to risk. Then, the risk context from Levels 1 and 2 iteratively informs activities performed as part of the second approach described in [NIST SP 800-37r2] The Risk Management Framework (RMF). The RMF predominantly operates at Level 3[48] – the operational level, and consists of 7 process steps: Prepare, Categorize, Select, Implement, Assess, Authorize, Monitor. Within the RMF, inputs from FARM at Levels 1 and 2 are synthesized as part of the RMF Prepare step, then iteratively applied, tailored and updated through each successive step of the RMF. Ultimately Level 1 and 2 assumptions are iteratively customized and tailored to fit the specific operational-level or procurement-action context. For example, an enterprise may decide on strategic priorities and threats at Level 1 (enterprise level), which inform the criticality determination of missions/business processes at Level 2, which in turn influence the system categorization, control selection, and control implementation as part of the RMF at Level 3 (operational-level). Information flow between the levels is bidirectional with aggregated Level 3 RMF outputs serving to update and refine assumptions made at Levels 1 and 2 on a periodic basis.

Frame

Inputs and Preconditions

Frame is the step that establishes context for C-SCRM in all three levels. The scope and structure of the enterprise supply chain, the overall risk management strategy, specific enterprise, mission and business process strategies and plans, and individual information systems are defined in this step. The data and information collected during Frame provides inputs for scoping and fine-tuning C-SCRM activities in other risk management process steps throughout the three levels. Frame is also where guidance in the form of frameworks and methodologies is established as part of the enterprise and mission/business process level risk management strategies. These

[48] The RMF does have some applications at Levels 1 and 2 such as the identification of common controls.

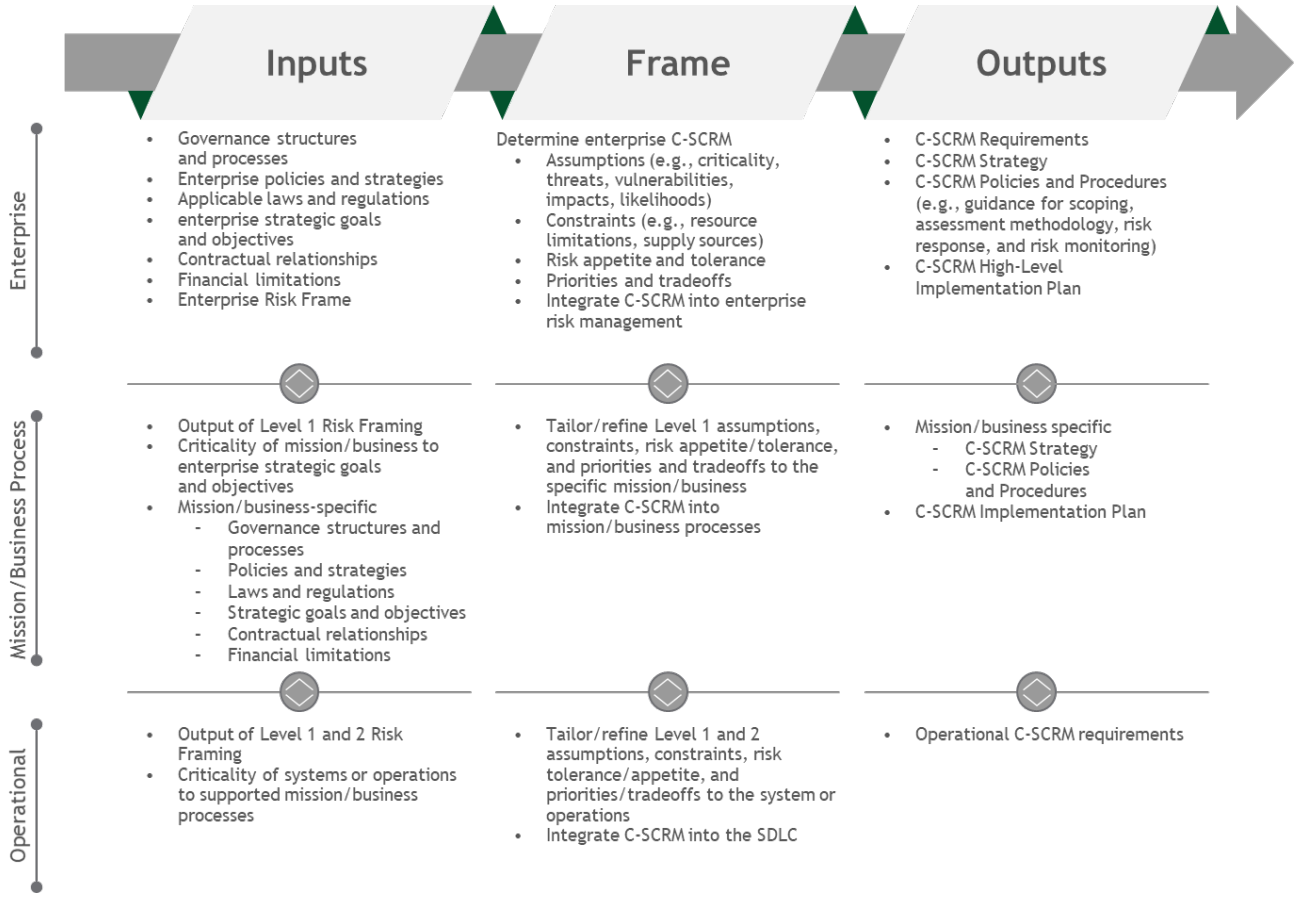
frameworks and methodologies provide bounds, standardization, and orientation for supply chain risk management activities performed within later steps.

[NIST SP 800-39] defines risk framing as "the set of assumptions, constraints, risk tolerances, and priorities/trade-offs that shape an enterprise's approach for managing risk." Enterprise-wide and C-SCRM risk framing activities should iteratively inform one another. Assumptions the enterprise makes about risk should flow down and inform risk framing within C-SCRM activities (e.g., enterprise's strategic priorities). As the enterprise's assumptions about cybersecurity risk in the supply chain evolve through the execution of C-SCRM activities, these assumptions should flow up and inform how risk is framed at the enterprise level (e.g., level of risk exposure to individual suppliers). Inputs into the C-SCRM risk framing process include, but are not limited to:

- Enterprise policies, strategies, and governance
- Applicable laws and regulations
- Agency critical suppliers and contractual services
- Enterprise processes (security, quality, etc.)
- Enterprise threats, vulnerabilities, risks, and risk tolerance
- Enterprise architecture
- Mission-level goals and objectives
- Criticality of missions/processes
- Mission-level security policies
- Functional requirements
- Criticality of supplied system/product components
- Security requirements

C-SCRM risk framing is an iterative process that also uses inputs from the other steps of the risk management processes (Assess, Respond, and Monitor) as inputs. Figure D-3 depicts the Frame Step with its inputs and outputs along the three enterprise levels. At the enterprise level, activities will focus on framing conditions (i.e., assumptions, constraints, appetites and tolerances, and priorities and tradeoffs) that are broadly applicable across the enterprise and its enterprises. The goal of framing is to contextualize cybersecurity risk in the supply chain to the enterprise and enterprise's strategic goals and objectives. At the mission/business process level, frame activities focus on the individual mission and business process segments (e.g., assumptions about a technology assets or service provider's role in enabling enterprise-level objectives to be met). Level 2 frame activities take cybersecurity risk in the supply chain conditions framed at Level 1, and tailor and contextualize them to reflect the role cybersecurity risk in the supply chain has in each individual mission/business process to meet operational objectives. Finally, at Level 3, conditions outlined at Levels 1 and 2 iteratively inform each step of the RMF process. Beginning with the Prepare step, conditions outlined at Levels 1 and 2 are used to establish the context and priorities for managing cybersecurity risk in the supply chain with respect to individual information systems, supplied system components, and system services providers. Then with each subsequent RMF step (Categorize through Monitor), these assumptions are iteratively updated and tailored to reflect applicable operational-level considerations. Information flow must be bi-directional between levels as insights discovered

8684 while performing lower-level activities may update what is known about conditions outlined in
8685 higher levels.
8686
8687



8688

8689 **Fig. G-3: C-SCRM in the Frame Step**

8690
8691 Figures G-3-G-6 depict inputs, activities, and outputs of the Frame Step distributed along the
8692 three risk management framework levels. The large arrows on the left and right sides of the
8693 activities depict the inputs and outputs to and from other steps of the Risk Management Process,
8694 with the arrow on the left depicting that steps are in constant interaction. Inputs into the Frame
8695 Step include inputs from other steps as well as inputs from the enterprise risk management
8696 process that are shaping the C-SCRM process. Up-down arrows between the levels depict flow
8697 of information and guidance from the upper levels to the lower levels and the flow of
8698 information and feedback from the lower levels to the upper levels. Together the arrows indicate
8699 that the inputs, activities, and outputs are continuously interacting and influencing one another.
8700
8701 As the Frame step is used to define the cybersecurity risk in the supply chain conditions,
8702 enterprises may find that Frame activities are performed relatively less often than the latter steps
8703 of the FARM process. Enterprises may re-perform Frame activities at defined intervals (e.g.,

annually, bi-annually) or based on defined triggers (e.g., based on business changes and/or new or updated insights from other levels).

Activities

RISK ASSUMPTIONS

TASK 1-1: Identify assumptions that affect how risk is assessed, responded to, and monitored within the enterprise.

Supplemental Guidance

As a part of identifying risk assumptions within the broader Risk Management process (described in [NIST SP 800-39]), agencies should do the following:

- Develop an enterprise-wide C-SCRM policy;
- Identify which mission and business processes and related components are critical to the enterprise to determine the *criticality*;
- Define which mission and business processes and information systems compose the supply chain, including relevant contracted services and commercial products;
- Prioritize the application of risk treatment for these critical elements, considering factors such as but not limited to national and homeland security concerns, FIPS 199 impact level, scope of use, or interconnections/interdependencies to other critical processes and assets;
- Identify, characterize, and provide representative examples of *threat sources, vulnerabilities, consequences/impacts*, and *likelihood* determinations related to supply chain;
- Define C-SCRM mission, business, and operational-level requirements;
- Select appropriate assessment methodologies for cybersecurity risk in the supply chain, depending on enterprise governance, culture, and diversity of the mission and business processes;
- Establish a method for the results of C-SCRM activities to be integrated into the overall agency Risk Management Process;
- Periodically review the supply chain to ensure definition remains current as evolutions occur over time.

These risk assumptions should be aligned as applicable to the enterprise's broader set of risk assumptions defined as part of the enterprise risk management program. A key C-SCRM responsibility (e.g., of the C-SCRM PMO) is identifying which of those assumptions apply to the cybersecurity risk in the supply chain context at each successive risk management framework level. If and when new C-SCRM assumptions are identified, these should be provided as updates to the enterprise risk assumptions as part of an iterative process.

Criticality

Critical processes are those processes, which if disrupted, corrupted or disabled, are likely to result in mission degradation or failure. Mission-critical processes are dependent on their

supporting systems that in turn depend on critical components in those systems (hardware, software, and firmware). Mission-critical processes also depend on information and processes (performed by technology or people, to include in some instances, support service contractors), that are used to execute the critical processes. Those components and processes that underpin and enable mission-critical processes or deliver defensive—and often commonly shared—processes (e.g., access control, identity management, and crypto) and unmediated access (e.g., power supply) should also be considered critical. A criticality analysis is the primary method by which mission-critical processes, associated systems/components, and enabling infrastructure and support services are identified and prioritized. The criticality analysis also involves analyzing critical suppliers which may not be captured by internal criticality analysis (e.g., supply chain interdependencies including 4th and 5th party suppliers).

Enterprises will make criticality determinations as part of enterprise risk management activities based on the process outlined in [NISTIR 8179].[49] Where possible, C-SCRM should inherit those assumptions and tailor/refine them to include the C-SCRM context. In C-SCRM, criticality tailoring includes initial criticality analysis of particular projects, products, and processes in the supply chain in relation to critical processes at each Level. For example, at Level 1 the enterprise may determine the criticality of holistic supplier relationships to the enterprise's overall strategic objectives. Then at Level 2, the enterprise may assess the criticality of individual suppliers, products and services to specific mission/business processes and strategic/operational objectives. Finally, at Level 3, the enterprise may assess the criticality of the supplied product or service to specific operational state objectives of the information systems.

Enterprises may begin by identifying key supplier-provided products or services which contribute to the operation and resiliency of enterprise processes and systems. The criticality determination may be based on the role of each supplier, product, or service in achieving the required strategic or operational objective of the process or system. Requirements, architecture, and design inform the analysis and help identify the minimum set of supplier-provided products and/or services required for operations (i.e., at enterprise, mission/business process, and operational-levels). The analysis combines top-down and bottom-up analysis approaches. The top-down approach in this model enables the enterprise to identify critical processes and then progressively narrow the analysis to critical systems that support those processes, and finally to critical components which support the critical functions of those systems. The bottom-up approach progressively traces the impact of a malfunctioning, compromised, or unavailable critical component would have on the system, and in turn, on the related mission and business process.

Enterprises performing this analysis should include agency system and cybersecurity supply chain dependencies, to include critical 4th-party suppliers. For example, an enterprise may find exposures to cybersecurity risk in the supply chain that result from 3rd-party suppliers receiving critical input or services from a common 4th-party supplier.

Determining criticality is an iterative process performed at all levels during both Frame and Assess. In Frame, criticality determination is expected to be performed at a high level, using the

[49] NISTIR 8179: Criticality Analysis Process Model: Prioritizing Systems and Components

available information with further detail incorporated through additional iterations or at the Assess step. Determining criticality may include, but is not limited to, the following:

- Define criticality analysis procedures to ensure there is a set of documented procedures to guide the enterprise's criticality analysis across levels;
- Conduct enterprise and mission-level criticality analysis to identify and prioritize enterprise and mission objectives, goals and requirements;
- Conduct operational-level criticality analysis (i.e., systems and subsystems) to identify and prioritize critical workflow paths, system functionalities and capabilities;
- Conduct system and subsystem component-level criticality analysis to identify and prioritize key system and subsystem inputs (e.g., COTS products);
- Conduct detailed review (e.g., bottom-up analysis) of impacts and interactions between enterprise, mission, system/sub systems, and components/subcomponents to ensure cross-process interaction and collaboration.

Given the potential impact a supply chain incident may have to an organization's operations, assets, and in some instances, its business partners or customers, it is important for organizations to ensure that in addition to criticality, materiality considerations are built into their supply chain risk management strategy, risk assessment practices and overall governance of supply chain risks.

Please note that criticality can be determined for existing systems or for future system investments, development, or integration efforts based on system architecture and design. It is an iterative activity that should be performed when a change warranting iteration is identified in the Monitor step.

Threat Sources

For C-SCRM, threat sources include: (i) adversarial threats such as cyber/physical attacks either to the supply chain or to an information system component(s) traversing the supply chain; (ii) accidental human errors; (iii) structural failures which include failure of equipment, environmental controls, resource depletion; and (iv) environmental threats such as geopolitical disruptions, pandemics, economic upheavals, and natural or man-made disasters; a. With regard to adversarial threats, [NIST SP 800-39] states that enterprises provide a succinct characterization of the types of tactics, techniques, and procedures employed by adversaries that are to be addressed by safeguards and countermeasures (i.e., security controls) deployed at Level 1 (enterprise-level), at Level 2 (mission/business process level), and at Level 3 (information system/services level)—making explicit the types of threat sources to be addressed as well as making explicit the threat sources not being addressed by the safeguards/countermeasures.

Threat information can include but is not limited to historical threat data, factual threat data, or business entity (e.g., suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers) or technology-specific threat information. Threat information may come from multiple information sources, including the U.S. Intelligence Community (for federal agencies), DHS, CISA, the FBI, Information Sharing and Analysis Centers (ISAC), as well as open source reporting such as news and trade publications, partners,

suppliers, and customers. When applicable, enterprises may rely on the Federal Acquisition Security Council's (FASC) Information Sharing Agency (ISA) for supply chain threat information in addition the aforementioned sources. As threat information may include classified intelligence, it is crucial that departments and agencies have the capabilities required to process classified intelligence. Threat information obtained as part of the Frame step should be used to document the enterprise's long-term assumptions about threat conditions based on its unique internal and external characteristics. During the Assess step, updated information is infused into the risk assessment to account for short-term variations in threat conditions (e.g., due to geopolitical circumstances) as well as to obtain supply chain threat information that is specifically relevant and essential to inform the risk-based analysis and decision-making concerning the procurement of a given product or a service.

Information about the supply chain (such as supply chain maps) provides the context for identifying possible locations or access points for threat sources and agents to affect the supply chain. The supply chain cybersecurity threats are similar to the information security threats, such as disasters, attackers, or industrial spies. Table G-1 lists examples of supply chain cybersecurity threat agents. Appendix G provides Risk Response Plans that provide examples of the Supply Chain Threat Sources and Threats listed in Table G-1.

Table G-1: Examples of Supply Chain Cybersecurity Threat Sources/Agents

Threat Sources	Threat	Examples
Adversarial: Counterfeiters	Counterfeits inserted into supply chain (see Appendix B Scenario 1)	Criminal groups seek to acquire and sell counterfeit cyber components for monetary gain. Specifically, organized crime groups seek disposed units, purchase overstock items, and acquire blueprints to obtain cyber components intended for sale through various gray market resellers to acquirers.[50]
Adversarial: Malicious Insiders	Intellectual property loss	Disgruntled insiders sell or transfer intellectual property to competitors or foreign intelligence agencies for a variety of reasons including monetary gain. Intellectual property includes software code, blueprints, or documentation.
Adversarial: Foreign Intelligence Services	Malicious code insertion (see Appendix B Scenario 4)	Foreign intelligence services seek to penetrate supply chain and implant unwanted functionality (by inserting new or modifying existing functionality) into system to gather information or

[50] "Defense Industrial Base Assessment: Counterfeit Electronics," [*Defense Industrial Base Assessment: Counterfeit Electronics*].

		subverting[51] system or mission operations when system is operational.
Adversarial: Terrorists	Unauthorized access	Terrorists seek to penetrate or disrupt the supply chain and may implant unwanted functionality to obtain information or cause physical disablement and destruction of systems through the supply chain.
Adversarial: Industrial Espionage/Cyber Criminals	Industrial Espionage/Intellectual Property Loss (see Appendix B Scenario 2)	Industrial spies/cyber criminals seek ways to penetrate supply chain to gather information or subvert system or mission operations (e.g., exploitation of an HVAC contractor to steal credit card information).
Adversarial: Organized Cyber Criminals	Ransomware leads to disruption of a critical production process	Cyber-criminal organizations seeking monetary gain target enterprises with ransomware attacks in hopes of securing ransom payments for monetary gain. Threat sources recognize that enterprises, especially manufacturers, have significant exposure to production disruptions.
Systemic: Legal/Regulatory	Legal/regulatory complications impact the availability of key supplier-provided products and/or services	Weak anti-corruption laws, lack of regulatory oversight, weak intellectual property considerations: this also includes the threats resulting from country-specific laws, policies, and practices intended to undermine competition and free market protections such as the requirement to transfer technology and intellectual property to domestic providers in a foreign country.[5]
Systemic Economic Risks	Business failure of a key supplier leads to supply chain disruption	Economic risks stem from threats to the financial viability of suppliers and the potential impact to the supply chain resulting from the failure of a key supplier as a result. Other threats to the supply chain that result in

[51] Examples of subverting operations include gaining unauthorized control to cybersecurity supply chain or flooding it with unauthorized service requests to reduce or deny legitimate access to cybersecurity supply chain.

[5]Information and Communications Technology Supply Chain Risk Management Task Force: Threat Evaluation Working. Group: Threat Scenarios Version 2.0

		economic risks include, but are not limited to, vulnerabilities to cost volatility, reliance on single source suppliers, cost to swap out suspect vendors, and resource constraints due to company size.[5]
Systemic Supply Disruptions	Production short-falls in rare earth metals leads to supply shortages for critical production inputs into semi-conductors	A variety of systemic and structural failures can cause supply shortage for products and product components, especially in cases where the source of supply is in a single geographical location
Environmental: Disasters	Geopolitical or natural disaster led to supply chain disruption	Availability of key supply chain inputs is subject to disruptions from geopolitical upheavals or natural disasters. This is especially the case when suppliers share a common 4th-party supplier,
Structural: Hardware Failure	Inadequate capacity planning leads to outage in cloud platform	A vendor or supplier service without the appropriate capacity controls in place could be subject to disruptions in the event of unexpected surges in resource demand.
Accidental: Negligent Insiders	Configuration error leads to data exposure	Employees and contractors with access to information systems are prone to errors which could result in the disclosure of sensitive data. This is specifically true in cases where training lapses or process gaps increase the opportunities for errors.

Agencies can identify and refine C-SCRM-specific threats in all three levels. Table G-2 provides examples of threat considerations and different methods for use in characterizing supply chain cybersecurity threats at different levels.

8868 **Table G-2: Supply Chain Cybersecurity Threat Considerations**

Level	Threat Consideration	Methods
Level 1	• Enterprise business and mission • Strategic supplier relationships • Geographical considerations related to the extent of the enterprise's supply chain	• Establish common starting points for identifying supply chain cybersecurity threat. • Establish procedures for countering enterprise-wide threats such as insertion of counterfeits into critical systems and components.
Level 2	• Mission and business processes • Geographic locations • Types of suppliers (COTS, external service providers, or custom, etc.) • Technologies used enterprise-wide	• Identify additional sources of threat information specific to enterprise mission and business processes. • Identify potential threat sources based on the locations and suppliers identified through examining available agency cybersecurity supply chain information (e.g., from supply chain map). • Scope identified threat sources to the specific mission and business processes, using the agency the cybersecurity supply chain information. • Establish mission-specific preparatory procedures for countering threat adversaries/natural disasters.
Level 3	• SDLC	• Base the level of detail with which threats should be considered on the SDLC phase. • Identify and refine threat sources based on the potential for threat insertion within individual SDLC processes.

8869

8870 *Vulnerabilities*

8871

8872 A vulnerability is a weakness in an information system, system security procedures, internal
8873 controls, or implementation that could be exploited or triggered by a threat source [FIPS 200],
8874 [NIST SP 800-34 Rev. 1], [NIST SP 800-53 Rev 4], [NIST SP 800-53A Rev. 4], [NIST SP 800-
8875 115]. Within the C-SCRM context, it is any weakness in the supply chain, provided services,
8876 system/component design, development, manufacturing, production, shipping and receiving,
8877 delivery, operation, and component end-of-life that can be exploited by a threat source. This
8878 definition applies to both the services/systems/components being developed and integrated (i.e.,

within the SDLC) and to the supply chain, including any security mitigations and techniques, such as identity management or access control systems. Vulnerability assumptions made in the Frame step of the FARM process capture the enterprise's long-term assumptions about the enterprise's weaknesses that can be exploited or triggered by a threat source. These will become further refined and updated to reflect point-in-time variances during the Assess step. Enterprises may make long-term supply chain cybersecurity vulnerability assumptions about:

- The entities within supply chain itself (e.g., individual supplier relationships);
- The critical services provided through the supply chain which support the enterprise's critical missions and business processes;
- The products/systems/components provided through the supply chain and used within the SDLC (i.e., being developed and integrated);
- The development and operational environment directly impacting the SDLC; and
- The logistics/delivery environment that transports systems and components (logically or physically).

Vulnerabilities manifest differently across the 3 levels (i.e., enterprise, mission/business process, information system). At Level 1, vulnerabilities present as susceptibilities of the enterprise at-large due to managerial and operating structures (e.g., policies, governance, processes) as well as conditions in the supply chain (e.g., concentration of products or services from a single supplier) or critical enterprise processes (e.g., use of a common system across critical processes). At Level 2, vulnerabilities are specific to a mission/business process and result from its operating structures and conditions such as reliance on a specific system or supplier provided input, or service to achieve specific mission/business process operating objectives. Level 2 vulnerabilities may vary widely across the different mission/business processes. Within Level 3, vulnerabilities manifest as supplied product or operational-level weaknesses or deficiencies arising from the SDLC, system security procedures, internal controls, implementations, as well as system inputs or services provided through the supply chain (e.g., system components, services).

Enterprises should identify approaches to characterize supply chain cybersecurity vulnerabilities consistent with the characterization of threat sources and events and with the overall approach employed by the enterprise for characterizing vulnerabilities. Vulnerabilities may be relevant to a single threat source or broadly applicable across threat sources (adversarial, structural, environmental, accidental). For example, a single point of failure in a network may be subject to disruptions caused by environmental threats (e.g., disasters) as well as adversarial threats (terrorists). Appendix B provides examples of supply chain cybersecurity threats, based on [NIST SP 800-30 Rev. 1, Appendix B].

All three levels should contribute to determining the enterprise's approach to characterizing vulnerabilities, with progressively more detail identified and documented in the lower levels. Table G-3 provides examples of considerations and different methods for use in characterizing supply chain cybersecurity vulnerabilities at different levels.

8922 **Table G-3: Supply Chain Cybersecurity Vulnerability Considerations**

Level	Vulnerability Consideration	Methods
Level 1	• Enterprise mission/business • Holistic supplier relationships (e.g., system integrators, COTS, external services) • Geographical considerations related to the extent of the enterprise's supply chain • Enterprise/Security Architecture • Criticality	• Examine agency cybersecurity supply chain information including that from supply chain maps to identify especially vulnerable entities, locations, or enterprises. • Analyze agency mission for susceptibility to potential supply chain cybersecurity vulnerabilities. • Examine 3rd party provider/ supplier relationships and interdependencies for susceptibility to potential supply chain cybersecurity vulnerabilities. • Review enterprise architecture and criticality to identify areas of weakness requiring more robust cybersecurity supply chain considerations.
Level 2	• Mission and business processes • Geographic locations • Mission/process level supplier dependencies (e.g., outsourced or contracted services) • Technologies used	• Refine analysis from Level 1 based on specific mission and business processes and applicable threat and supply chain information. • If appropriate, use the National Vulnerability Database (NVD), including Common Vulnerabilities and Exposures (CVE) and Common Vulnerability Scoring System (CVSS), to characterize, categorize, and score vulnerabilities[52] or other acceptable methodologies. • Consider using scoring guidance to prioritize vulnerabilities for remediation.
Level 3	• Individual technologies, solutions, and services should be considered • Supply chain SDLC inputs such as system components or services	• Refine analysis based on inputs from related Level 2 missions and business processes. • Use CVEs where available to characterize and categorize vulnerabilities. • Identify weaknesses.

8923

8924

8925

[52] See https://nvd.nist.gov/

Consequences and Impact

Impact is the effect on enterprise operations, enterprise assets, individuals, other enterprises, or the Nation (including the national security interests of the United States) of a loss of confidentiality, integrity, or availability of information or an information system [NIST SP 800-53 Rev.5]. Impact estimated within the Frame step represents the enterprise's long-term assumptions about the effects different cybersecurity events will have on its primary processes. These assumptions are updated and refined as part of the Assess step to ensure that point-in-time relevant information (e.g., market conditions)—which may alter the impact scope, duration, or magnitude—is appropriately reflected in the analysis.

When possible, enterprises should inherit assumptions made by the enterprise on consequences and impact as part of enterprise risk management activities. For example, one of these activities is performing an impact analysis (BIA) on a periodic business to determine or revalidate mission-critical and mission-enabling processes, as part of the enterprise's continuity and emergency preparedness responsibilities. However, these assumptions may need to be developed if they do not yet exist. Enterprises may maintain impact or loss libraries which capture the enterprise's standing assumptions about the impact of different cybersecurity event types (e.g., disclosure, disruption, destruction, modification) on the enterprise's assets. These libraries may break down impact and loss into individual impact types (e.g., operational, environmental and /or individual safety, reputational, regulatory/legal fines and penalties, IT recovery/replacement, direct financial, damage to critical infrastructure sector).

For C-SCRM, enterprises should refine and update their consequences and impact assumptions to reflect the role that availability, confidentiality and integrity of supplier-provided products or services have on the enterprise operations, assets, and individuals. For example, depending on its criticality, the loss of a key supplier-provided input or service may reduce the enterprise's operational capacity or completely inhibit its operations. In this publication, impact is always in relation to the enterprise's mission and includes the systems or components traversing the supply chain as well as the supply chain itself.

C-SCRM consequences and impact will manifest differently across all three levels in the risk management hierarchy. Impact determinations require a combined top-down and bottom-up approach. Table G-4 provides examples of how consequences and impact may be characterized at different levels of the enterprise.

8969 **Table G-4: Supply Chain Cybersecurity Consequence & Impact Considerations**

Level	Impact Considerations	Methods
Level 1	• General enterprise-level impact assumptions • Supplier criticality (e.g., holistic supplier relationships)	• Examine magnitude of exposure to individual entities within the supply chain. • Refine Level 2 analysis to determine aggregate Level 1 impact on the enterprise's primary function resulting from cybersecurity events to and through the supply chain.
Level 2	• Process role in enterprise's primary function • Supplier criticality to mission/process (inputs and services)	For each type of cybersecurity event: • Refine Level 3 analysis to determine aggregate mission/business process impact due to operational-level impacts from cybersecurity events to and through the supply chain. • Examine supplier network to identify business/mission-level impacts due to events affecting individual supplier entities.
Level 3	• Criticality of upstream and downstream Level 2 processes • System criticality • Supplier criticality to system operations (system components and services)	• Examine the systems aggregated criticality to Level 1 and Level 2 primary processes • Examine the criticality of supplied system components or services to the system's overall function. • Examine supplier network to identify individual entities which may disrupt availability of critical system inputs or services.

8970

8971 Enterprises should look to several sources for information that helps contextualize consequences
8972 and impact. Historical data is preferential and can be gathered by reviewing historical data for
8973 the agency, similar peer enterprises, supplier organizations, or applicable industry surveys.
8974 Where gaps in historical data exist, enterprises should consider the use of expert elicitation
8975 protocols (e.g., calibrated estimation training) which make use of the tacit knowledge of
8976 appropriate individuals across the enterprise. By interviewing well positioned experts (e.g.,
8977 technology or mission/business owners of assets) enterprises can tailor impact assumptions to
8978 reflect the enterprise's unique conditions and dependencies. [NISTIR 8286] offers a more in-
8979 depth discussion of how different quantitative and qualitative methodologies can be used to
8980 analyze risk.
8981
8982 The following are examples of cybersecurity supply chain consequences and impact:
8983 • An earthquake in Malaysia reduces the amount of commodity Dynamic Random-Access
8984 Memory (DRAM) to 60 percent of the world's supply, creating a shortage for hardware
8985 maintenance and new design;

- Accidental procurement of a counterfeit part results in premature component failure, thereby impacting the enterprise's mission performance;
- Disruption in at a key cloud service provider resulting in operational downtime losses between $1.5M – $15M dollars.

Likelihood

In an information security risk analysis, likelihood is a weighted factor based on a subjective analysis of the probability that a given threat is capable of exploiting a given vulnerability [CNSSI 4009]. General likelihood assumptions should be inherited from the enterprise's enterprise risk management process then refined to account for C-SCRM specific implications, however, the general assumptions may need developing if they do not yet exist. Likelihood analysis in the Frame step sets the enterprise's long-term assumptions about the relative likelihood of different adverse cybersecurity events. Likelihood is subject to extreme short-term variations based on point-in-time conditions (i.e., internal and external) and thus must be updated and refined as part of the Assess step.

In adversarial cases a likelihood determination may be made using intelligence trend data, historical data, and expert intuition on (i) adversary intent; (ii) adversary capability; and (iii) adversary targeting. In non-adversarial cases (e.g., structural, environmental, accidental), likelihood determinations will draw on expert intuition and historical data. When available, historical data may help further reduce uncertainty about what cybersecurity risk in the supply chain are probable to occur. Historical data may be sourced from internal sources (e.g., frequency of past security incidents, threat intelligence on threat activity levels) as well as external sources (e.g., peer org. data, info-sharing). Likelihood analysis can leverage many of the same expert elicitation protocols as consequences and impact. Similar to consequences and impact, likelihood determinations may rely on qualitative or quantitative form and draw on similar techniques. To ensure likelihood is appropriately contextualized for decision makers, enterprises should make time-bound likelihood estimates for cybersecurity events affecting the supply chain (e.g., likelihood within a given year).

Likelihood analysis will manifest differently across the three levels. Table G-5 captures some of the considerations and methods specific to each level:

9020 **Table G-5: Supply Chain Cybersecurity Likelihood Considerations**

Level	Likelihood Consideration	Methods
Level 1	• General threat and likelihood assumptions for the enterprise • Level 2 and 3 likelihood findings • Overall engagement models with suppliers that alter opportunities for contact with threat sources	• Analyze critical national infrastructure implications which may increase the enterprise's target value. • Refine analyses from Levels 2 and 3 to determine aggregate exposure to threat source contact.
Level 2	• Mission/process level threat and likelihood assumptions • Mission/process level engagement model with suppliers (e.g., criticality of assets interacted with) • Level 3 findings for relevant systems	• Evaluate mission/business process level conditions which present opportunities for threat sources to come into contact with processes or assets via the supply chain. • Evaluate the aggregate supply chain threat conditions facing key systems relied upon by the mission/business process.
Level 3	• Enterprise system threat and likelihood assumptions • Supplier & system target value • Location & operating conditions • Supplier & system security policies, processes, and controls • Nature and degree of supplier contact with system (inputs, services)	• Analyze nature of system inputs coming through the supply chain into the SDLC which alter likelihood of encountering threat sources. • Evaluate the systems role in Level 1 and Level 2 processes which alter target value for potential adversaries. • Analyze supply chain characteristics (e.g., location of supplier) which may increase the likelihood that a system is affected by a threat source.

9021

9022 Agencies should determine which approach(es) they will use to determine the likelihood of a
9023 supply chain cybersecurity compromise, consistent with the overall approach used by the
9024 agency's risk management process. Agencies should ensure that appropriate procedures are in
9025 place to thoroughly document any risk analysis assumptions leading to the tabulation of the final
9026 risk score, especially in cases where high or critical impact risks are involved. Visibility into
9027 assumptions may be critical in enabling decision makers to take action.
9028

RISK MANAGEMENT PROCESS CONSTRAINTS

TASK 1-2: Identify constraints[53] on the conduct of risk assessment, risk response, and risk monitoring activities within the enterprise.

Supplemental Guidance

Identify the following two types of constraints to ensure the cybersecurity supply chain is integrated into the agency risk management process:

1. Agency constraints; and
2. Supply chain-specific constraints.

Agency constraints serve as an overall input to framing the cybersecurity supply chain policy at Level 1, mission requirements at Level 2, and system-specific requirements at Level 3. Table G-6 lists the specific agency and cybersecurity supply chain constraints. Supply chain constraints, such as C-SCRM policy and C-SCRM requirements, may need to be developed if they do not exist.

Table G-6: Supply Chain Constraints

Level	Agency Constraints	Supply Chain Constraints
Level 1	• Enterprise policies, strategies, governance • Applicable laws and regulations • Mission and business processes • Enterprise processes (security, quality, etc.) • Resource limitations	• Enterprise C-SCRM policy based on the existing agency policies, strategies, and governance; applicable laws and regulations; mission and business processes; and enterprise processes. • Acquisition regulations and policy. • Available, mandated or restricted sources of supply or products.
Level 2	• Mission and business processes • Criticality of processes • Enterprise architecture • Mission-level security policies	• C-SCRM Mission/business requirements that are incorporated into mission/business processes and enterprise architecture. • Supplier service contracts, product warranties and liability agreements.

[53] Refer to [NIST SP 800-39], Section 3.1, Task 1-2 for a description of constraints in the risk management context.

Level 3	• Functional requirements • Security requirements	• Product and Operational-level C-SCRM capabilities. • Supplier-provided system component warranties and service agreements.

An enterprise's C-SCRM policy is a critical vehicle for directing C-SCRM activities. Driven by applicable laws and regulations, this policy should support applicable enterprise policies including acquisition and procurement, information security, quality, and supply chain and logistics. It should address goals and objectives articulated in the overall agency strategic plan, as well as specific mission and business processes and business goals, along with the internal and external customer requirements. It should also define the integration points for C-SCRM with the agency's Risk Management Process and SDLC.

C-SCRM policy should define C-SCRM-related roles and responsibilities of the agency C-SCRM team, any dependencies among those roles, and the interaction among the roles. C-SCRM-related roles will articulate responsibilities for collecting supply chain cybersecurity threat intelligence, conducting risk assessments, identifying and implementing risk-based mitigations, and performing monitoring processes. Identifying and validating roles will help to specify the amount of effort required to implement the C-SCRM Plan. Examples of C-SCRM-related roles include:

- C-SCRM PMO that provides overarching guidance on cybersecurity risk in the supply chain to engineering decisions that specify and select cyber products as the system design is finalized;
- Procurement officer and maintenance engineering responsible for identifying and replacing the hardware when defective;
- Delivery enterprise and acceptance engineers who verify that the system component is acceptable to receive into the acquiring enterprise;
- System integrator responsible for system maintenance and upgrades, whose staff resides in the acquirer facility and uses system integrator development infrastructure and the acquirer operational infrastructure;
- System Security Engineer/Systems Engineer responsible for ensuring that information system security concerns are properly identified and addressed throughout the SDLC; and
- The end user of cyber systems/components/services.

C-SCRM requirements should be guided by C-SCRM policy(ies), as well as by the mission and business processes and their criticality at Level 2 and by known functional and security requirements at Level 3.

RISK APPETITE AND TOLERANCE

TASK 1-3: Identify the levels of risk appetite and tolerance across the enterprise.

Supplemental Guidance

Risk appetite represents the types and amount of risk, on a broad level, an enterprise is willing to accept in pursuit of value [NISTIR 8286]. Conversely, risk tolerance is the enterprise or stakeholder's readiness to bear the remaining risk after risk response in order to achieve its objectives, with the consideration that such tolerance can be influenced by legal or regulatory requirements [NISTIR 8286]. This definition is adapted from COSO, which states risk tolerance is the acceptable level of variation relative to achievement of a specific objective. Often, risk tolerance is best measured in the same units as those used to measure the related objective [COSO 2011]. Where applicable, enterprises should align with risk appetite and tolerance assumptions and thresholds from the enterprise risk management process. For C-SCRM, these assumptions and thresholds should be contextualized to inform decisions in the C-SCRM domain. Those responsible for C-SCRM across the enterprise should work with and support enterprise leaders on the development of C-SCRM-related risk appetite and risk tolerance statements. This should be done in accordance with criteria provided from the Enterprise Risk Strategy (e.g., based on ERM risk categories).

Risk appetite and tolerance statements strongly influence decisions made about C-SCRM across the three levels. Some enterprises may define risk appetite and risk tolerance as part of their broader enterprise risk management activities. In enterprises without a clearly defined risk appetite, Level 1 stakeholders should collaborate with enterprise leadership to define and articulate the enterprise's appetite for risk within the scope of the C-SCRM program's mandates. Enterprises with multiple organizations may choose to tailor risk appetite statements for specific organizations and mission/business processes. In general, risk appetite at Level 1 may be set to empower the enterprise to meet its value objectives (e.g., high appetite for supplier risk in support of reducing operating costs by 5%). At Levels 2 and 3 an organization's risk appetite statement(s) are operationalized through risk tolerance statements. For example, an organization with a low appetite for supply chain cybersecurity risk may issue risk tolerance statements that necessitate restraint and control by Level 2 and 3 decision makers as they pursue strategic value (e.g., tolerance statement crafted based on strict production targets for an organization that supports a national security-related mission).

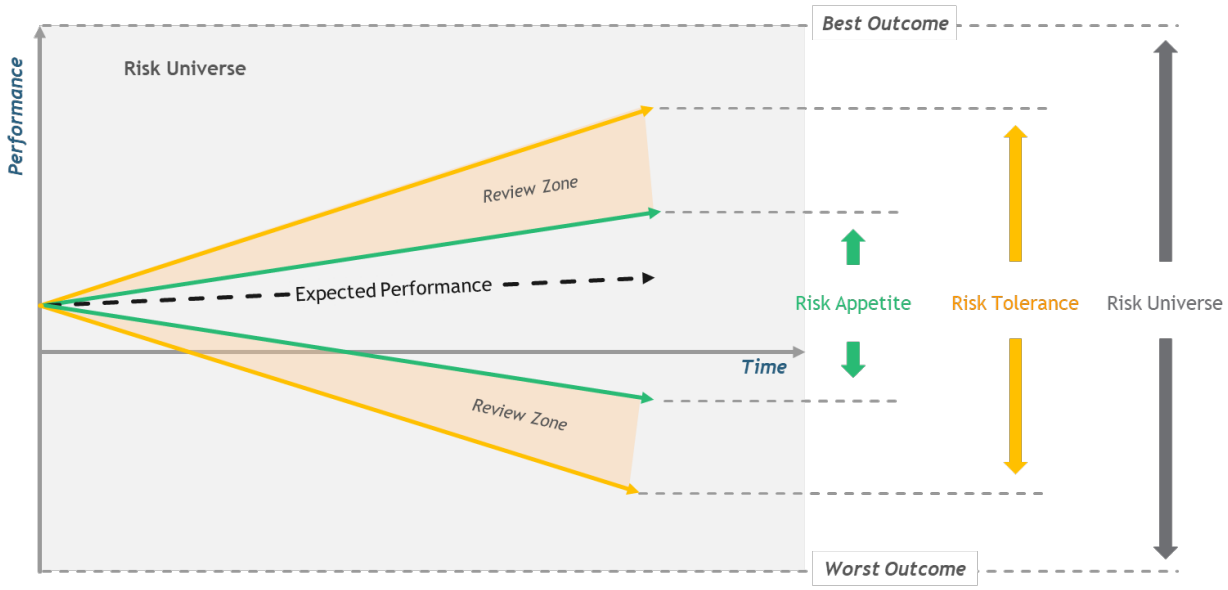


Fig. G-4: Risk Appetite & Risk Tolerance

Together risk appetite and risk tolerance provide the expectations and acceptable boundaries for performance against the organization's strategic objectives. Figure G-4 illustrates how risk appetite and risk tolerance may be used as guidelines for the organization's operational decision makers. Risk tolerance may be set with boundaries that exceed risk appetite to provide a degree of flexibility needed to achieve the organization's strategic objectives. However, operational decision makers should strive to remain within risk appetite during normal conditions and exceed the boundaries only as absolutely necessary (e.g., to capitalize on significant opportunities, avoid highly adverse conditions). Observed periods of performance in the *Review Zone* which lies outside of risk appetite boundaries should trigger a review of operational decisions as well as defined risk appetite and risk tolerance thresholds. The review is critical to ensuring that the organizations appetite for risk remains appropriate and applicable given the organization's internal and external operating conditions. For example, an organization operating during a global pandemic may find it necessary to take on additional levels of cyber risk exposure via alternate suppliers as they aim to circumvent supply shortages. Figure G-5 below provides an illustrative risk appetite and risk tolerance review process

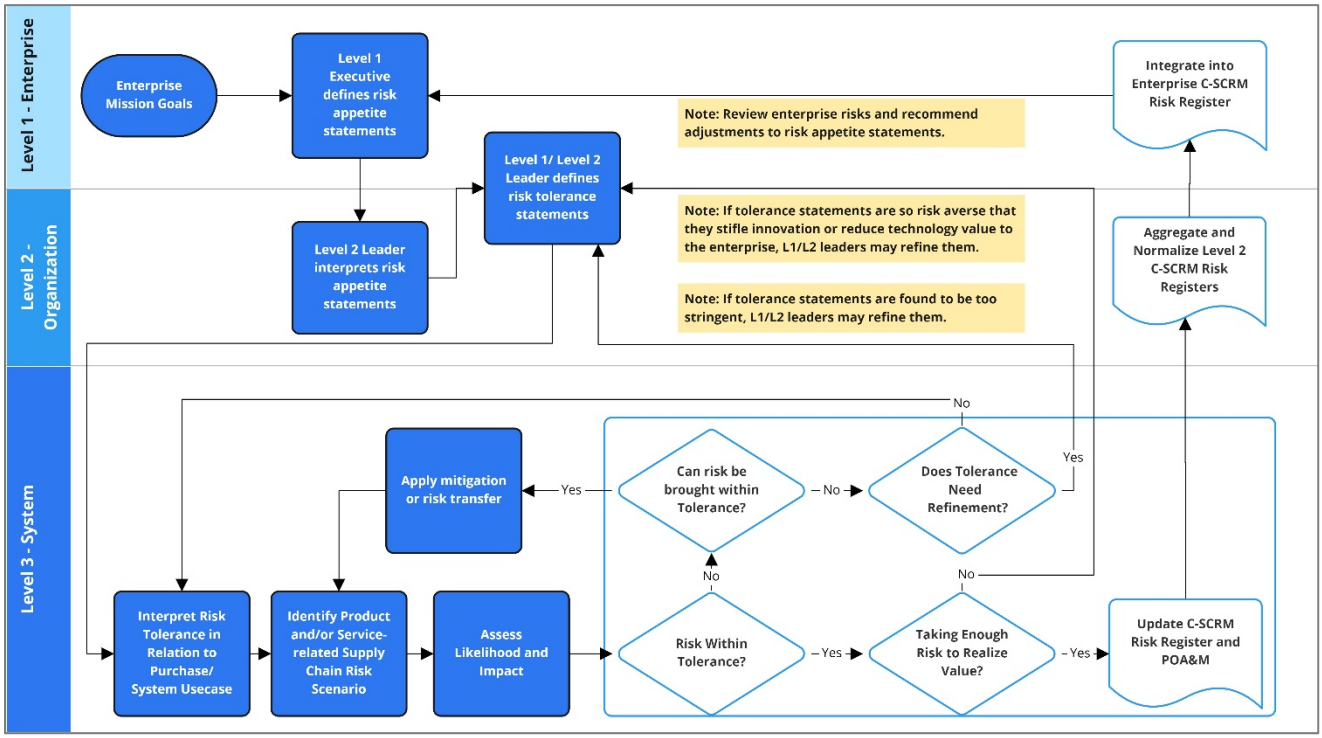


Fig. G-5: Risk Appetite & Risk Tolerance Review Process

In some cases, organization leaders may find it necessary to rebalance guidance to as to avoid excess risk aversion behavior (i.e., performance below appetite) by decision makers or rein in decision makers so as to avoid excess risk seeking behavior (i.e., performance above appetite).

Table G-7 shows additional examples of how risk appetite and risk tolerance statements work together to frame risk within an enterprise.

Table G-7: Supply Chain Risk Appetite & Risk Tolerance

Enterprise Constraints	Supply Chain Constraints
• **Low appetite** for risk with respect to market objectives and require 24/7 uptime.	• **Low tolerance** (i.e., no more than 5% probability) for service provider downtime that causes system disruptions to exceed contractual service level agreements (SLAs) by more than 10%.
• **Low appetite** for risk with respect to production objectives which require >99% on-time delivery of products to customers with national security missions.	• **Near-zero tolerance (**i.e., no more than 5% probability) of supply chain disruptions that cause production levels to fall below 99% of target threshold for military products.
• **Low appetite** for risk related to national security objectives which require 99% effectiveness of security processes	• **Low tolerance** (i.e., no more than 1% of contractor access authorizations) for inappropriate contractor access that exceeds authorized windows by more than 10% in systems with classified information.
• **Moderate appetite** for risk related to operational objectives of non-mission critical areas which require 99.5% availability	• **Moderate tolerance** (i.e., no more than 15% probability) for system component failures causing non-critical system disruptions that exceed recovery time objectives by more than 10%.

To ensure leadership has the appropriate information when making risk-based decisions, enterprises should establish measures (e.g., Key Performance Indicators (KPIs), Key Risk Indicators (KRIs)) to measure performance against defined risk appetite and risk tolerance thresholds. Identification of corresponding data sources for measurement should play a key role in the enterprise's defined processes for setting and refining risk appetite and tolerance thresholds. Risk appetite and risk tolerance should be treated as dynamic thresholds by the enterprise. This requires periodic update and revision based on internal (e.g., new leadership, strategy) and external (e.g., market, environmental) changes which impact the enterprise.

Enterprises should consider supply chain cybersecurity threats, vulnerabilities, constraints, and criticality when establishing, operationalizing, and maintaining the overall level of risk appetite and risk tolerance.[54]

PRIORITIES AND TRADE-OFFS

TASK 1-4: Identify priorities and trade-offs considered by the enterprise in managing risk.

Supplemental Guidance

Priorities and tradeoffs are closely linked to the enterprise's risk appetite and tolerance thresholds, which communicate the amount of risk that is acceptable and tolerable to the enterprise in pursuit of its objectives. Priorities will take the form of long-term strategic objectives or near-term strategic imperatives which alter risk decision calculus. From priorities and tradeoffs, C-SCRM then receives critical strategic context required for Response step activities such as Evaluation of Alternatives and Risk Response Decision. As a part of identifying priorities and trade-offs, enterprises should consider risk appetite, risk tolerance, supply chain cybersecurity threats, vulnerabilities, constraints, and criticality.

Priority and tradeoff considerations will manifest different across the 3 levels. Within Level 1, priority and tradeoff considerations may favor existing supplier relationships in established regions at the expense of new supplier cost advantages due to a desire to maintain confidence and stability. At Level 2, priority and tradeoff considerations may favor centralized C-SCRM governance models covering product teams in favor of greater security practice standardization. At Level 3, priorities and tradeoffs may favor system components/subcomponents produced in certain geographies in an effort to avoid environmental or geopolitical risks to the supply chain.

[54] Federal Departments' and Agencies' governance structures vary widely (see [NIST SP 800-100, Section 2.2.2]). Regardless of the governance structure, individual agency risk decisions should apply to the agency and any subordinate organizations, but not in the reverse direction.

Outputs and Post Conditions

Within the scope of [NIST SP 800-39], the output of the risk framing step is the risk management strategy that identifies how enterprises intend to assess, respond to, and monitor risk over time. This strategy should clearly include any identified C-SCRM considerations and should result in the establishment of C-SCRM-specific processes throughout the agency. These processes should be documented in one of three ways:

1. Integrated into existing agency documentation;
2. A separate set of documents addressing C-SCRM; or
3. A mix of separate and integrated documents based on agency needs and operations.

The following information should be provided as an output of the risk framing step, regardless of how the outputs are documented:

- C-SCRM Policy;
- Criticality including prioritized mission and business processes and [FIPS 199] impact;
- Supply chain cybersecurity risk assessment methodology and guidance;
- Cybersecurity supply chain risk response guidance;
- Cybersecurity supply chain risk monitoring guidance;
- C-SCRM mission/business requirements;
- Revised mission/business processes and enterprise architecture with C-SCRM considerations integrated;
- Operational-level C-SCRM requirements; and
- Acquisition security guidance/requirements.

Outputs from the risk framing step are enabling pre-requisites to effectively manage cybersecurity risk in the supply chain and serve as inputs to the risk assessment, risk response, and risk monitoring steps.

Assess

Inputs and Preconditions

Assess is the step where assumptions, established methodologies and collected data is used to conduct a risk assessment. Numerous inputs (including criticality, risk appetite and tolerance, threats, and vulnerability analysis results; stakeholder knowledge; and policy, constraints, and requirements) are combined and analyzed to gauge the likelihood and impact of a supply chain cybersecurity compromise. Assess step activities are used to update the enterprises long-term risk-framing assumptions to account for near-term variations and changes.

A supply chain cybersecurity risk assessments should be integrated into the overall enterprise risk assessment process. C-SCRM risk assessment results should be used and aggregated as appropriate to communicate potential or actual cybersecurity risk in the supply chain relevant to each risk management framework level. Figure D-4 depicts the Assess Step with its inputs and outputs along the three levels.

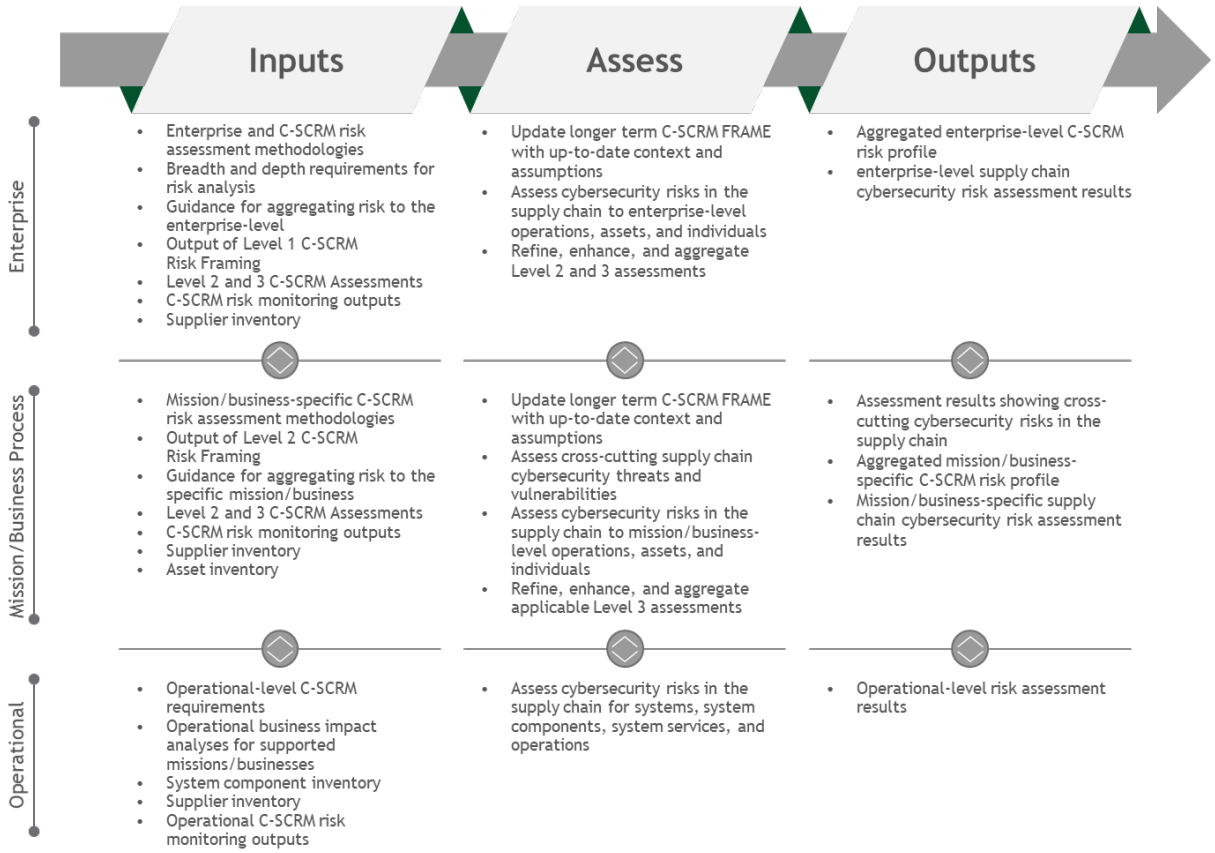


Fig. G-6: C-SCRM in the Assess Step[55]

Criticality, vulnerability, and threat analyses are essential to the supply chain risk assessment process. The order of activities begins with updating the criticality analysis to ensure the assessment is scoped to minimally include relevant critical mission and business processes and to understand the relevance and impact of supply chain elements on these mission and business processes. As depicted in Figure G-5, vulnerability and threat analyses can then be performed, in any order, but should be performed iteratively to ensure that all applicable threats and vulnerabilities have been identified to understand which vulnerabilities may be more susceptible to exploitation by certain threats, and, if and as applicable, to associate identified vulnerabilities and threats to one or more mission and business processes or supply chain elements. Once viable threats and potential or actual vulnerabilities are assessed, this information will be used to evaluate the likelihood of exploitability—a key step to understanding impact. This is a synthesis point for criticality analysis, vulnerability analysis, and threat analysis and helps to further clarify and contextualize impact to support an informed and justifiable risk decision.

[55] More detailed information on the Risk Management Process can be found in Appendix C

Activities

CRITICALITY ANALYSIS

TASK 2-0: Update Criticality Analysis of mission and business processes, systems, and system components to narrow the scope (and resource needs) for C-SCRM activities to those most important to mission success.

Supplemental Guidance

Criticality analysis should include the supply chain for both the enterprise and applicable suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers, as well as relevant non-system services and products. Criticality analysis assesses the direct impact they each have on the mission priorities. The supply chain includes the SDLC for applicable systems, services, and components because the SDLC defines whether security considerations are built into the systems/components or added after systems/components have been created.

Enterprises should update and tailor criticality established during the Frame step of the risk management process, including [FIPS 199] system. For low-impact systems, enterprises should minimally assess criticality regarding interdependencies that systems may have with moderate or high-impact system(s). If systems are used extensively throughout the enterprise, enterprises should determine the holistic impact of component failure or compromise in the low impact system.

In addition to updating and tailoring criticality, performing criticality analysis in the Assess Step may include the following:

- Refine the dependency analysis and assessment to update understanding of which components may require hardening given the system or network architecture;
- Obtain and review existing information that the agency has about critical systems/components such as locations where they are manufactured or developed, physical and logical delivery paths, information flows and financial transactions associated with these components, and any other available information that can provide insights into supply chain of these components;[56]
- Update information about the supply chain, historical data, and the SDLC to identify changes in critical supply chain paths and conditions.

The outcome of the updated criticality analysis is a narrowed, prioritized list of the enterprise's critical processes, systems, and system components as well as a refined understanding of corresponding dependencies within the supply chain. Enterprises can use the Criticality process in Task 1-1, to update Criticality Analysis.

[56] This information may be available from a supply chain map for the agency or individual IT projects or systems. Supply chain maps are descriptions or depictions of supply chains including the physical and logical flow of goods, information, processes, and money upstream and downstream through a supply chain. They may include supply chain entities, locations, delivery paths, or transactions.

Because more information will be available in the Assess step, enterprises can narrow the scope and increase the granularity of a criticality analysis. When identifying critical processes and associated systems/components and assigning them criticality levels, consider the following:

- Functional breakdown is an effective method of identifying processes, associated critical components, and supporting defensive functions;
- Dependency analysis is used to identify the processes on which critical processes depend (e.g., defensive functions such as digital signatures used in software patch acceptance) which become critical processes themselves;
- Identification of all access points to identify and limit unmediated access to critical function/components (e.g., least-privilege implementation);
- Value chain analysis to understand inputs, process actors, outputs and customers of services and products; and
- Malicious alteration or other types of supply chain compromise can happen throughout the SDLC.

The resulting list of critical processes and supply chain dependencies is used to guide and inform the vulnerability analysis and threat analysis in determining the initial C-SCRM risk as depicted in Figure D-4. Supply chain countermeasures and mitigations can then be selected and implemented to reduce risk to acceptable levels.

Criticality analysis is performed iteratively and may be performed at any point in the SDLC and concurrently by level. The first iteration is likely to identify critical processes and systems/components that have a direct impact on mission and business processes. Successive iterations will include information from the criticality analysis, threat analysis, vulnerability analysis, and mitigation strategies defined at each of the other levels. Each iteration will refine the criticality analysis outcomes and result in the addition of defensive functions. Several iterations are likely required to establish and maintain the criticality analysis results. Enterprises should document or record the results of their criticality analysis and review and update this assessment on an annual basis at minimum.

THREAT AND VULNERABILITY IDENTIFICATION

TASK 2-1: Identify threats to and vulnerabilities in enterprise information systems and the environments in which the systems operate.

Supplemental Guidance

In addition to threat and vulnerability identification, as described in [NIST SP 800-39] and [NIST SP 800-30 Rev. 1], enterprises should conduct supply chain cybersecurity threat analysis and vulnerability analysis.

Threat Analysis

For C-SCRM, a threat analysis provides specific and timely threat characterization of threat events (see Appendix C) and potential threat actors (e.g., nation-state) and threat vectors (e.g., 3rd party supplier), to inform management, acquisition, engineering, and operational activities within an enterprise.[57] A variety of information can be used to assess potential threats, including open source, intelligence, and counterintelligence. Enterprises should include, update and refine the threat sources and assumptions defined during the *Frame* step. The results of the threat analysis will ultimately support acquisition decisions, alternative build decisions, and development and selection of appropriate mitigations to be applied in the *Respond* step. The focus of supply chain threat analysis should be based on the results of the criticality analysis.

Agencies should use information available from existing incident management activities to determine whether they have experienced a supply chain cybersecurity compromise and to further investigate such compromises. Agencies should define criteria for what constitutes a supply chain cybersecurity compromise to ensure that such compromises can be identified as a part of post-incident activities, including forensics investigations. Additionally - at agency defined intervals – agencies should review other sources of incident information within the enterprise to determine whether in fact a supply chain compromise has occurred.

An supply chain cybersecurity threat analysis should capture at least the following data:

- Observation of cybersecurity supply chain-related attacks while they are occurring;
- Incident data collected post-cybersecurity supply chain-related compromise;
- Observation of tactics, techniques, and procedures used in specific attacks, whether observed or collected using audit mechanisms; and
- Natural and man-made disasters before, during, and after occurrence.

Vulnerability Analysis

For C-SCRM, a vulnerability is a weakness in an information system, system security procedures, internal controls, or implementation that could be exploited or triggered by a threat source [FIPS 200], [NIST SP 800-34 Rev. 1], [NIST SP 800-53 Rev 4], [NIST SP 800-53A Rev. 4], [NIST SP 800-115].

A vulnerability analysis is an iterative process that informs risk assessment and countermeasure selection. The vulnerability analysis works alongside the threat analysis to help inform the impact analysis and to help scope and prioritize vulnerabilities to be mitigated.

Vulnerability analysis in the Assess Step should use the approaches defined during the Frame Step to update and refine assumptions about supply chain cybersecurity vulnerabilities. Vulnerability analysis should begin by identifying vulnerabilities that are applicable to critical mission and business processes and systems/system components identified by the criticality

[57] Please note that threat characterization of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers may be benign.

analysis. An investigation of vulnerabilities may indicate the need to raise or at least reconsider the criticality levels of processes and components identified in earlier criticality analyses. Later iterations of the vulnerability analysis may also identify additional threats, or opportunities for threats, not considered in earlier threat assessments.

Table G-8 provides examples of applicable supply chain cybersecurity vulnerabilities that can be observed within the three levels.

Table G-8: Examples of Supply Chain Cybersecurity Vulnerabilities Mapped to the Enterprise Levels

Level	Agency Constraints	Supply Chain Constraints
Level 1 – Enterprise	1) Deficiencies or weaknesses in enterprise governance structures or processes such as a lack of C-SCRM Plan 2) Weaknesses in the supply chain itself (e.g., vulnerable entities, over-reliance on certain entities)	1) Provide guidance on how to consider dependencies on external enterprises as vulnerabilities. 2) Seek out alternate sources of new technology including building in-house, leveraging trustworthy shared services/common solutions.
Level 2 – Mission/ Business	1) No operational process is in place for detecting counterfeits 2) No budget was allocated for the implementation of a technical screening for acceptance testing of supplied system components entering the SDLC as replacement parts 3) Susceptibility to adverse issues from innovative technology supply sources (e.g., technology owned or managed by third parties is buggy)	1) Develop a program for detecting tainted or counterfeit products and allocate appropriate budgets for putting in resources and training. 2) Allocate budget for acceptance testing – technical screening of components entering SDLC.
Level 3 – Operation	1) Discrepancy in system functions not meeting requirements, resulting in substantial impact to performance	1) Initiate engineering change. Malicious alteration can happen throughout the system life cycle to an agency system to address functional discrepancy and test correction for performance impact.

RISK DETERMINATION

TASK 2-2: Determine the risk to enterprise operations and assets, individuals, other enterprises, and the Nation if identified threats exploit identified vulnerabilities.

Supplemental Guidance

Enterprises determine cybersecurity risk in the supply chain by considering the likelihood that known threats exploit known vulnerabilities to and through the supply chain and the resulting consequences or adverse impacts (i.e., magnitude of harm) if such exploitations occur. Enterprises use threat and vulnerability information together with likelihood and consequences/impact information to determine C-SCRM risk either qualitatively or quantitatively. Outputs from the Risk Determination at Levels 1 and 2 should correspond directly with the RMF Prepare – Enterprise Level tasks described within [NIST 800-37r2], while risk assessments completed for Level 3 should correspond to directly with the RMF Prepare – Operational-level tasks.

Likelihood

Likelihood is a weighted factor based on a subjective analysis of the probability that a given threat is capable of exploiting a given vulnerability [CNSSI 4009]. Determining this likelihood requires the consideration of the characteristics of the threat sources, the identified vulnerabilities, and the enterprise's susceptibility to the supply chain cybersecurity compromise, prior to and while the safeguards/mitigations are implemented. Likelihood determination should draw on methodologies defined as part of the Frame step, and update, refine, and expand any assumptions made about likelihood. For adversarial threats, this analysis should consider the degree of an adversary's capability and intent to interfere with the enterprise's mission. Supply chain cybersecurity risk assessment should consider two views:

- The likelihood that one or more elements within the supply chain itself is compromised. This may impact, for example, the availability of quality components or increase the risk of intellectual property theft; and
- The likelihood of the system or component within the supply chain being compromised, for example, by malicious code inserted into a system or an electric storm damaging a component.

In some cases, these two views may overlap or be indistinguishable, but both may have an impact on the agency's ability to perform its mission.

Likelihood determination should consider:

- Threat assumptions that articulate the types of threats the system or the component may be subject to, such as cybersecurity threats, natural disasters, or physical security threats
- Actual supply chain threat information such as adversaries' capabilities, tools, intentions, and targets

- Historical data about the frequency of supply chain events in peer or like enterprises
- Internal expert perspectives on the probability systems or process compromise through the supply chain
- Exposure of components to external access (i.e., outside of the system boundary)
- Identified system, process, or component vulnerabilities
- Empirical data on weaknesses and vulnerabilities available from any completed analysis (e.g., system analysis, process analysis) to determine probabilities of supply chain cybersecurity threat occurrence

Factors for consideration include the ease or difficulty of successfully attacking through a vulnerability and the ability to detect the method employed to introduce or trigger a vulnerability. The objective is to assess the net effect of the vulnerability, which will be combined with threat information to determine the likelihood of successful attacks within a defined time frame as part of the risk assessment process. The likelihood can be based on threat assumptions or actual threat data, such as previous breaches of the supply chain, specific adversary capability, historical breach trends, or frequency of breaches. The enterprise may use empirical data and statistical analysis to determine specific probabilities of breach occurrence, depending on the type of data available and accessible within the enterprise.

Impact

Enterprises should begin impact analysis using methodologies and potential impact assumptions defined during the Frame step, determining the impact of a compromise and the impact of mitigating said compromise. Enterprises need to identify the various adverse impacts of compromise, including: (i) the characteristics of the threat sources that could initiate the events; (ii) identified vulnerabilities; and (iii) the enterprise susceptibility to such events based on planned or implemented countermeasures. Impact analysis is an iterative process performed initially when a compromise occurs, when mitigation approach is decided to evaluate the impact of change, and finally, in the ever-changing SDLC, when the situation/context of the system or environment changes.

Enterprises should use the result of impact analysis to define an acceptable level of cybersecurity risk in the supply chain for a given system. Impact is derived from criticality, threat, and vulnerability analysis results, and should be based on the magnitude of effect on enterprise operations, enterprise assets, individuals, other enterprises, or the Nation (including the national security interests of the United States) of a loss of confidentiality, integrity, or availability of information or an information system [NIST SP 800-53 Rev. 5]. Impact is likely to be a qualitative measure requiring analytic judgment. Executive/decision-makers use impact as an input into the risk-based decisions whether to accept, avoid, mitigate, or share the resulting risks and the consequences of such decisions.

Enterprises should document the overall results of assessments of cybersecurity risk in the supply chain in risk assessment reports.[58] Supply chain cybersecurity risk assessment reports

[58] See [NIST SP 800-30 Rev. 1 Appendix K] for a description of risk assessment reports.

should cover risks in all three enterprise levels as applicable. Based on the enterprise structure and size, multiple assessment reports on cybersecurity risk in the supply chain may be required. Agencies are encouraged to develop individual reports at Level 1. For Level 2, agencies should integrate cybersecurity risk in the supply chain into the respective mission-level Business Impact Assessments (BIA) and may want to develop separate mission-level assessment reports on cybersecurity risk in the supply chain. For Level 3, agencies may want to integrate cybersecurity risk in the supply chain into the respective Risk Response Framework. Risk Response Frameworks at all three levels should be interconnected, reference each other when appropriate, integrate with the C-SCRM Plans, and comprise part of authorization packages.

Aggregation

Enterprises and enterprises may use risk aggregation to roll up several discrete or lower-level risks into a more general or higher-level risk [NIST SP 800-30 Rev. 1]. This is especially important for C-SCRM as enterprises and enterprises strive to understand their exposure to the supply chain at operational-levels as well as at the relationship level (i.e., Level 1). Ultimately, enterprises may wish to aggregate and normalize their C-SCRM risk assessment results with other enterprise risk assessments to develop an understanding of total risk exposure across risk types (e.g., financial, operational, legal/regulatory). This aggregation may occur to an enterprise level in cases where the enterprise consists of multiple lower-level enterprises. Each subordinate enterprise would roll up and normalize the enterprise-level risks into a single enterprise risk register. Risk aggregation may also occur from Level 2 mission and business process level registers into a single Level 1 enterprise-level risk register. To ease this process, enterprises should maximize inheritance of common frameworks and lexicons from higher-order risk processes (e.g., enterprise risk management).

When dealing with discrete risks (i.e., non-overlapping), enterprises can more easily develop a holistic understanding of aggregate Level 1 and 2 risk exposures. In many cases, however, enterprises will find that risk assessments completed at lower levels contain overlapping estimates for likelihood and/or impact magnitude. In these cases, the sum of the pieces (i.e., risk exposure ratings at lower levels) are greater than the whole (i.e., aggregate risk exposure of the enterprise). To overcome these challenges, enterprises can employ a variety of techniques. Enterprises may elect to use visualizations or heat maps to demonstrate the likelihood and impact of risks relative to one another. When presenting aggregate risk as a number, enterprises should ensure that assessments of risk produce discrete outputs by adopting mutually exclusive and collectively exhaustive (MECE) frameworks. MECE frameworks guide analysis of inputs (e.g., threats, vulnerabilities, impacts) and allow the enterprise to minimize overlapping assumptions and estimates. Instead of summing together risks from lower levels, enterprises may elect to perform a new holistic assessment at an upper level leveraging the combined assessment results from lower levels. Doing so can help enterprises avoid double counting of risk resulting in overestimation of their aggregate risk exposure. Enterprises should apply discretion in aggregating risks so as to avoid risk aggregations that are difficult to explain (e.g., combining highly differentiated scenarios into a single number).

Quantitative methods offer distinct advantages for risk aggregation. Through the use of probabilistic techniques (e.g., Monte Carlo methods, Bayesian analysis), enterprises can combine

similar risks into a single, easily understood figure (e.g., dollars) in a mathematically defensible manner. Mutually exclusive and collectively exhaustive frameworks remain an important requirement for quantitative methods.

Outputs and Post Conditions

This step results in:

- Confirmed mission and business process criticality;
- Establishment of relationships between the critical aspects of the system's supply chain infrastructure (e.g., SDLC) and applicable threats and vulnerabilities;
- Understanding of the likelihood and the impact of a potential supply chain cybersecurity compromise;
- Understanding mission and system-specific risks;
- Documented assessments of cybersecurity risk in the supply chain for mission processes and individual systems; and
- Integration of relevant assessments of cybersecurity risk in the supply chain results into the enterprise risk management process.

Respond

Inputs and Preconditions

Respond is the step in which the individuals conducting risk assessment will communicate the assessment results, proposed mitigation/controls options, and the corresponding acceptable level of risk for each proposed option to the decision makers. This information should be presented in a manner appropriate to inform and guide risk-based decisions. This will allow decision makers to finalize appropriate risk response based on the set of options and taking into account the corresponding risk factors of choosing the various options. Sometimes an appropriate response is to do nothing and to monitor the adversary's activities and behavior to better understand the tactics and to attribute the activities.

Cybersecurity supply chain risk response should be integrated into the overall enterprise risk response. Figure G-6 depicts the Respond Step with its inputs and outputs along the three enterprise levels.

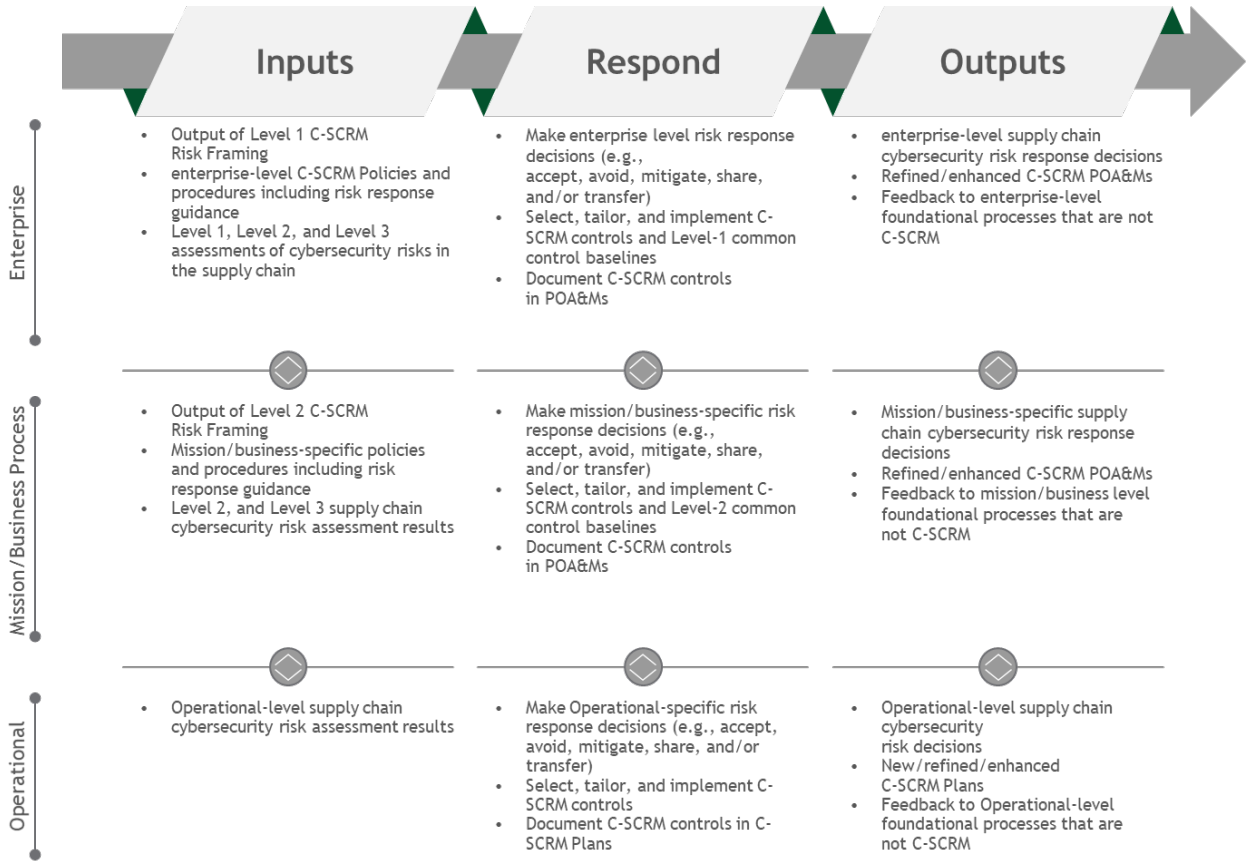


Fig. G-7: C-SCRM in the Respond Step[59]

Activities

RISK RESPONSE IDENTIFICATION

TASK 3-1: Identify alternative courses of action to respond to risk determined during the risk assessment.

Enterprise's risk response strategies will be informed by risk management strategies developed for the enterprise (i.e., Level 1) and mission/business process (i.e., Level 2). Risk response strategies will include general courses of action the enterprise may take as part of its risk response efforts (e.g., accept, avoid, mitigate, transfer or share). As part of mitigation efforts, enterprises should select C-SCRM controls and tailor these controls based on the risk determination. C-SCRM controls should be selected for all three levels, as appropriate per findings of the risk assessments for each of the levels.

Many of the C-SCRM controls included in this document may be part of an IT security plan and should be incorporated as requirements in agreements made with third party providers. These controls are included because they apply to C-SCRM.

[59] More detailed information on the Risk Management Process can be found in Appendix C

This process should begin by determining acceptable risk to support the evaluation of alternatives (also known as trade-off analysis).

EVALUATION OF ALTERNATIVES

TASK 3-2: Evaluate alternative courses of action for responding to risk.

Once an initial acceptable level of risk has been defined, risk response courses of action should be identified and evaluated for efficacy in enabling the enterprise to achieve its defined risk threshold. Evaluation of alternatives typically occurs at Levels 1 or 2 with a focus on anticipated enterprise-wide impacts of C-SCRM to the enterprise's ability to successfully carry out enterprise missions and processes. When carried out at Level 3, evaluation of alternatives will focus on the SDLC or the amount of time available for implementing the course of action.

Each courses of action analyzed may include a combination of risk acceptance, avoidance, mitigation, transfer and/or sharing. For example, an enterprise may elect to share a portion of its risk to a strategic supplier through the selection of controls included under contractual terms. Alternatively, an enterprise may choose to mitigate to acceptable levels though the selection and implementation of controls. In many cases, risk strategies will leverage a combination of risk response courses of action.

During evaluation of alternatives, enterprise will analyze available risk response courses of action for identified cybersecurity risk in the supply chain. The goal of this exercise is to enable the enterprise to achieve an appropriate balance among C-SCRM and functionality needs of the enterprise. As a first step, enterprises should ensure risk appetites and tolerances, priorities and tradeoffs, applicable requirements and constraints are reviewed with stakeholders familiar with broader enterprise requirements, such as cost, schedule, performance, policy, and compliance. Through this process, the enterprise will identify risk response implications to the enterprise's broader requirements. Equipped with a holistic understanding of risk response implications, enterprises should perform the C-SCRM, mission, and operational-level trade-off analyses to identify the correct balance of C-SCRM controls to respond to risk. At Level 3, the Frame, Assess, Respond, and Monitor process feeds into the RMF Select step described in [NIST SP 800-37 Rev. 2].

The selected C-SCRM controls for a risk response course of action will vary depending on where they are applied within enterprise levels and SDLC processes. For example, C-SCRM controls may range from using a blind buying strategy to obscure end use of a critical component, to design attributes (e.g., input validation, sandboxes, and anti-tamper design). For each implemented control, the enterprise should identify someone responsible for its execution and develop a time- or event-phased plan for implementation throughout the SDLC. Multiple controls may address a wide range of possible risks. Therefore, understanding how the controls impact the overall risk is essential and must be considered before choosing and tailoring the combination of controls as yet another trade-off analysis may be needed before the controls can be finalized. The enterprise may be trading one risk for a larger risk unknowingly if the

dependencies between the proposed controls and the overall risk are not well-understood and addressed.

RISK RESPONSE DECISION

TASK 3-3: Decide on the appropriate course of action for responding to risk.

As described in [NIST SP 800-39], enterprises should select, tailor, and finalize C-SCRM controls, based on the evaluation of alternatives and an overall understanding of threats, risks, and supply chain priorities. Within Levels 1 and 2, the resulting decision, along with selected and tailored common control baselines (i.e., revisions to established baselines) should be documented within a C-SCRM-specific Risk Response Framework.[60] Within Level 3, the resulting decision, along with the selected and tailored controls, should be documented within the C-SCRM Plan as part of an authorization package.

Risk response decisions may be made by a risk executive or delegated by the risk executive to someone else in the enterprise. While the decision can be delegated to Level 2 or Level 3, the significance and the reach of the impact should determine the level at which the decision is being made. Risk response decisions may be made in collaboration with an enterprise's risk executives, mission owners, and system owners, as appropriate. Risk response decisions are heavily influenced by the enterprise's predetermined appetite and tolerance for risk. Using robust risk appetite and tolerance definitions, decision makers can ensure consistent alignment of the enterprise's risk decisions with its strategic imperatives. Robust definitions of risk appetite and tolerance may also enable enterprises to delegate risk decision responsibility to lower levels of the enterprise and provide greater autonomy across the Levels.

Within Levels 1 and 2, the resulting decisions should be documented, along with any changes to requirements or selected common control baselines (enterprise, enterprise or mission and business process level), within C-SCRM-specific Risk Response Frameworks. The C-SCRM Risk Response Framework may influence other related Risk Response Frameworks.

The Risk Response Framework should include:

- Describing the threat source, threat event, exploited vulnerability, and threat event outcome;
- Providing an analysis of the likelihood and impact of the risk and final risk score;
- Describing the selected mitigating strategies and controls along with an estimate of the cost and effectiveness of the mitigation against the risk.

Within Level 3, the resulting decision, along with the selected and tailored controls, should be documented in a C-SCRM Plan. While the C-SCRM Plan is ideally developed proactively, it may also be developed in response to a supply chain cybersecurity compromise. Ultimately, the C-SCRM Plan should cover the full SDLC, document a C-SCRM baseline, and identify cybersecurity supply chain requirements and controls at the Level 3 operational-level. The C-

[60] More information can be found on Risk Response Frameworks in Appendix B along with explicit examples.

SCRM Plan should be revised and updated based on the output of cybersecurity supply chain monitoring.

C-SCRM Plans should:

- Summarize the environment as determined in Frame such as applicable policies, processes, and procedures based on enterprise and mission requirements currently implemented in the enterprise;
- State the role responsible for the plan such as Risk Executive, Chief Financial Officer (CFO), Chief Information Officer (CIO), Program Manager, or System Owner;
- Identify key contributors such as CFO, Chief Operations Officer (COO), Acquisition/Contracting, Procurement, C-SCRM PMO, System Engineer, System Security Engineer, Developer/Maintenance Engineer, Operations Manager, or System Architect;
- Provide the applicable (per level) set of risk mitigation measures and controls resulting from the Evaluation of Alternatives (in Respond);
- Provide tailoring decisions for selected controls including the rationale for the decision;
- Describe feedback processes among the levels to ensure that cybersecurity supply chain interdependencies are addressed;
- Describe monitoring and enforcement activities (including auditing if appropriate) applicable to the scope of each specific C-SCRM Plan;
- If appropriate, state qualitative or quantitative measures to support implementation of the C-SCRM Plan and assess effectiveness of this implementation;[61]
- Define frequency for deciding whether the plan needs to be reviewed and revised;
- Include criteria that would trigger revision, for example, life cycle milestones, gate reviews, or significant contracting activities; and
- Include suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers C-SCRM Plans if made available as part of agreements.

Agencies may want to integrate C-SCRM controls into the respective System Security Plans or develop separate operational-level C-SCRM Plans. At Level 3, the C-SCRM Plan applies to High and Moderate Impact systems per [FIPS 199]. Requirements and inputs from the Enterprise C-SCRM strategy at Level 1, and Mission C-SCRM strategy and implementation plan at Level 2, should flow down and be used to guide the develop C-SCRM Plans at Level 3. Conversely, the C-SCRM controls and requirements at Level 3 should be considered in developing and revising requirements and controls applied at the higher levels. C-SCRM Plans should be interconnected and reference each other when appropriate.

Table G-9 summarizes the controls to be contained in Risk Response Frameworks at Levels 1 and 2, and C-SCRM Plans at Level 3 and provides examples of those controls.

[61] NIST SP 800-55 Revision 1, *Performance Measurement Guide for Information Security* (July 2008), provides guidance on developing information security measures. Agencies can use general guidance in that publication to develop specific measures for their C-SCRM plans. See http://csrc.nist.gov/publications/nistpubs/800-55-Rev1/SP800-55-rev1.pdf.

Table G-9: Controls at Levels 1, 2, and 3

Level	Controls	Examples
Level 1	Provides enterprise common controls baseline to Levels 2 and 3	• Minimum sets of controls applicable to all suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers. • Enterprise-level controls applied to processing and storing suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers information. • Cybersecurity supply chain training and awareness for acquirer staff at the enterprise-level.
Level 2	• Inherits common controls from Level 1 • Provides mission and business process0level common controls baseline to Level 3 Provides feedback to Level 1 about what is working and what needs to be changed	• Minimum sets of controls applicable suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers for the specific mission and business process. • Program-level refinement of Identity and Access Management controls to address C-SCRM concerns. • Program-specific supply chain training and awareness.
Level 3	• Inherits common controls from Levels 1 and 2 • Provides system-specific controls for Level 3 Provides feedback to Level 2 and Level 1 about what is working and what needs to be changed	• Minimum sets of controls applicable to service providers or specific hardware and software for the individual system. • Appropriately rigorous acceptance criteria for change management for systems that support supply chain, e.g., as testing or integrated development environments. • System-specific cybersecurity supply chain training and awareness. • Intersections with the SDLC.

Appendix C provides an example C-SCRM Plan template with the sections and types of information enterprises should include in their C-SCRM Planning activities.

RISK RESPONSE IMPLEMENTATION

TASK 3-4: Implement the course of action selected to respond to risk.

Enterprises should implement the C-SCRM Plan in a manner that integrates the C-SCRM controls into the overall agency risk management processes.

Outputs and Post Conditions

The output of this step is a set of C-SCRM controls that address C-SCRM requirements and can be incorporated into the system requirements baseline and in agreements with third-party providers. These requirements and resulting controls will be incorporated into the SDLC and other enterprise processes, throughout the three levels.

For general risk types, this step results in:

- Selected, evaluated, and tailored C-SCRM controls that address identified risks;
- Identified consequences of accepting or not accepting the proposed mitigations; and
- Development and implementation of the C-SCRM Plan.

Monitor

INPUTS AND PRECONDITIONS

Monitor is the step in which enterprises: (i) verify compliance; (ii) determine the ongoing effectiveness of risk response measures; and (iii) identify risk-impacting changes to enterprise information systems and environments of operation.

Changes to the enterprise, mission/business, operations, or the supply chain can directly impact the enterprise's cybersecurity supply chain. The Monitor step provides a mechanism for tracking such changes and ensuring they are appropriately assessed for impact (in Assess). If the cybersecurity supply chain is redefined as a result of monitoring, enterprises should coordinate with the suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers to resolve implications and mutual obligations. A critical component of the monitor step includes the upward dissemination of information to inform higher level risk assessments (e.g., mission/business process assessment informs enterprise assessment). This ensure that enterprise leaders maintain visibility into risk conditions across the enterprise.

Enterprises should integrate C-SCRM into existing continuous monitoring programs.[62] In the event a Continuous Monitoring program does not exist, C-SCRM can serve as a catalyst for establishing a comprehensive continuous monitoring program. Figure G-7 depicts the Monitor Step with inputs and outputs along the three enterprise levels.

[62] NIST SP 800-137, *Information Security Continuous Monitoring (ISCM) for Federal Information Systems and Organizations* (September 2011), describes how to establish and implement a continuous monitoring program. See http://csrc.nist.gov/publications/nistpubs/800-137/SP800-137-Final.pdf.

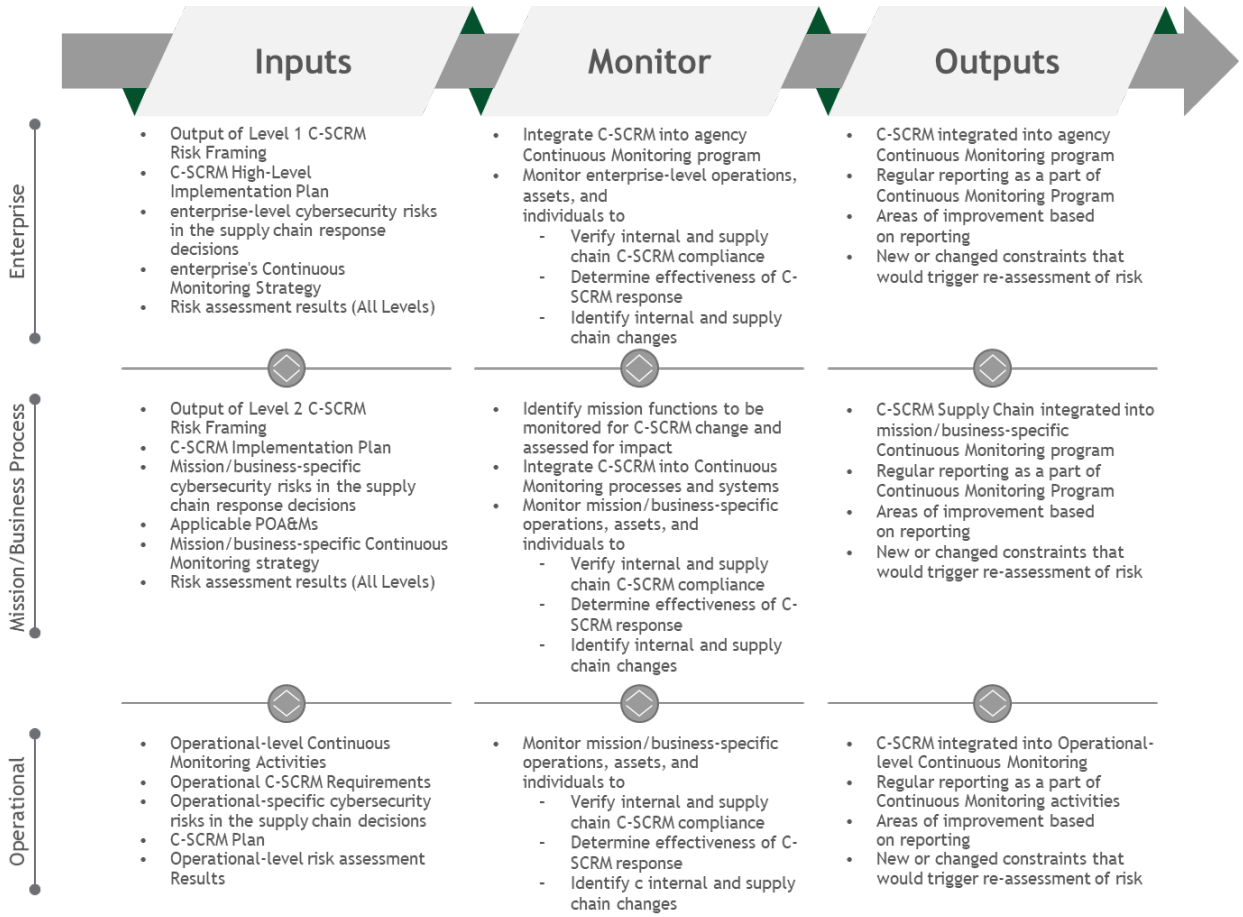


Fig. G-8: C-SCRM in the Monitor Step[63]

Activities

RISK MONITORING STRATEGY

TASK 4-1: Develop a risk monitoring strategy for the enterprise that includes the purpose, type, and frequency of monitoring activities.

Supplemental Guidance

Enterprises should integrate C-SCRM considerations into their overall risk monitoring strategy. Monitoring cybersecurity risk in the supply chain may require access to information that agencies may not have traditionally collected. Some of the information will require needing to be gathered from outside the agency, such as from open sources or suppliers and integrators. The strategy should, among other things, include the data to be collected, state the specific measures compiled from the data (e.g., number of contractual compliance violations by the vendor), identify existing or include assumptions about required tools needed to collect the data, identify how the data will be protected, and define reporting formats for the data. Potential data sources may include:

[63] More detailed information on the Risk Management Process can be found in Appendix C

- Agency vulnerability management and incident management activities;
- Agency manual reviews;
- Interagency information sharing;
- Information sharing between the agency and suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers;
- Supplier information sharing; and
- Contractual reviews of suppliers, developers, system integrators, external system service providers, and other ICT/OT-related service providers.

Enterprises should ensure the appropriate protection of supplier data if that data is collected and stored by the agency. Agencies may also require additional data collection and analysis tools to appropriately evaluate the data to achieve the objective of monitoring applicable cybersecurity risk in the supply chain.

RISK MONITORING

TASK 4-2: Monitor enterprise information systems and environments of operation on an ongoing basis to verify compliance, determine effectiveness of risk response measures, and identify changes.

According to [NIST SP 800-39], enterprises should monitor compliance, effectiveness, and change. Monitoring compliance within the context of C-SCRM involves monitoring an enterprise's processes and supplied products and services for compliance with the established security and C-SCRM requirements. Monitoring effectiveness involves monitoring the resulting risks to determine whether the established security and C-SCRM requirements produce the intended results. Monitoring change involves monitoring the environment for any changes that would signal changing requirements and mitigations/controls to maintain an acceptable level of cybersecurity risk in the supply chain.

To monitor for changes, enterprises should establish regular intervals at which they review and reassess suppliers as well as the products and services they provide. The reassessment intervals should be determined as needed and appropriate for the enterprise. Enterprises also need to identify and document a set of off-cycle triggers that would signal an alteration to the state of cybersecurity risk in the supply chain arising from a supplier relationship. While the categories of triggers will likely include changes to constraints, identified in Table D-6 (during the Frame Step), such as policy, mission, change to the threat environment, enterprise architecture, SDLC, or requirements, the specific triggers within those categories may be substantially different for different enterprises.

An example of a cybersecurity supply chain change is two key vetted suppliers[64] announcing their departure from a specific market, therefore creating a supply shortage for specific

[64] A vetted supplier is a supplier with whom the organization is comfortable doing business. This level of comfort is usually achieved through developing an organization-defined set of supply chain criteria and then *vetting* suppliers against those criteria.

components. This would trigger the need to evaluate whether reducing the number of suppliers could create vulnerabilities in component availability and integrity. In this scenario, potential deficit of components may result simply from insufficient supply of components, because fewer components are available. If none of the remaining suppliers are vetted, this deficit may result in uncertain integrity of the remaining components. If the enterprise policy directs use of vetted components, this event may result in the enterprise's inability to fulfill its mission needs. Supply Chain Change may also arise as a result of a company experiencing a change in ownership. A change in ownership could have significant implications especially in cases where the change involves a transfer of ownership to foreign nationals of a country different from that of the original owners.

In addition to regularly updating existing risks assessments at all levels of the enterprise with the results of the ongoing monitoring, the enterprise should determine the triggers of a reassessment. Some of these triggers may include availability of resources, changes to cybersecurity risk in the supply chain, natural disasters, or mission collapse.

In order for monitoring to be effective, the state of cybersecurity supply chain risk management needs to be communicated to decision-makers across the enterprise in the form of C-SCRM reporting. Reporting should be tailored to meet the specific needs of its intended audience. For example, reporting to Level 1 decision-makers may summarize the C-SCRM implementation coverage, efficiency, effectiveness, and overall levels of exposure to cybersecurity risk in the supply chain at aggregate levels across the enterprise. Where applicable and appropriate for the audience, reporting may focus on specific areas in Levels 2 and 3 requiring executive leadership attention. To aid in tailoring reporting, reporting requirements should be defined in collaboration with the intended audience and updated periodically to ensure reporting is efficient and effective.

Outputs and Post Conditions

Enterprises should integrate the cybersecurity supply chain outputs of the Monitor Step into the C-SCRM Plan. This plan will provide inputs into iterative implementations of the Frame, Assess, and Respond Steps as required.

9857

APPENDIX H: GLOSSARY

Term	Definition	Source
Acceptable Risk	A level of residual risk to the organization's operations, assets, or individuals that falls within the defined risk appetite and risk tolerance thresholds set by the organization.	
Acquirer	Organization or entity that acquires or procures a product or service.	[ISO/IEC 15288] (adapted)
Acquisition	Includes all stages of the process of acquiring product or services, beginning with the process for determining the need for the product or services and ending with contract completion and closeout.	[NIST SP 800-64 Rev. 2] (adapted)
Agreement	Mutual acknowledgement of terms and conditions under which a working relationship is conducted, or goods are transferred between parties. EXAMPLE: contract, memorandum, or agreement	
Authorization	Authorization to operate: The official management decision given by a senior Federal official or officials to authorize operation of an information system and to explicitly accept the risk to agency operations (including mission, functions, image, or reputation), agency assets, individuals, other organizations, and the Nation based on the implementation of an agreed-upon set of security and privacy controls. Authorization also applies to common controls inherited by agency information systems.	[NIST SP 800-53 Rev. 5]
Authorization Boundary	All components of an information system to be authorized for operation by an authorizing official. This excludes separately authorized systems to which the information system is connected.	[NIST SP 800-53 Rev. 5]
Authorizing Official (AO)	A senior Federal official or executive with the authority to authorize (i.e., assume responsibility for) the operation of an information system or the use of a designated set of common controls at an acceptable level of risk to agency operations (including mission, functions, image, or reputation), agency assets, individuals, other organizations, and the nation.	[NIST SP 800-53 Rev. 5]
Baseline	Hardware, software, databases, and relevant documentation for an information system at a given point in time.	[CNSSI No. 4009]

C-SCRM Control	A safeguard or countermeasures prescribed for the purpose of reducing or eliminating the likelihood and/or impact/consequences of a cybersecurity risk in the supply chain.
Supply Chain	A linked set of resources that can be subject to cybersecurity risk in the supply chain from suppliers, their supply chains, and their products or services.
Cybersecurity Risk in Supply Chains	Cybersecurity risk in the supply chain is the potential for harm or compromise that arises as a result of cybersecurity risks from suppliers, their supply chains, and their products or services. Cybersecurity risk in the supply chain arise from threats that exploit vulnerabilities or exposures within products and services traversing the supply chain as well as threats exploiting vulnerabilities or exposures within the supply chain itself.
Supply Chain Cybersecurity Risk Assessment	Supply Chain Cybersecurity Risk Assessment is a systematic examination of cybersecurity risk in the supply chain, likelihoods of their occurrence, and potential impacts.
Cybersecurity Compromise in the Supply Chain	A cybersecurity incident in the supply chain (also known as compromise) is an occurrence within the supply chain whereby the confidentiality, integrity, or availability of a system or the information the system processes, stores, or transmits is jeopardized. A supply chain incident can occur anywhere during the life cycle of the system, product or service.
Cybersecurity Supply Chain Risk Management	A systematic process for managing exposures to cybersecurity risk in the supply chain, threats, and vulnerabilities throughout the supply chain and developing risk response strategies to the cybersecurity risk in the supply chain presented by the supplier, the supplied products and services, or the supply chain. For the purposes of NIST pubs SCRM and C-SCRM refer to the same concept. This is because NIST is addressing only the cybersecurity aspects of SCRM. Other organizations may use a different definition of SCRM which is outside the scope of this publication. This publication does not address many of the non-cybersecurity aspects of SCRM.

Defense-in-Breadth	A planned, systematic set of multidisciplinary activities that seek to identify, manage, and reduce risk of exploitable vulnerabilities at every stage of the system, network, or subcomponent life cycle, including system, network, or product design and development, manufacturing, packaging, assembly, system integration, distribution, operations, maintenance, and retirement.	[NIST SP 800-53 Rev. 5]
Defense-in-Depth	Information security strategy that integrates people, technology, and operations capabilities to establish variable barriers across multiple layers and missions of the organization.	[NIST SP 800-53 Rev. 5]
Degradation	A decline in quality or performance; the process by which the decline is brought about.	
Developer	A general term that includes developers or manufacturers of systems, system components, or system services, systems integrators, suppliers, and product resellers. Development of systems, components, or services can occur internally within organizations or through external entities.	[NIST SP 800-53 Rev. 5]
Element	Supply chain element: organizations, entities, or tools employed for the research and development, design, manufacturing, acquisition, delivery, integration, operations and maintenance, and/or disposal of systems and system components.	
Enhanced Overlay	An overlay that adds processes, controls, enhancements, and additional implementation guidance specific to the purpose of the overlay.	
Exposure	Extent to which an organization and/or stakeholder is subject to a risk	[ISO Guide 73:2009] (adapted)
External systems Service Provider	A provider of external system services to an organization through a variety of consumer-producer relationships, including joint ventures; business partnerships; outsourcing arrangements (i.e., through contracts, interagency agreements, lines of business arrangements); licensing agreements; and/or supply chain exchanges.	[NIST SP 800-53 Rev. 5]

External System Service	A system service that is provided by an external service provider and for which the organization has no direct control over the implementation of required security and privacy controls or the assessment of control effectiveness.	[NIST SP 800-53 Rev. 5]
Fit for purpose	Fit for purpose is used informally to describe a process, configuration item, IT service, etc., that is capable of meeting its objectives or service levels. Being fit for purpose requires suitable design, implementation, control, and maintenance.	[ITIL Service Strategy] (adapted)
ICT/OT-related service providers	Any organization or individual providing services which may include authorized access to an ICT or OT system	
Information and Communications Technology (ICT)	Encompasses the capture, storage, retrieval, processing, display, representation, presentation, organization, management, security, transfer, and interchange of data and information.	[ISO/IEC 2382] (adapted)
Information System	A discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information.	[NIST SP 800-53 Rev. 5]
Life Cycle	Evolution of a system, product, service, project, or other human-made entity.	[ISO/IEC 15288] (adapted)
Likelihood	Chance of something happening.	[ISO/IEC 27000:2018]
Organizational Users	An organizational employee or an individual the organization deemed to have similar status of an employee including, for example, contractor, guest researcher, or individual detailed from another organization.	[NIST SP 800-53 Rev. 4] (adapted)
Overlay	A specification of security or privacy controls, control enhancements, supplemental guidance, and other supporting information employed during the tailoring process, that is intended to complement (and further refine) security control baselines. The overlay specification may be more stringent or less stringent than the original security control baseline specification and can be applied to multiple information systems.	[NIST SP 800-53 Rev. 5]

Pedigree	The validation of the composition and provenance of technologies, products, and services is referred to as the pedigree. For microelectronics, this includes material composition of components. For software this includes the composition of open source and proprietary code, including the version of the component at a given point in time. Pedigrees increase the assurance that the claims suppliers assert about the internal composition and provenance of the products, services, and technologies they provide are valid.	
Provenance	The chronology of the origin, development, ownership, location, and changes to a system or system component and associated data. It may also include personnel and processes used to interact with or make modifications to the system, component, or associated data.	[NIST SP 800-53 Rev. 5]
Risk	A measure of the extent to which an entity is threatened by a potential circumstance or event, and typically a function of: (i) the adverse impacts that would arise if the circumstance or event occurs; and (ii) the likelihood of occurrence.	[NIST SP 800-39]
Residual Risk	Portion of risk remaining after controls/countermeasures have been applied.	[NIST SP 800-16] (adapted)
Risk Appetite	The types and amount of risk, on a broad level, it is willing to accept in its pursuit of value.	[NISTIR 8286]
Risk Framing	The set of assumptions, constraints, risk tolerances, and priorities/trade-offs that shape an organization's approach for managing risk.	[NIST SP 800-39]
Risk Management	The program and supporting processes to manage risk to agency operations (including mission, functions, image, reputation), agency assets, individuals, other organizations, and the Nation, and includes establishing the context for risk-related activities; assessing risk; responding to risk once determined; and monitoring risk over time.	[NIST SP 800-53 Rev. 5]
Risk Mitigation	Prioritizing, evaluating, and implementing the appropriate risk-reducing controls/countermeasures recommended from the risk management process.	[NIST SP 800-53 Rev. 5]

Risk Response	Intentional and informed decision and actions to accept, avoid, mitigate, share, or transfer an identified risk.	[NIST SP 800-53 Rev. 5] (adapted)
Risk Response Plan	A summary of potential consequence(s) of the successful exploitation of a specific vulnerability or vulnerabilities by a threat agent, as well as mitigating strategies and C-SCRM controls.	
Risk Tolerance	the organization or stakeholders' readiness to bear the remaining risk after responding to or considering the risk in order to achieve its objectives.	[NIST 8286]
Secondary Market	An unofficial, unauthorized, or unintended distribution channel.	
Security Control	The safeguards or countermeasures prescribed for an information system or an organization to protect the confidentiality, integrity, and availability of the system and its information.	[NIST SP 800-53 Rev. 5]
Supplier	Organization or individual that enters into an agreement with the acquirer or integrator for the supply of a product or service. This includes all suppliers in the supply chain, developers or manufacturers of systems, system components, or system services; systems integrators; suppliers; product resellers; and third-party partners.	[ISO/IEC 15288] (adapted); adapted from definition of "developer" from [NIST SP 800-53 Rev. 5]
Supply Chain	Supply chain: Linked set of resources and processes between and among multiple levels of organizations, each of which is an acquirer, that begins with the sourcing of products and services and extends through their life cycle.	[ISO 28001] (adapted)

Cybersecurity Supply Chain Risk Information	Cybersecurity supply chain risk information includes, but is not limited to, information that describes or identifies: (1) Functionality of covered articles, including access to data and information system privileges; (2) Information on the user environment where a covered article is used or installed; (3) The ability of the source to produce and deliver covered articles as expected (i.e., supply chain assurance); (4) Foreign control of, or influence over, the source (e.g., foreign ownership, personal and professional ties between the source and any foreign entity, legal regime of any foreign country in which the source is headquartered or conducts operations); (5) Implications to national security, homeland security, and/or national critical functions associated with use of the covered source; (6) Vulnerability of federal systems, programs, or facilities; (7) Market alternatives to the covered source; (8) Potential impact or harm caused by the possible loss, damage, or compromise of a product, material, or service to an organization's operations or mission; (9) Likelihood of a potential impact or harm, or the exploitability of a system; (10) Security, authenticity, and integrity of covered articles and their supply and compilation chain; (11) Capacity to mitigate risks identified; (12) Credibility of and confidence in other supply chain risk information; (13) Any other information that would factor into an analysis of the security, integrity, resilience, quality, trustworthiness, or authenticity of covered articles or sources; (14) A summary of the above information, including: Summary of the threat level on 1 (low) to 5 (high) scale; and summary of the vulnerability level on 1 (low) to 5 (high) scale; and, any other information determined to be relevant to the determination of supply chain risk.	[FASCA]
System Integrator	An organization that customizes (e.g., combines, adds, optimizes) components, systems, and corresponding processes. The integrator function can also be performed by acquirer.	[NISTIR 7622] (adapted)

System	Combination of interacting elements organized to achieve one or more stated purposes. *Note 1:* There are many types of systems. Examples include general and special-purpose information systems; command, control, and communication systems; crypto modules; central processing unit and graphics processor boards; industrial control systems; flight control systems; weapons, targeting, and fire control systems; medical devices and treatment systems; financial, banking, and merchandising transaction systems; and social networking systems. *Note 2:* The interacting elements in the definition of system include hardware, software, data, humans, processes, facilities, materials, and naturally occurring physical entities. *Note 3:* System-of-systems is included in the definition of system.	[NIST SP 800-53 Rev. 5] (adapted)
System Component	A discrete identifiable information or operational technology asset that represents a building block of a system and may include hardware, software, and firmware.	
System Development Life Cycle (SDLC)	The scope of activities associated with a system, encompassing the system's initiation, development and acquisition, implementation, operation and maintenance, and ultimately its disposal.	[NIST SP 800-34 Rev. 1] (adapted)
System Integrator	Those organizations that provide customized services to the acquirer including for example, custom development, test, operations, and maintenance.	
System Assurance	The justified confidence that the system functions as intended and is free of exploitable vulnerabilities, either intentionally or unintentionally designed or inserted as part of the system at any time during the life cycle.	[NDIA]
System Owner	System owner (or program manager): Official responsible for the overall procurement, development, integration, modification, or operation and maintenance of a system.	[NIST SP 800-53 Rev. 5]

Threat	Any circumstance or event with the potential to adversely impact organizational operations, organizational assets, individuals, other organizations, or the Nation through a system via unauthorized access, destruction, disclosure, modification of information, and/or denial of service.	[NIST SP 800-53 Rev. 5]
Threat Assessment/Analysis	Formal description and evaluation of threat to a system or organization.	[NIST SP 800-53 Rev. 5] (adapted)
Threat Event	An event or situation that has the potential for causing undesirable consequences or impact.	[NIST SP 800-30 Rev. 1]
Threat Event Outcome	The effect a threat acting upon a vulnerability has on the confidentiality, integrity, and/or availability of the organization's operations, assets, or individuals.	
Threat Scenario	A set of discrete threat events, associated with a specific threat source or multiple threat sources, partially ordered in time.	[NIST SP 800-30 Rev. 1]
Threat Source	The intent and method targeted at the intentional exploitation of a vulnerability or a situation and method that may accidentally trigger a vulnerability.	[NIST SP 800-53 Rev. 5]
Trust	The confidence one element has in another, that the second element will behave as expected.	[Software Assurance in Acquisition: Mitigating Risks to the Enterprise]
Trustworthiness	The interdependent combination of attributes of a person, system, or enterprise that provides confidence to others of the qualifications, capabilities, and reliability of that entity to perform specific tasks and fulfill assigned responsibilities. The degree to which a system (including the technology components that are used to build the system) can be expected to preserve the confidentiality, integrity, and availability of the information being processed, stored, or transmitted by the system across the full range of threats.	[NIST SP 800-53 Rev. 5] (adapted)
Validation	Confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled. Note: The requirements were met.	[ISO 9000]

Verification	Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled. Note: The intended output is correct.	[CNSSI No. 4009], [ISO 9000] (adapted)
Visibility (also Transparency)	Amount of information that can be gathered about a supplier, product, or service and how far through the supply chain this information can be obtained.	[ISO/IEC 27036-2] (adapted)
Vulnerability	Weakness in an information system, system security procedures, internal controls, or implementation that could be exploited or triggered by a threat source.	[NIST SP 800-53 Rev. 5]
Vulnerability Assessment	Systematic examination of a system or product or supply chain element to determine the adequacy of security measures, identify security deficiencies, provide data from which to predict the effectiveness of proposed security measures, and confirm the adequacy of such measures after implementation.	[NIST SP 800-53 Rev. 5] (adapted)

9859
9860
9861

APPENDIX I: ACRONYMS

A&A	Assessment and Authorization
AO	Authorizing Official
API	Application Programming Interface
APT	Advanced Persistent Threat
BIA	Business Impact Analysis
BYOD	Bring Your Own Device
CAC	Common Access Card
CAO	Chief Acquisition Officer
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CISA	Cybersecurity and Infrastructure Security Agency
CISO	Chief Information Security Officer
CLO	Chief Legal Officer
COO	Chief Operating Officer
CPO	Chief Privacy Officer
CRO	Chief Risk Officer
CSO	Chief Security Officer
CTO	Chief Technology Officer
CNSS	Committee on National Security Systems
CNSSI	Committee on National Security Systems Instruction
CONUS	Continental United States
COSO	Committee of Sponsoring Organizations of the Treadway Commission
COTS	Commercial Off-The-Shelf

CRO	Chief Risk Officer
C-SCRM	Cybersecurity Supply Chain Risk Management
CSF	Cybersecurity Framework
CTO	Chief Technology Officer
CUI	Controlled Unclassified Information
CVE	Common Vulnerability Enumeration
CVSS	Common Vulnerability Scoring System
CWE	Common Weakness Enumeration
DHS	Department of Homeland Security
DMEA	Defense Microelectronics Activity
DoD	Department of Defense
DODI	Department of Defense Instruction
ERM	Enterprise Risk Management
ERP	Enterprise Resource Planning
FAR	Federal Acquisition Regulation
FARM	Frame, Assess, Respond, Monitor
FASC	Federal Acquisition Security Council
FASCA	Federal Acquisition Supply Chain Security Act
FBI	Federal Bureau of Investigation
FedRAMP	Federal Risk and Authorization Program
FIPS	Federal Information Processing Standards
FISMA	Federal Information Security Management Act
FITARA	Federal Information Technology Acquisition Reform Act
FOCI	Foreign Ownership, Control or Influence
FSP	Financial Services Cybersecurity Framework Profile

GAO	Government Accountability Office
GIDEP	Government-Industry Data Exchange Program
GOTS	Government Off-The-Shelf
GPS	Global Positioning System
HR	Human Resources
IA	Information Assurance
ICT	Information and Communication Technology
ICT/OT	Information, communications, and operational technology
IDE	Integrated Development Environment
IDS	Intrusion Detection System
IEC	International Electrotechnical Commission
IOT	Internet of Things
IP	Internet Protocol/Intellectual Property
ISA	Information Sharing Agency
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
IT	Information Technology
ITIL	Information Technology Infrastructure Library
ITL	Information Technology Laboratory (NIST)
JWICS	Joint Worldwide Intelligence Communications System
KPI	Key Performance Indicators
KRI	Key Risk Indicators
KSA	Knowledge, Skills, and Abilities
MECE	Mutually Exclusive and Collectively Exhaustive
NISPOM	National Industrial Security Program Operating Manual

NIST	National Institute of Standards and Technology
NCCIC	National Cybersecurity and Communications Integration Center
NDI	Non-developmental Items
NDIA	National Defense Industrial Association
NIAP	National Information Assurance Partnership
NICE	National Initiative for Cybersecurity Education
NISTIR	National Institute of Standards and Technology Interagency or Internal Report
OCONUS	Outside of Continental United States
OEM	Original Equipment Manufacturer
OGC	Office of the General Counsel
OMB	Office of Management and Budget
OPSEC	Operations Security
OSS	Open Source Solutions
OSY	Office of Security
OT	Operations Technology
OTS	Off-The-Shelf
OTTF	Open Group Trusted Technology Forum
O-TTPS	Open Trusted Technology Provider™ Standard
OWASP	Open Web Application Security Project
PACS	Physical Access Control System
PII	Personally Identifiable Information
PIV	Personal Identity Verification
PM	Program Manager
PMO	Program Management Office
POA&M	Plan of Action & Milestones

QA/QC	Quality Assurance/Quality Control
R&D	Research and Development
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Questions
RMF	Risk Management Framework
SAFECode	Software Assurance Forum for Excellence in Code
SCIF	Sensitive Compartmented Information Facility
SCRM	Supply Chain Risk Management
SDLC	System Development Life Cycle
SECURE	Strengthening and Enhancing Cyber-capabilities by Utilizing Risk Exposure (Technology Act)
SLA	Service-Level Agreement
SME	Subject Matter Expert
SOO	Statement of Objective
SOW	Statement of Work
SP	Special Publication (NIST)
SSP	System Security Plan
SWA	Software Assurance
SWID	Software Identification Tag
TTP	Tactics, Techniques, and Procedures
U.S.	United States (of America)
US CERT	United States Computer Emergency Readiness Team

9863

APPENDIX J: REFERENCES

RELATIONSHIP TO OTHER PROGRAMS AND PUBLICATIONS

The revision to NIST SP 800-161 builds upon concepts described in a number of NIST and other publications to facilitate integration with the agencies' existing enterprise-wide activities, as well as a series of legislative developments following its initial release. These resources are complementary and help enterprises build risk-based information security programs to protect their operations and assets against a range of diverse and increasingly sophisticated threats. This publication will be revised to remain consistent with the NIST SP 800-53 security controls catalog using an iterative process as the C-SCRM discipline continues to mature.

NIST Publications

[NIST SP 800-161 Rev. 1] leverages the latest versions of the publications and programs that guided its initial development, as well as new publications following its initial release:

- NIST Cybersecurity Framework (CSF) Version 1.1;
- FIPS 199, *Standards for Security Categorization of Federal Information and Information Systems,* to conduct criticality analysis to scoping C-SCRM activities to high-impact components or systems [FIPS 199];
- NIST SP 800-30, Revision 1, *Guide for Conducting Risk Assessments,* to integrate ICT/OT SCRM into the risk assessment process [NIST SP 800-30 Rev. 1];
- NIST SP 800-37, Revision 2, *Risk Management Framework for Information Systems and Organizations: A System Life Cycle Approach for Security and Privacy* [NIST SP 800-37 Rev. 2]*;*
- NIST SP 800-39, *Managing Information Security Risk: Organization, Mission, and Information System View,* to integrate ICT/OT SCRM into the risk management levels and risk management process [NIST SP 800-39];
- NIST SP 800-53 Revision 5, *Security and Privacy Controls for Information Systems and Organizations,* to provide information security controls for enhancing and tailoring to C-SCRM context [NIST SP 800-53 Rev. 5];
- NIST SP 800-53B Revision 5, *Control Baselines for Information Systems and Organizations*, to codify control baselines and C-SCRM supplementary guidance and [NIST SP 800-53B Rev. 5];
- NIST SP 800-150, *Guide to Cyber Threat Information Sharing*, to provide guidelines for establishing and participating in cyber threat information relationships [NIST SP 800-150];
- NIST SP 800-160 Vol. 1, *Systems Security Engineering* [NIST SP 800-160 Vol. 1] and NIST SP 800-160 Vol. 2, *Developing Cyber Resilient Systems: A Systems Security Engineering Approach* [NIST SP 800-160 Vol. 2] for specific guidance on the security engineering aspects of C-SCRM;
- NIST SP 800-181 Revision 1, *National Initiative for Cybersecurity Education (NICE) Cybersecurity Workforce Framework*, as a means of forming a common lexicon on C-SCRM workforce topics [NIST SP-800-181 Rev. 1];

- NISTIR 7622, *Notional Supply Chain Risk Management Practices for Federal Information Systems*, for background materials in support of applying the special publication to their specific acquisition processes [NISTIR 7622];
- NISTIR 8179, *Criticality Analysis Process Model: Prioritizing Systems and Components*, to guide ratings of supplier criticality [NISTIR 8179];
- NISTIR 8272, *Impact Analysis Tool for Interdependent Cyber Supply Chain Risks* for guidance on how to prioritize supplier criticality [NISTIR 8272];
- NISTIR 8276, *Key Practices in Cyber Supply Chain Risk Management: Observations from Industry*, to elucidate recent C-SCRM trends in the private sector [NISTIR 8276]; and
- NISTIR 8286, *Identifying and Estimating Cybersecurity Risk for Enterprise Risk Management (ERM)*, to inform the content on integrating C-SCRM into enterprise risk management [NISTIR 8286].

Regulatory and Legislative Guidance

[NIST SP 800-161 Rev. 1] is informed heavily by regulatory and legislative guidance, including:

- Office of Management and Budget (OMB) Circular A-123, *Management's Responsibility for Internal Control*
- Office of Management and Budget (OMB) Circular A-130, *Managing Information as a Strategic Resource*
- The Federal Acquisition Supply Chain Security Act (FASCA), *Title II of the Strengthening and Enhancing Cyber-capabilities by Utilizing Risk Exposure Technology Act (SECURE) Technology Act of 2018*
- Public Law 115–232 § 889, *Prohibition on Contracting Certain Telecommunications and Video Surveillance Services or Equipment*
- Federal Register, Vol. 84, No. 156, *Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment*, August 13, 2019
- FAR Part 4, Subpart 4.20, *Prohibition on Contracting for Hardware, Software, and Services Developed or Provided by Kaspersky Lab*
- (GAO), *Challenges and Policy Considerations Regarding Offshoring and Foreign Investment Risks*, September 2019
- Executive Order 14028, *Improving the Nation's Cybersecurity,* May 12, 2021

Other U.S. Government Reports

[NIST SP 800-161 Rev. 1] is also informed by additional government reports:

- Government Accountability Office (GAO) Report, *Information Technology: Federal Agencies Need to Take Urgent Action to Manage Supply Chain Risks*, December 2020, GAO-21-171 [GAO]
- Department of Defense and Department of Homeland Security Software Assurance Acquisition Working Group, *Software Assurance in Acquisition: Mitigating Risks to the Enterprise* [SwA]

- National Defense Industrial Association (NDIA), *Engineering for System Assurance* [NDIA]

Standards, Guidelines, and Best Practices

Additionally, [NIST SP 800-161] draws inspiration from a number of international standards, guidelines, and best practice documents:

- The Federal Risk and Authorization Management Program (FedRAMP), *Securing Cloud Services For The Federal Government* [https://www.fedramp.gov/]
- International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 15288 – *Systems and software engineering – System Life Cycle Processes* [ISO/IEC 15288]
- ISO/IEC 27036 – *Information Technology – Security Techniques – Information Security for Supplier Relationships* [ISO/IEC 27036]
- ISO/IEC 20243 – *Information Technology — Open Trusted Technology Provider™ Standard (O-TTPS) — Mitigating maliciously tainted and counterfeit products* [ISO/IEC 20243]
- ISO/IEC 27000 – *Information Technology – Security Techniques – Information Security Management System – Overview and Vocabulary* [ISO/IEC 27000]
- ISO/IEC 27002 – *Information Technology – Security Techniques – Code of Practice for Information Security Controls* [ISO/IEC 27002]
- Software Assurance Forum for Excellence in Code (SAFECode) *Software Integrity Framework* [SAFECode 2] and *Software Integrity Best Practices* [SAFECode 1]
- Cyber Risk Institute, *Financial Services Cybersecurity Framework Profile Version 1.1* [FSP]

Guidance for Cloud Service Providers

The *external system service providers* discussed in this publication include *cloud service providers*. This publication does not replace guidance provided with respect to federal agency assessment of cloud service providers' security. When applying this publication to cloud service providers, federal agencies should first use Federal Risk and Authorization Program (FedRAMP) cloud services security guidelines and then apply [NIST SP 800-161 Rev. 1] for those processes and controls that are not addressed by FedRAMP.[65]

METHODOLOGY FOR BUILDING C-SCRM GUIDANCE USING SP 800-39, SP 800-37 REVISION 2, AND NIST SP 800-53 REVISION 5

This publication applies the multileveled risk management approach of [NIST SP 800-39] by providing C-SCRM guidance at the enterprise, mission, and operational levels. It also introduces a navigational system for [SP 800-37 Rev. 2] allowing users to focus on relevant sections of this publication more easily. Finally, it contains an enhanced overlay of specific C-SCRM controls, building on [NIST SP 800-53 Rev. 5].

[65] For cloud services, FedRAMP is applicable for low-, moderate-, high-impact systems [FedRAMP]. Ongoing work will address high-impact systems utilizing cloud services. Once the work is completed, agencies should refer to FedRAMP for guidance applicable to high-impact systems utilizing cloud services.

The guidance/controls contained in this publication are built on existing multidisciplinary practices and are intended to increase the ability of enterprises to strategically and operationally manage the associated cybersecurity risk in the supply chain over the entire life cycle of systems, products, and services. It should be noted that this publication gives enterprises the flexibility to either develop stand-alone documentation (e.g., policies, assessment and authorization [A&A] plan, and C-SCRM plan) for C-SCRM or to integrate it into existing agency documentation.

For individual systems, this guidance is recommended for use with information systems at all impact categories, according to [FIPS 199]. The agencies may choose to prioritize applying this guidance to systems at a higher-impact level or to specific system components. Finally, [NIST SP 800-161 Rev. 1] describes the development and implementation of C-SCRM Strategies and Implementation Plans for development at the enterprise and mission/business level of an enterprise and a C-SCRM system plan at the operational level of an enterprise. A C-SCRM plan at the operational level is informed by the supply chain cybersecurity risk assessments and should contain C-SCRM controls tailored to specific agency mission/business needs, operational environments, and/or implementing technologies.

Integration into Risk Management Process

The processes in this publication should be integrated into agencies' existing SDLCs and enterprise environments at all levels of risk management processes and hierarchy (enterprise, mission, system) as described in [NIST SP 800-39]. Section 2 provides an overview of the [NIST SP 800-39] risk management hierarchy and approach and identifies C-SCRM activities in the risk management process. Appendix C builds on Section 2 of [NIST SP 800-39], providing descriptions and explanations of ICT/OT SCRM activities. The structure of Appendix C mirrors [NIST SP 800-39].

Implementing C-SCRM in the Context of SP 800-37 Revision 2

C-SCRM activities described in this publication are closely related to the Risk Management Framework described in [NIST SP 800-37, Rev. 2]. Specifically, C-SCRM processes conducted at the operational level should closely mirror and/or serve as inputs to those steps completed as part of the [NIST SP 800-37, Rev 2]. C-SCRM activities completed at Levels 1 and 2 should provide inputs (e.g., risk assessment results) to the operational level, RMF-type processes where possible and applicable. Section 2 and Appendix C describe in further detail the linkages between C-SCRM and [NIST SP 800-37, Rev. 2].

Enhanced C-SCRM Overlay

This publication contains an enhanced overlay of [NIST SP 800-53 Rev. 5]. Appendix A identifies, refines, and expands C-SCRM-related controls from [NIST SP 800-53 Rev. 5], adds new controls that address specific C-SCRM concerns, and offers C-SCRM-specific supplemental guidance where appropriate. Figure 1-4 illustrates the process used to create the enhanced overlay. The individual controls and enhancements from [NIST SP 800-53 Rev. 5] that were relevant to C-SCRM were extracted. These controls were analyzed to determine how they apply 0to C-SCRM. Additional supplemental guidance was then developed and included for each

control and control enhancement. The resulting set of controls and enhancements were evaluated to determine whether all C-SCRM concerns were addressed.

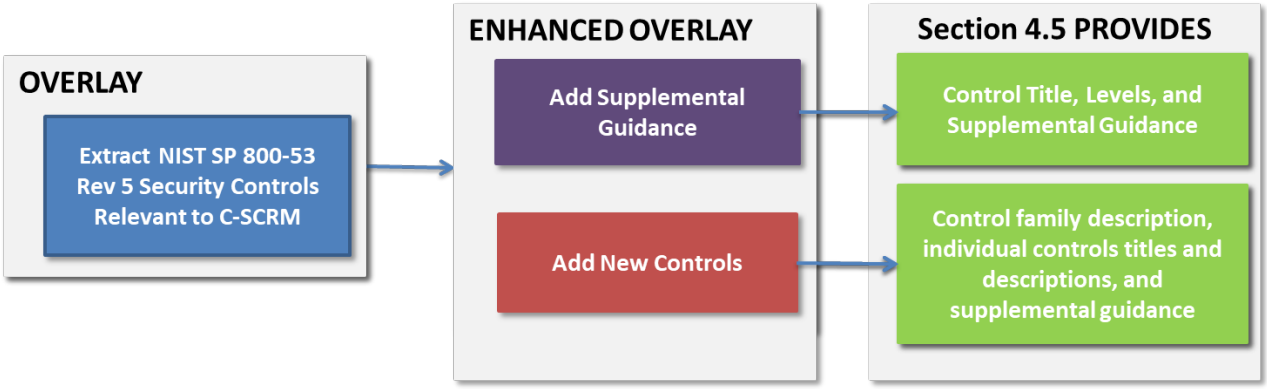


Fig. H-1: C-SCRM Security Controls in NIST SP 800-161, Revision 1, Section 4.5

FULL LIST OF REFERENCES

[18 U.S.C.] 18 U.S.C. § 2320.

[41 U.S.C.] 41 U.S.C.

[48 C.F.R.] 48 C.F.R.

[ANSI/NASPO] *ANSI / NASPO Security Assurance Standard*, American National Standards Institute / North American Security Products Organization, 2008.

[ITIL Service Strategy] Cannon, David, *ITIL Service Strategy*, 2nd Edition, The Stationary Office,, July 29, 2011.

[COSO 2011] Thought Leadership in ERM, *Enterprise Risk Management: Understanding and Communicating Risk Appetite,* Committee of Sponsoring Organization of the Treadway Commission (COSO), 2012, https://www.coso.org/Documents/ERM-Understanding-and-Communicating-Risk-Appetite.pdf.

[COSO 2020] Thought Leadership in ERM, *Risk Appetite – Critical to Success: Using Risk Appetite To Thrive in a Changing World,* Committee of Sponsoring Organization of the Treadway Commission (COSO), 2020, https://www.coso.org/Documents/COSO-Guidance-Risk-Appetite-Critical-to-Success.pdf.

[CISA TEWG] Cybersecurity and Infrastructure Agency (CISA), *Information and Communications Technology Supply Chain Risk Management Task Force – Threat Evaluation Working Group: Threat Scenarios,* Version 2.0, Arlington, Virginia, 2021, https://www.cisa.gov/sites/default/files/publications/ict-scrm-task-force-threat-scenarios-report-v2.pdf.

[CISA SCRM WG4] Cybersecurity and Infrastructure Agency (CISA), *Vendor Supply Chain Risk Management (SCRM) Template,* Arlington, Virginia, 2021, https://www.cisa.gov/sites/default/files/publications/ICTSCRMTF_Vendor-SCRM-Template_508.pdf

[Defense Industrial Base Assessment: Counterfeit Electronics] *Defense Industrial Base Assessment: Counterfeit Electronics,* U.S. Department of Commerce, Bureau of Industry and Security, Office of Technology Evaluation, January 2010, https://www.bis.doc.gov/index.php/documents/technology-evaluation/37-defense-industrial-base-assessment-of-counterfeit-electronics-2010/file.

[FEDRAMP] *FedRAMP*, http://www.fedramp.gov/.

[Gardner] Gardner, John T. and Cooper, Martha C., "Strategic Supply Chain Mapping Approaches," *Journal of Business Logistics*, 24 (2003), doi:10.1002/j.2158-1592.2003.tb00045.x.

[GAO] Government Accountability Office (GAO) Report, *Information Technology: Federal Agencies Need to Take Urgent Action to Manage Supply Chain Risks,* U.S. Government Accountability Office, Washington D.C., 2020, https://www.gao.gov/assets/gao-21-171.pdf.

[IRM[Institute of Risk Management, *Risk Appetite & Tolerance Guidance Paper*, London, UK, 2011, https://www.iia.nl/SiteFiles/IRMGuidancePaper-Sep2011.pdf.

[NIAP-CCEVS] *Common Criteria Evaluation & Validation Scheme*, National Information Assurance Partnership, https://www.niap-ccevs.org/.

[NIST SCRM Proceedings 2012] *Summary of the Workshop on Information and Communication Technologies Supply Chain Risk Management*, Gaithersburg, MD, 2012, http://www.nist.gov/customcf/get_pdf.cfm?pub_id=913338.

[SwA] *Software Assurance in Acquisition: Mitigating Risks to the Enterprise. A Reference Guide for Security-Enhanced Software Acquisition and Outsourcing,* DoD & DHS SwA Acquisition Working Group, 2008, https://apps.dtic.mil/dtic/tr/fulltext/u2/a495389.pdf.

[SAFECode 1] Software Assurance Forum for Excellence in Code (Safecode), *Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain*, 2010, http://www.safecode.org/publications/SAFECode_Software_Integrity_Controls0610.pdf.

[SAFECode 2] Software Assurance Forum for Excellence in Code (Safecode), *The Software Supply Chain Integrity Framework: Defining Risks and Responsibilities for Securing Software in the Global Supply Chain*, 2009, http://www.safecode.org/publication/SAFECode_Supply_Chain0709.pdf.

[O-TTPS] The Open Group, Open Trusted Technology Provider™ Standard (O-TTPS), Version 1.1.1, *Mitigating Maliciously Tainted and Counterfeit Products: Part 1: Requirements and Recommendations*, Open Trusted Technology Provider Standard (O-TTPS), 2018, https://publications.opengroup.org/c185-1.

[O-TTPS] The Open Group, Open Trusted Technology Provider™ Standard (O-TTPS), Version 1.1.1, *Mitigating Maliciously Tainted and Counterfeit Products: Part 2: Assessment Procedures for the*

O-TTPS and ISO/IEC, Open Trusted Technology Provider Standard (O-TTPS), 2018, https://publications.opengroup.org/c185-2.

[CNSSI 4009] *National Security Systems (CNSS) Glossary*, April 26, 2010, https://www.serdp-estcp.org/content/download/47576/453617/file/CNSSI%204009%20Glossary%202015.pdf.

[DHS SSPD 4300A] *Department of Homeland Security (DHS) Sensitive Systems Policy Directive 4300A,* Department of Homeland Security (DHS), 2011, http://www.dhs.gov/xlibrary/assets/foia/mgmt_directive_4300a_policy_v8.pdf.

[DODI 5200.39] Department of Defense Instruction (DODI) 5200.39, *Critical Program Information (CPI) Protection Within the Department of Defense* U.S. Department of Defense, 2010, https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/520039p.pdf.

[FAR] *Federal Acquisition Regulation (FAR)*, Acquisition Central, https://acquisition.gov/far/.

[FASCA] Federal Acquisition Supply Chain Security Act of 2018 (FASCA), T*itle II of the Strengthening and Enhancing Cyber-capabilities by Utilizing Risk Exposure Technology Act (SECURE) Technology Act of 2018,* 2018, https://www.congress.gov/115/plaws/publ390/PLAW-115publ390.pdf.

[FIPS 199] Federal Information Systems Processing Standard (FIPS) 199, *Standards for Security Categorization of Federal Information and Information Systems*, 2004, http://csrc.nist.gov/publications/fips/fips199/FIPS-PUB-199-final.pdf.

[FIPS 200] Federal Information Processing Standard (FIPS) 200, *Minimum Security Requirements for Federal Information and Information Systems*, 2006, http://csrc.nist.gov/publications/fips/fips200/FIPS-200-final-march.pdf.

[FSP] The Profile Version 1.0, *Financial Services Cybersecurity Framework Profile Version 1.0,* Cyber Risk Institute, 2020, https://cyberriskinstitute.org/the-profile/.

[ISO 9000] ISO 9000:2015, *Quality Management — Fundamentals and vocabulary*, International Organization for Standardization, 2018, https://www.iso.org/standard/45481.html.

[ISO 9001] ISO 9001:2018, *Quality management systems — Requirements,* International Organization for Standardization, 2018, https://www.iso.org/standard/62085.html.

[ISO 28000] ISO 28000:2007, *Specification for Security Management Systems for the Supply Chain*, International Organization for Standardization, 2007, http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=44641.

[ISO 28001] ISO 28001:2007, *Security management systems for the supply chain -- Best practices for implementing supply chain security, assessments and plans -- Requirements and guidance*, International Organization for Standardization, 2007, http://www.iso.org/iso/catalogue_detail?csnumber=45654.

[ISO/IEC 2382] ISO/IEC 2382-36:2013, *Information Technology -- Vocabulary*, International Organization for Standardization / International Electrotechnical Commission, 2013, http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=63598.

[ISO/IEC 12207] ISO/IEC 12207: 2017, *Systems and software engineering -- Software life cycle processes*, International Organization for Standardization / International Electrotechnical Commission, 2017, https://www.iso.org/standard/63712.html.

[ISO/IEC 15288] ISO/IEC 15288:2015, *Systems and software engineering -- System life cycle processes*, International Organization for Standardization / International Electrotechnical Commission, 2015, https://www.iso.org/standard/63711.html.

[ISO/IEC 27000] ISO/IEC 27000:2014, *Information Technology – Security Techniques – Information Security Management Systems – Overview and Vocabulary*, International Organization for Standardization / International Electrotechnical Commission, 2014, http://www.iso.org/iso/catalogue_detail?csnumber=41933.

[ISO/IEC 27001] ISO/IEC 27001:2013, *Information technology -- Security techniques -- Information security management systems -- Requirements*, International Organization for Standardization / International Electrotechnical Commission, 2013, http://www.iso.org/iso/catalogue_detail?csnumber=54534.

[ISO/IEC 27002] ISO/IEC 27002:2013, *Information technology -- Security techniques -- Code of practice for information security controls*, International Organization for Standardization / International Electrotechnical Commission, 2013, http://www.iso.org/iso/catalogue_detail?csnumber=54533.

[ISO/IEC 27036] ISO/IEC 27036-2:2014, *Information technology -- Security techniques -- Information security for supplier relationships*, International Organization for Standardization / International Electrotechnical Commission, 2014, http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=59680.

[ISO/IEC 20243] ISO/IEC 20243:2018, – *Information Technology — Open Trusted Technology Provider™ Standard (O-TTPS) — Mitigating maliciously tainted and counterfeit products,* International Organization for Standardization / International Electrotechnical Commission, 2018, https://www.iso.org/standard/74399.html.

[IRM] Institute of Risk Management, *Risk Appetite & Tolerance Guidance Paper,* London, 2011 https://www.iia.nl/SiteFiles/IRMGuidancePaper-Sep2011.pdf

[NDIA] National Defense Industrial Association (NDIA) System Assurance Committee, *Engineering for System Assurance*, NDIA, Arlington, VA, 2008, https://www.ndia.org/-/media/sites/ndia/meetings-and-events/divisions/systems-engineering/sse-committee/systems-assurance-guidebook.ashx.

[NISPOM] DoD 5220.22-M: *National Industrial Security Program - Operating Manual (NISPOM),* Department of Defense, 2006, https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodm/522022m.pdf.

[NIST CSF] *Framework for Improving Critical Infrastructure Cybersecurity,* Version 1.1, National Institute of Standards and Technology, Gaithersburg, MD, 2018,

[NISTIR 7622] NIST Interagency Report (IR) 7622: *Notional Supply Chain Risk Management Practices for Federal Information Systems,* National Institute of Standards and Technology, Gaithersburg, MD, 2012, http://dx.doi.org/10.6028/NIST.IR.7622.

[NISTIR 8179] NIST Interagency Report (IR) 8179: *Criticality Analysis Process Model Prioritizing Systems and Component,* National Institute of Standards and Technology, Gaithersburg, MD, 2018, https://nvlpubs.nist.gov/nistpubs/ir/2018/NIST.IR.8179.pdf.

[NISTIR 8272] NIST Interagency Report (IR) 8272: *Impact Analysis Tool for Interdependent Cyber Supply Chain Risks,* National Institute of Standards and Technology, Gaithersburg, MD, 2020, https://nvlpubs.nist.gov/nistpubs/ir/2020/NIST.IR.8272.pdf.

[NISTIR 8276] NIST Interagency Report (IR) 8276: *Key Practices in Cyber Supply Chain Risk Management: Observations from Industry,* National Institute of Standards and Technology, Gaithersburg, MD, 2021, https://nvlpubs.nist.gov/nistpubs/ir/2021/NIST.IR.8276.pdf.

[NISTIR 8286] NIST Interagency Report (IR) 8286: *Integrating Cybersecurity and Enterprise Risk Management (ERM),* National Institute of Standards and Technology, Gaithersburg, MD, 2020, https://nvlpubs.nist.gov/nistpubs/ir/2020/NIST.IR.8286.pdf.

[NIST SP 800-30 Rev. 1] NIST Special Publication (SP) 800-30 Revision 1, *Guide for Conducting Risk Assessments,* National Institute of Standards and Technology, Gaithersburg, MD, 2012, http://csrc.nist.gov/publications/nistpubs/800-30-rev1/sp800_30_r1.pdf.

[NIST SP 800-32] NIST Special Publication (SP) 800-32: *Introduction to Public Key Technology and the Federal PKI Infrastructure,* National Institute of Standards and Technology, Gaithersburg, MD, 2001, http://csrc.nist.gov/publications/nistpubs/800-32/sp800-32.pdf.

[NIST SP 800-34 Rev. 1] NIST Special Publication (SP) 800-34 Revision 1, *Contingency Planning Guide for Federal Information Systems,* National Institute of Standards and Technology, Gaithersburg, MD, 2010, http://csrc.nist.gov/publications/nistpubs/800-34-rev1/sp800-34-rev1_errata-Nov11-2010.pdf.

[NIST SP 800-37] NIST Special Publication (SP) 800-37 Revision 2, *Risk Management Framework for Information Systems and Organizations: A System Life Cycle Approach for Security and Privacy,* National Institute of Standards and Technology, Gaithersburg, MD, 2018, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-37r2.pdf.

[NIST SP 800-39] NIST Special Publication (SP) 800-39, *Managing Information Security Risk,* National Institute of Standards and Technology, Gaithersburg, MD, 2011, http://csrc.nist.gov/publications/nistpubs/800-39/SP800-39-final.pdf.

[NIST SP 800-53 Rev. 5] NIST Special Publication (SP) 800-53 Revision 5, *Security and Privacy Controls for Federal Information Systems and Organizations,* National Institute of Standards and Technology, Gaithersburg, Maryland, 2020, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53r5.pdf.

[NIST SP 800-53A Rev. 4] NIST Special Publication (SP) 800-53A Revision 4, *Guide for Assessing the Security Controls in Federal Information Systems and Organizations: Building Effective Security*

Assessment Plans, National Institute of Standards and Technology, Gaithersburg, MD, 2014, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53Ar4.pdf.

[NIST SP 800-53B Rev. 5] NIST Special Publication (SP) 800-53B Revision 5, *Control Baselines for Information Systems and Organizations*, National Institute of Standards and Technology, Gaithersburg, Maryland, 2020, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53B.pdf.

[NIST SP 800-55 Rev. 1] NIST Special Publication (SP) 800-53 Revision 1, *Performance Measurement Guide for Information Security*, National Institute of Standards and Technology, Gaithersburg, Maryland, 2008,

[NIST SP 800-100] NIST Special Publication (SP) 800-100, *Information Security Handbook: A Guide for Managers,* National Institute of Standards and Technology, 2006, http://csrc.nist.gov/publications/nistpubs/800-100/SP800-100-Mar07-2007.pdf.

[NIST SP 800-115] NIST Special Publication (SP) 800-115, *Technical Guide to Information Security Testing and Assessment,* National Institute of Standards and Technology, Gaithersburg, MD, 2008, http://csrc.nist.gov/publications/nistpubs/800-115/SP800-115.pdf.

[NIST SP 800-160 Vol. 1] NIST Special Publication (SP) 800-160 Volume 1, *Systems Security Engineering: Considerations for a Multidisciplinary Approach in the Engineering of Trustworthy Secure Systems,* National Institute of Standards and Technology, Gaithersburg, MD, 2016, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-160v1.pdf.

[NIST SP 800-181 Rev. 1] NIST Special Publication (SP) 800-181, *Workforce Framework for Cybersecurity (NICE Framework),* National Institute of Standards and Technology, Gaithersburg, MD, 2020, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-181r1.pdf.

[NIST SSDF] NIST Secure Software Development Framework, *),* National Institute of Standards and Technology, Gaithersburg, MD, 2021, https://csrc.nist.gov/projects/ssdf

[OMB A-76] OMB Circular A-76, *Performance of Commercial Activities,* Office of Management and Budget, 2003, https://obamawhitehouse.archives.gov/omb/circulars_a076_a76_incl_tech_correction/.

[OMB A-123] OMB Circular A-123, *Management's Responsibility for Internal Control,* Office of Management and Budget, 2004, https://obamawhitehouse.archives.gov/omb/circulars_a123_rev

[OMB A-130] OMB Circular A-130, *Managing Information as a Strategic Resource,* Office of Management and Budget, 2016, https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/OMB/circulars/a130/a130revised.pdf

10322