Set Theory Relationship Mapping (STRM)

Reference Document : Secure Controls Framework (SCF) version 2024.3
Focal Document: NIST SP 800-218 Secure Software Development Framework (SSDF) Version 1.1
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STRM URL: https://securecontrolsframework.com/content/strm/scf-2024-3-nist-800-218.pdf

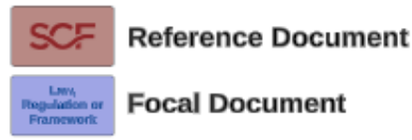
Set Theory Relationship Mapping (STRM) is well-suited for mapping between sets of elements that exist in two distinct concepts that are mostly the same as each other (e.g., cybersecurity & data privacy requirements). STRM also allows the strength of the mapping to be captured.

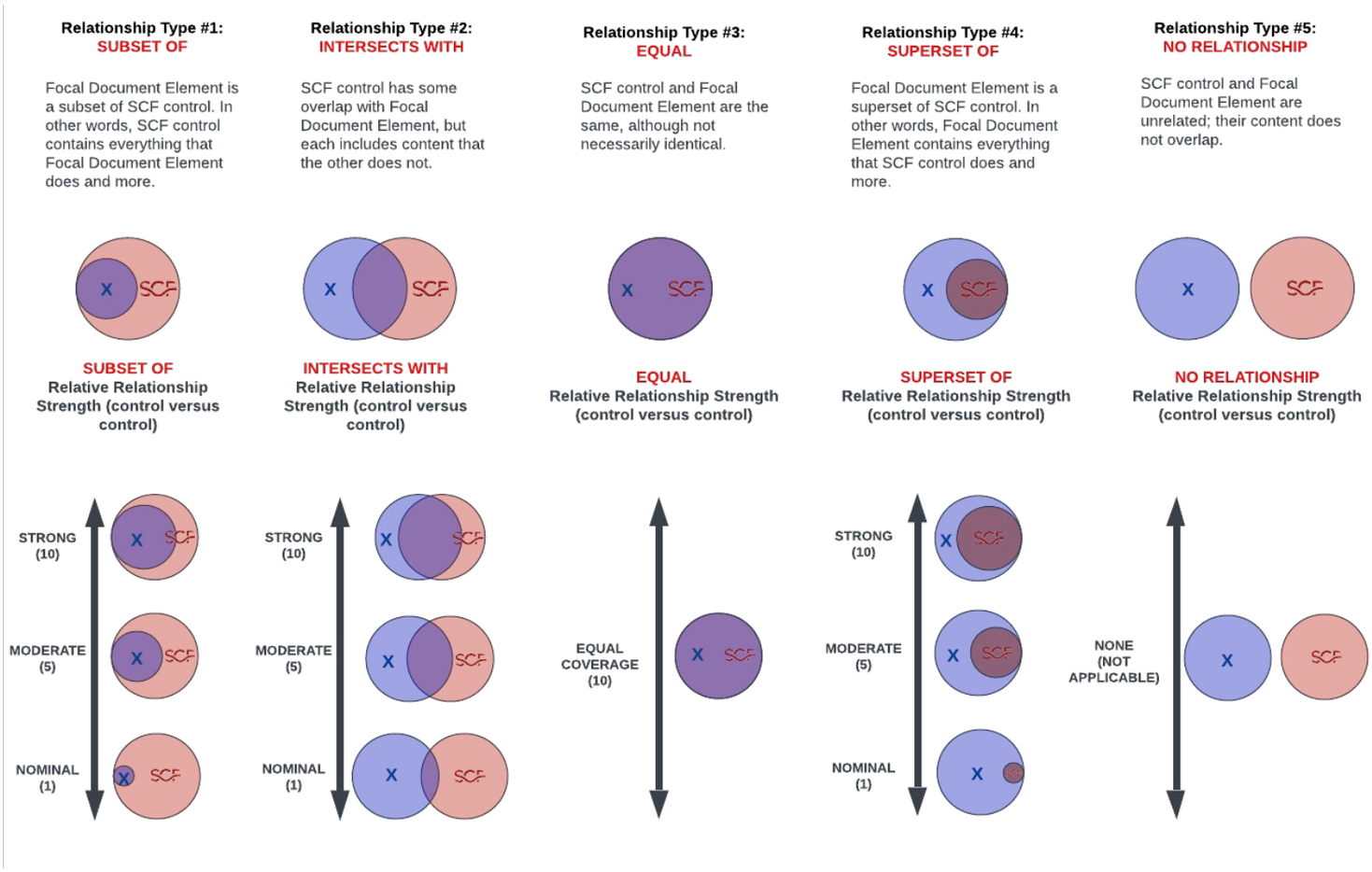
STRM relies on a justification for the relationship claim. There are three (3) options for the rationale, which is a high-level context within which the two concepts are related:

1. **Syntactic**: How similar is the wording that expresses the two concepts? This is a word-for-word analysis of the relationship, not an interpretation of the language.
2. **Semantic**: How similar are the meanings of the two concepts? This involves some interpretation of each concept's language.
3. **Functional**: How similar are the results of executing the two concepts? This involves understanding what will happen if the two concepts are implemented, performed, or otherwise executed.

Based on NIST IR 8477, STRM supports five (5) five relationship types to describe the logical similarity between two distinct concepts:

1. **Subset Of**
2. **Intersects With**
3. **Equal**
4. **Superset Of**
5. **No Relationship**





FDE #	FDE Name	Focal Document Element (FDE) Description	STRM Rationale	STRM Relationship	SCF Control	SCF #	Secure Controls Framework (SCF) Control Description	Strength of Relationship (optional)	Notes (optional)
PO.1	Define Security Requirements for Software Development	Ensure that security requirements for software development are known at all times so that they can be taken into account throughout the SDLC and duplication of effort can be minimized because the requirements information can be collected once and shared. This includes requirements from internal sources (e.g., the organization's policies, business objectives, and risk management strategy) and external sources (e.g., applicable laws and regulations).	Functional	Intersects With	Statutory, Regulatory & Contractual Compliance	CPL-01	Mechanisms exist to facilitate the identification and implementation of relevant statutory, regulatory and contractual controls.		Example 1: Define policies for securing software development infrastructures and their components, including development endpoints, throughout the SDLC and maintaining that security. Example 2: Define policies for securing software development
			Functional	Intersects With	Compliance Scope	CPL-01.2	Mechanisms exist to document and validate the scope of cybersecurity & data privacy controls that are determined to meet statutory, regulatory and/or contractual		
			Functional	Intersects With	Data Privacy Requirements for Contractors & Service Providers	PRI-07.1	Mechanisms exist to include data privacy requirements in contracts and other acquisition-related documents that establish data privacy roles and responsibilities for		
			Functional	Intersects With	Cybersecurity & Data Privacy Requirements Definition	PRM-05	Mechanisms exist to identify critical system components and functions by performing a criticality analysis for critical systems, system components or services at pre-defined		
			Functional	Intersects With	Secure Development Life Cycle (SDLC) Management	PRM-07	Mechanisms exist to ensure changes to systems within the Secure Development Life Cycle (SDLC) are controlled through formal change control procedures.		
			Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		
			Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		
			Functional	Subset Of	Technology Development & Acquisition	TDA-01	Mechanisms exist to facilitate the implementation of tailored development and acquisition strategies, contract tools and procurement methods to meet unique		
			Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		
			Functional	Intersects With	Third-Party Contract Requirements	TPM-05	Mechanisms exist to require contractual requirements for cybersecurity & data privacy requirements with third-parties, reflecting the organization's needs to protect its		
PO.1.1	N/A	Identify and document all security requirements for the organization's software development infrastructures and processes, and maintain the requirements over time.	Functional	Intersects With	Cybersecurity & Data Privacy Requirements Definition	PRM-05	Mechanisms exist to identify critical system components and functions by performing a criticality analysis for critical systems, system components or services at pre-defined		Example 1: Define policies that specify risk-based software architecture and design requirements, such as making code modular to facilitate code reuse and updates; isolating security components from other components during execution; avoiding
			Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		
			Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		
PO.1.2	N/A	Identify and document all security requirements for organization-developed software to meet, and maintain the requirements over time.	Functional	Subset Of	Statutory, Regulatory & Contractual Compliance	CPL-01	Mechanisms exist to facilitate the identification and implementation of relevant statutory, regulatory and contractual controls.		Example 1: Define a core set of security requirements for software components, and include it in acquisition documents, software contracts, and other agreements with third parties. Example 2: Define security-related criteria for selecting
			Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		
			Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		
PO.2	Implement Roles and Responsibilities	Ensure that everyone inside and outside of the organization involved in the SDLC is prepared to perform their SDLC-related roles and responsibilities throughout the SDLC.	Functional	Intersects With	Defined Roles & Responsibilities	HRS-03	Mechanisms exist to define cybersecurity roles & responsibilities for all personnel.		
			Functional	Intersects With	Competency Requirements for Security-Related Positions	HRS-03.2	Mechanisms exist to ensure that all security-related positions are staffed by qualified individuals who have the necessary skill set.		
PO.2.1	N/A	Create new roles and alter responsibilities for existing roles as needed to encompass all parts of the SDLC. Periodically review and maintain the defined roles and responsibilities, updating them as needed.	Functional	Subset Of	Human Resources Security Management	HRS-01	Mechanisms exist to facilitate the implementation of personnel security controls.		Example 1: Define SDLC-related roles and responsibilities for all members of the software development team. Example 2: Integrate the security roles into the software development team.
			Functional	Intersects With	Defined Roles & Responsibilities	HRS-03	Mechanisms exist to define cybersecurity roles & responsibilities for all personnel.		
PO.2.2	N/A	Provide role-based training for all personnel with responsibilities that contribute to secure development. Periodically review personnel proficiency and role-based training, and update the training as needed.	Functional	Equal	Role-Based Cybersecurity & Data Privacy Training	SAT-03	Mechanisms exist to provide role-based cybersecurity & data privacy-related training: • Before authorizing access to the system or performing assigned duties;		Example 1: Document the desired outcomes of training for each role. Example 2: Define the type of training or curriculum required to achieve the desired outcome for each role.
			Functional	Intersects With	Sensitive Information Storage, Handling & Processing	SAT-03.3	Mechanisms exist to ensure that every user accessing a system processing, storing or transmitting sensitive information is formally trained in data handling requirements.		
			Functional	Intersects With	Privileged Users	SAT-03.5	Mechanisms exist to provide specific training for privileged users to ensure privileged users understand their unique roles and responsibilities		
			Functional	Intersects With	Cyber Threat Environment	SAT-03.6	Mechanisms exist to provide role-based cybersecurity & data privacy awareness training that is current and relevant to the cyber threats that users might encounter in		
PO.2.3	N/A	Obtain upper management or authorizing official commitment to secure development, and convey that commitment to all with development-related roles and responsibilities.	Functional	Intersects With	Assigned Cybersecurity & Data Protection Responsibilities	GOV-04	Mechanisms exist to assign one or more qualified individuals with the mission and resources to centrally-manage, coordinate, develop, implement and maintain an		Example 1: Appoint a single leader or leadership team to be responsible for the entire secure software development process, including being accountable for releasing software to production and delegating responsibilities as appropriate.
			Functional	Intersects With	Stakeholder Accountability Structure	GOV-04.1	Mechanisms exist to enforce an accountability structure so that appropriate teams and individuals are empowered, responsible and trained for mapping,		
PO.3	Implement Supporting Toolchains	Use automation to reduce human effort and improve the accuracy, reproducibility, usability, and comprehensiveness of security practices throughout the SDLC, as well as provide a way to document and demonstrate the use of these practices. Toolchains and tools may be used at different levels of the organization, such as organization-wide or project-specific, and may address a particular part of the SDLC, like a build pipeline.	Functional	Subset Of	Technology Development & Acquisition	TDA-01	Mechanisms exist to facilitate the implementation of tailored development and acquisition strategies, contract tools and procurement methods to meet unique		
			Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
			Functional	Equal	Supporting Toolchain	TDA-06.4	Automated mechanisms exist to improve the accuracy, consistency and comprehensiveness of secure practices throughout the asset's lifecycle.		
PO.3.1	N/A	Specify which tools or tool types must or should be included in each toolchain to mitigate identified	Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		Example 1: Define categories of toolchains, and specify the mandatory tools or tool types to be used for each category. Example 2: Identify security tools to integrate into the developer toolchain.

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PO.3.1	N/A	risks, as well as how the toolchain components are to be integrated with each other.	Functional	Intersects With	Supporting Toolchain	TDA-06.4	Automated mechanisms exist to improve the accuracy, consistency and comprehensiveness of secure practices throughout the asset's lifecycle.		
PO.3.2	N/A	Follow recommended security practices to deploy, operate, and maintain tools and toolchains.	Functional	Intersects With	Technology Development & Acquisition	TDA-01	Mechanisms exist to facilitate the implementation of tailored development and acquisition strategies, contract tools and procurement methods to meet unique		Example 1: Evaluate, select, and acquire tools, and assess the security of each tool. Example 2: Integrate tools with other tools and existing software development processes and workflows.
			Functional	Intersects With	Standardized Operating Procedures (SOP)	OPS-01.1	Mechanisms exist to identify and document Standardized Operating Procedures (SOP), or similar documentation, to enable the proper execution of day-to-day / assigned tasks.		
			Functional	Intersects With	Service Delivery (Business Process Support)	OPS-03	Mechanisms exist to define supporting business processes and implement appropriate governance and service management to ensure appropriate planning,		
			Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
			Functional	Intersects With	Supporting Toolchain	TDA-06.4	Automated mechanisms exist to improve the accuracy, consistency and comprehensiveness of secure practices throughout the asset's lifecycle.		
PO.3.3	N/A	Configure tools to generate artifacts of their support of secure software development practices as defined by the organization.	Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		Example 1: Use existing tooling (e.g., workflow tracking, issue tracking, value stream mapping) to create an audit trail of the secure development-related actions that are performed for continuous improvement purposes.
			Functional	Intersects With	Identification & Justification of Ports, Protocols & Services	TDA-02.5	Mechanisms exist to require process owners to identify, document and justify the business need for the ports, protocols and other services necessary to operate their	3	
			Functional	Intersects With	Documentation Requirements	TDA-04	Mechanisms exist to obtain, protect and distribute administrator documentation for systems that describe: ▪ Secure configuration, installation and		
			Functional	Intersects With	Functional Properties	TDA-04.1	Mechanisms exist to require software developers to provide information describing the functional properties of the security controls to be utilized within systems, system	3	
PO.4	Define and Use Criteria for Software Security Checks	Help ensure that the software resulting from the SDLC meets the organization's expectations by defining and using criteria for checking the software's security during development.	Functional	Intersects With	Software Design Review	TDA-06.5	Mechanisms exist to have an independent review of the software design to confirm that all cybersecurity & data privacy requirements are met and that any identified risks are	5	
			Functional	Intersects With	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and	5	
			Functional	Intersects With	Static Code Analysis	TDA-09.2	Mechanisms exist to require the developers of systems, system components or services to employ static code analysis tools to identify and remediate common flaws and	3	
			Functional	Intersects With	Dynamic Code Analysis	TDA-09.3	Mechanisms exist to require the developers of systems, system components or services to employ dynamic code analysis tools to identify and remediate common flaws and	3	
PO.4.1	N/A	Define criteria for software security checks and track throughout the SDLC.	Functional	Intersects With	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		Example 1: Ensure that the criteria adequately indicate how effectively security risk is being managed. Example 2: Define key performance indicators (KPIs), key risk indicators (KRIs), vulnerability severity scores, and other
PO.4.2	N/A	Implement processes, mechanisms, etc. to gather and safeguard the necessary information in support of the criteria.	Functional	Intersects With	Standardized Operating Procedures (SOP)	OPS-01.1	Mechanisms exist to identify and document Standardized Operating Procedures (SOP), or similar documentation, to enable the proper execution of day-to-day / assigned tasks.		Example 1: Use the toolchain to automatically gather information that informs security decision-making. Example 2: Deploy additional tools if needed to support the generation and collection of information supporting the criteria.
			Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		
			Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
PO.5	Implement and Maintain Secure Environments for Software Development	Ensure that all components of the environments for software development are strongly protected from internal and external threats to prevent compromises of the environments or the software being developed or maintained within them. Examples of environments for software development include development, build, test, and distribution environments.	Functional	Intersects With	Development & Test Environment Configurations	CFG-02.4	Mechanisms exist to manage baseline configurations for development and test environments separately from operational baseline configurations to minimize the risk		
			Functional	Subset Of	Secure Development Environments	TDA-07	Mechanisms exist to maintain a segmented development network to ensure a secure development environment.		
			Functional	Intersects With	Separation of Development, Testing and Operational Environments	TDA-08	Mechanisms exist to manage separate development, testing and operational environments to reduce the risks of unauthorized access or changes to the		
			Functional	Intersects With	Secure Migration Practices	TDA-08.1	Mechanisms exist to ensure secure migration practices purge systems, applications and services of test/development/staging data and accounts before it is migrated into a		
PO.5.1	N/A	Separate and protect each environment involved in software development.	Functional	Subset Of	Secure Development Environments	TDA-07	Mechanisms exist to maintain a segmented development network to ensure a secure development environment.		Example 1: Use multi-factor, risk-based authentication and conditional access for each environment. Example 2: Use network segmentation and access controls to separate the environments from each other and from
			Functional	Intersects With	Separation of Development, Testing and Operational Environments	TDA-08	Mechanisms exist to manage separate development, testing and operational environments to reduce the risks of unauthorized access or changes to the		
PO.5.2	N/A	Secure and harden development endpoints (i.e., endpoints for software designers, developers, testers, builders, etc.) to perform development-related tasks using a risk-based approach.	Functional	Subset Of	System Hardening Through Baseline Configurations	CFG-02	Mechanisms exist to develop, document and maintain secure baseline configurations for technology platforms that are consistent with industry-accepted system hardening		Example 1: Configure each development endpoint based on approved hardening guides, checklists, etc.; for example, enable FIPS-compliant encryption of all sensitive data at rest and in transit.
			Functional	Intersects With	Development & Test Environment Configurations	CFG-02.4	Mechanisms exist to manage baseline configurations for development and test environments separately from operational baseline configurations to minimize the risk		
			Functional	Intersects With	Configure Systems, Components or Services for High-Risk Areas	CFG-02.5	Mechanisms exist to configure systems utilized in high-risk areas with more restrictive baseline configurations.		
PS.1	Protect All Forms of Code from Unauthorized Access and Tampering	Help prevent unauthorized changes to code, both inadvertent and intentional, which could circumvent or negate the intended security characteristics of the software. For code that is not intended to be publicly accessible, this helps prevent theft of the software and may make it more difficult or time-consuming for attackers to find vulnerabilities in the software.	Functional	Intersects With	Access Restriction For Change	CHG-04	Mechanisms exist to enforce configuration restrictions in an effort to restrict the ability of users to conduct unauthorized changes.		
			Functional	Intersects With	Library Privileges	CHG-04.5	Mechanisms exist to restrict software library privileges to those individuals with a pertinent business need for access.		
PS.1.1	N/A	Store all forms of code – including source code, executable code, and configuration-as-code – based on the principle of least privilege so that only authorized personnel, tools, services, etc. have access.	Functional	Equal	Access to Program Source Code	TDA-20	Mechanisms exist to limit privileges to change software resident within software libraries.		
PS.2	Provide a Mechanism for Verifying Software Release Integrity	Help software acquirers ensure that the software they acquire is legitimate and has not been tampered with.	Functional	Equal	Software Release Integrity Verification	TDA-20.1	Mechanisms exist to publish integrity verification information for software releases.		

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PS.2.1	N/A	Make software integrity verification information available to software acquirers.	Functional	Equal	Software Release Integrity Verification	TDA-20.1	Mechanisms exist to publish integrity verification information for software releases.		Example 1: Post cryptographic hashes for release files on a well-secured website. Example 2: Use an established certificate authority for code signing so that consumers' operating systems or other tools and
PS.3	Archive and Protect Each Software Release	Preserve software releases in order to help identify, analyze, and eliminate vulnerabilities discovered in the software after release.	Functional	Equal	Archiving Software Releases	TDA-20.2	Mechanisms exist to archive software releases and all of their components (e.g., code, package files, third-party libraries, documentation) to maintain integrity		
PS.3.1	N/A	Securely archive the necessary files and supporting data (e.g., integrity verification information, provenance data) to be retained for each software release.	Functional	Equal	Archiving Software Releases	TDA-20.2	Mechanisms exist to archive software releases and all of their components (e.g., code, package files, third-party libraries, documentation) to maintain integrity		Example 1: Store the release files, associated images, etc. in repositories following the organization's established policy. Allow read-only access to them by necessary personnel and no access by anyone else.
			Functional	Intersects With	Software Escrow	TDA-20.3	Mechanisms exist to escrow source code and supporting documentation to ensure software availability in the event the software provider goes out of business or is unable to		
PS.3.2	N/A	Collect, safeguard, maintain, and share provenance data for all components of each software release (e.g., in a software bill of materials [SBOM]).	Functional	Intersects With	Documentation Requirements	TDA-04	Mechanisms exist to obtain, protect and distribute administrator documentation for systems that describe: • Secure configuration, installation and		
			Functional	Intersects With	Software Bill of Materials (SBOM)	TDA-04.2	Mechanisms exist to generate, or obtain, a Software Bill of Materials (SBOM) for systems, applications and services that lists software packages in use, including versions and		
PW.1	Design Software to Meet Security Requirements and Mitigate Security Risks	Identify and evaluate the security requirements for the software; determine what security risks the software is likely to face during operation and how the software's design and architecture should mitigate those risks; and justify any cases where risk-based analysis indicates that security requirements should be relaxed or waived. Addressing security requirements and risks during software design (secure by design) is key for improving software security and also helps improve development efficiency.	Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		
			Functional	Intersects With	Criticality Analysis	TDA-06.1	Mechanisms exist to require the developer of the system, system component or service to perform a criticality analysis at organization-defined decision points in the Secure		
			Functional	Intersects With	Threat Modeling	TDA-06.2	Mechanisms exist to perform threat modelling and other secure design techniques, to ensure that threats to software and solutions are identified and		
			Functional	Intersects With	Software Assurance Maturity Model (SAMM)	TDA-06.3	Mechanisms exist to utilize a Software Assurance Maturity Model (SAMM) to govern a secure development lifecycle for the development of systems, applications and		
PW.1.1	N/A	Use forms of risk modeling – such as threat modeling, attack modeling, or attack surface mapping – to help assess the security risk for the software.	Functional	Intersects With	Threat Modeling	TDA-06.2	Mechanisms exist to perform threat modelling and other secure design techniques, to ensure that threats to software and solutions are identified and		Example 1: Train the development team (security champions, in particular) or collaborate with a risk modeling expert to create models and analyze how to use a risk-based approach to communicate the risks and determine how to address them,
PW.1.2	N/A	Track and maintain the software's security requirements, risks, and design decisions.	Functional	Subset Of	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		Example 1: Record the response to each risk, including how mitigations are to be achieved and what the rationales are for any approved exceptions to the security requirements. Add any mitigations to the software's security requirements.
			Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		
PW.1.3	N/A	Where appropriate, build in support for using standardized security features and services (e.g., enabling software to integrate with existing log management, identity management, access control, and vulnerability management systems) instead of creating proprietary implementations of security features and services. [Formerly PW.4.3]	Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		Example 1: Maintain one or more software repositories of modules for supporting standardized security features and services. Example 2: Determine secure configurations for modules for
			Functional	Intersects With	Secure Settings By Default	TDA-09.6	Mechanisms exist to implement secure configuration settings by default to reduce the likelihood of software being deployed with weak security settings that would put		
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		
PW.2	Review the Software Design to Verify Compliance with Security Requirements and Risk Information	Help ensure that the software will meet the security requirements and satisfactorily address the identified risk information.	Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		
			Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
			Functional	Intersects With	Insecure Ports, Protocols & Services	TDA-02.6	Mechanisms exist to mitigate the risk associated with the use of insecure ports, protocols and services necessary to operate technology solutions.		
			Functional	Intersects With	Cybersecurity & Data Privacy Representatives For Product Changes	TDA-02.7	Mechanisms exist to include appropriate cybersecurity & data privacy representatives in the product feature and/or functionality change control review process.		
			Functional	Intersects With	Software Assurance Maturity Model (SAMM)	TDA-06.3	Mechanisms exist to utilize a Software Assurance Maturity Model (SAMM) to govern a secure development lifecycle for the development of systems, applications and		
			Functional	Intersects With	Software Design Review	TDA-06.5	Mechanisms exist to have an independent review of the software design to confirm that all cybersecurity & data privacy requirements are met and that any identified risks are		
PW.2.1	N/A	Have 1) a qualified person (or people) who were not involved with the design and/or 2) automated processes instantiated in the toolchain review the software design to confirm and enforce that it meets all of the security requirements and satisfactorily addresses the identified risk information.	Functional	Equal	Software Design Review	TDA-06.5	Mechanisms exist to have an independent review of the software design to confirm that all cybersecurity & data privacy requirements are met and that any identified risks are		Example 1: Review the software design to confirm that it addresses applicable security requirements. Example 2: Review the risk models created during software design to determine if they appear to adequately identify the
PW.4	Reuse Existing, Well-Secured Software When Feasible Instead of Duplicating Functionality	Lower the costs of software development, expedite software development, and decrease the likelihood of introducing additional security vulnerabilities into the software by reusing software modules and services that have already had their security posture checked. This is particularly important for software that implements security functionality, such as cryptographic modules and protocols.	Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		
			Functional	Intersects With	Pre-Established Secure Configurations	TDA-02.4	Mechanisms exist to ensure vendors / manufacturers: ▪ Deliver the system, component, or service with a pre-established, secure configuration		
			Functional	Intersects With	Commercial Off-The-Shelf (COTS) Security Solutions	TDA-03	Mechanisms exist to utilize only Commercial Off-the-Shelf (COTS) security products.		
PW.4.1	N/A	Acquire and maintain well-secured software components (e.g., software libraries, modules, middleware, frameworks) from commercial, open-source, and other third-party developers for use by the organization's software.	Functional	Intersects With	Commercial Off-The-Shelf (COTS) Security Solutions	TDA-03	Mechanisms exist to utilize only Commercial Off-the-Shelf (COTS) security products.		Example 1: Review and evaluate third-party software components in the context of their expected use. If a component is to be used in a substantially different way in the future, perform the review and evaluation again with that new
PW.4.2	N/A	Create and maintain well-secured software components in-house following SDLC processes to meet common internal software development needs that cannot be better met by third-party software components.	Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		Example 1: Follow organization-established security practices for secure software development when creating and maintaining the components. Example 2: Determine secure configurations for software
			Functional	Intersects With	Developer Architecture & Design	TDA-05	Mechanisms exist to require the developers of systems, system components or services to produce a design specification and security architecture that:		
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		
			Functional	Intersects With	Software Assurance Maturity Model (SAMM)	TDA-06.3	Mechanisms exist to utilize a Software Assurance Maturity Model (SAMM) to govern a secure development lifecycle for the development of systems, applications and		

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PW.4.4	N/A	Verify that acquired commercial, open-source, and all other third-party software components comply with the requirements, as defined by the organization, throughout their life cycles.	Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		Example 1: Regularly check whether there are publicly known vulnerabilities in the software modules and services that vendors have not yet fixed. Example 2: Build into the toolchain automatic detection of
			Functional	Intersects With	Ports, Protocols & Services In Use	TDA-02.1	Mechanisms exist to require the developers of systems, system components or services to identify early in the Secure Development Life Cycle (SDLC), the functions, ports,		
			Functional	Intersects With	Identification & Justification of Ports, Protocols & Services	TDA-02.5	Mechanisms exist to require process owners to identify, document and justify the business need for the ports, protocols and other services necessary to operate their		
			Functional	Intersects With	Insecure Ports, Protocols & Services	TDA-02.6	Mechanisms exist to mitigate the risk associated with the use of insecure ports, protocols and services necessary to operate technology solutions.		
			Functional	Intersects With	Software Bill of Materials (SBOM)	TDA-04.2	Mechanisms exist to generate a Software Bill of Materials (SBOM) for systems, applications and services that lists software packages in use, including versions and applicable		
PW.5	Create Source Code by Adhering to Secure Coding Practices	Decrease the number of security vulnerabilities in the software, and reduce costs by minimizing vulnerabilities introduced during source code creation that meet or exceed organization-defined vulnerability severity criteria.	Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		
			Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		
PW.5.1	N/A	Follow all secure coding practices that are appropriate to the development languages and environment to meet the organization's requirements.	Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		Example 1: Validate all inputs, and validate and properly encode all outputs. Example 2: Avoid using unsafe functions and calls. Example 3: Detect errors, and handle them gracefully.
			Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		
			Functional	Intersects With	Pre-Established Secure Configurations	TDA-02.4	Mechanisms exist to ensure vendors / manufacturers: ▪ Deliver the system, component, or service with a pre-established, secure configuration		
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		
			Functional	Intersects With	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		
			Functional	Intersects With	Secure Settings By Default	TDA-09.6	Mechanisms exist to implement secure configuration settings by default to reduce the likelihood of software being deployed with weak security settings that would put		
PW.6	Configure the Compilation, Interpreter, and Build Processes to Improve Executable Security	Decrease the number of security vulnerabilities in the software and reduce costs by eliminating vulnerabilities before testing occurs.	Functional	Intersects With	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		
			Functional	Intersects With	Secure Settings By Default	TDA-09.6	Mechanisms exist to implement secure configuration settings by default to reduce the likelihood of software being deployed with weak security settings that would put		
PW.6.1	N/A	Use compiler, interpreter, and build tools that offer features to improve executable security.	Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		Example 1: Use up-to-date versions of compiler, interpreter, and build tools. Example 2: Follow change management processes when deploying or updating compiler, interpreter, and build tools, and
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		Example 1: Use up-to-date versions of compiler, interpreter, and build tools. Example 2: Follow change management processes when deploying or updating compiler, interpreter, and build tools, and
			Functional	Intersects With	Supporting Toolchain	TDA-06.4	Automated mechanisms exist to improve the accuracy, consistency and comprehensiveness of secure practices throughout the asset's lifecycle.		
PW.6.2	N/A	Determine which compiler, interpreter, and build tool features should be used and how each should be configured, then implement and use the approved configurations.	Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		Example 1: Enable compiler features that produce warnings for poorly secured code during the compilation process. Example 2: Implement the "clean build" concept, where all compiler warnings are treated as errors and eliminated except
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		
			Functional	Intersects With	Supporting Toolchain	TDA-06.4	Automated mechanisms exist to improve the accuracy, consistency and comprehensiveness of secure practices throughout the asset's lifecycle.		
PW.7	Review and/or Analyze Human-Readable Code to Identify Vulnerabilities and Verify Compliance with Security Requirements	Help identify vulnerabilities so that they can be corrected before the software is released to prevent exploitation. Using automated methods lowers the effort and resources needed to detect vulnerabilities. Human-readable code includes source code, scripts, and any other form of code that an organization deems human-readable.	Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		
			Functional	Intersects With	Static Code Analysis	TDA-09.2	Mechanisms exist to require the developers of systems, system components or services to employ static code analysis tools to identify and remediate common flaws and		
			Functional	Intersects With	Dynamic Code Analysis	TDA-09.3	Mechanisms exist to require the developers of systems, system components or services to employ dynamic code analysis tools to identify and remediate common flaws and		
			Functional	Intersects With	Malformed Input Testing	TDA-09.4	Mechanisms exist to utilize testing methods to ensure systems, services and products continue to operate as intended when subject to invalid or unexpected inputs on its		
			Functional	Intersects With	Application Penetration Testing	TDA-09.5	Mechanisms exist to perform application-level penetration testing of custom-made applications and services.		
PW.7.1	N/A	Determine whether code review (a person looks directly at the code to find issues) and/or code analysis (tools are used to find issues in code, either in a fully automated way or in conjunction with a person) should be used, as defined by the organization.	Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		Example 1: Follow the organization's policies or guidelines for when code review should be performed and how it should be conducted. This may include third-party code and reusable code modules written in-house.
PW.7.2	N/A	Perform the code review and/or code analysis based on the organization's secure coding standards, and record and triage all discovered issues and recommended remediations in the development team's workflow or issue tracking system.	Functional	Intersects With	Static Code Analysis	TDA-09.2	Mechanisms exist to require the developers of systems, system components or services to employ static code analysis tools to identify and remediate common flaws and		Example 1: Perform peer review of code, and review any existing code review, analysis, or testing results as part of the peer review. Example 2: Use expert reviewers to check code for backdoors
			Functional	Intersects With	Dynamic Code Analysis	TDA-09.3	Mechanisms exist to require the developers of systems, system components or services to employ dynamic code analysis tools to identify and remediate common flaws and		
PW.8	Test Executable Code to Identify Vulnerabilities and Verify	Help identify vulnerabilities so that they can be corrected before the software is released in order to prevent exploitation. Using automated methods lowers the effort and resources needed to detect vulnerabilities and improves traceability and repeatability. Executable code includes	Functional	Intersects With	Malformed Input Testing	TDA-09.4	Mechanisms exist to utilize testing methods to ensure systems, services and products continue to operate as intended when subject to invalid or unexpected inputs on its		

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PW.8	Compliance with Security Requirements	detect vulnerabilities and improves traceability and repeatability. Executable code includes binaries, directly executed bytecode and source code, and any other form of code that an organization deems executable.	Functional	Intersects With	Application Penetration Testing	TDA-09.5	Mechanisms exist to perform application-level penetration testing of custom-made applications and services.		
PW.8.1	N/A	Determine whether executable code testing should be performed to find vulnerabilities not identified by previous reviews, analysis, or testing and, if so, which types of testing should be used.	Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		Example 1: Follow the organization's policies or guidelines for when code testing should be performed and how it should be conducted (e.g., within a sandboxed environment). This may include third-party executable code and reusable executable
			Functional	Intersects With	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		
PW.8.2	N/A	Scope the testing, design the tests, perform the testing, and document the results, including recording and triaging all discovered issues and recommended remediations in the development team's workflow or issue tracking system.	Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		Example 1: Perform robust functional testing of security features. Example 2: Integrate dynamic vulnerability testing into the project's automated test suite.
PW.9	Configure Software to Have Secure Settings by Default	Help improve the security of the software at the time of installation to reduce the likelihood of the software being deployed with weak security settings, putting it at greater risk of compromise.	Functional	Equal	Secure Settings By Default	TDA-09.6	Mechanisms exist to implement secure configuration settings by default to reduce the likelihood of software being deployed with weak security settings that would put		
PW.9.1	N/A	Define a secure baseline by determining how to configure each setting that has an effect on security or a security-related setting so that the default settings are secure and do not weaken the security functions provided by the platform, network infrastructure, or services.	Functional	Equal	System Hardening Through Baseline Configurations	CFG-02	Mechanisms exist to develop, document and maintain secure baseline configurations for technology platforms that are consistent with industry-accepted system hardening		Example 1: Conduct testing to ensure that the settings, including the default settings, are working as expected and are not inadvertently causing any security weaknesses, operational issues, or other problems.
			Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		
			Functional	Intersects With	Pre-Established Secure Configurations	TDA-02.4	Mechanisms exist to ensure vendors / manufacturers: ▪ Deliver the system, component, or service with a pre-established, secure configuration		
			Functional	Intersects With	Secure Settings By Default	TDA-09.6	Mechanisms exist to implement secure configuration settings by default to reduce the likelihood of software being deployed with weak security settings that would put		
PW.9.2	N/A	Implement the default settings (or groups of default settings, if applicable), and document each setting for software administrators.	Functional	Intersects With	Minimum Viable Product (MVP) Security Requirements	TDA-02	Mechanisms exist to ensure risk-based technical and functional specifications are established to define a Minimum Viable Product (MVP).		Example 1: Verify that the approved configuration is in place for the software. Example 2: Document each setting's purpose, options, default value, security relevance, potential operational impact, and
			Functional	Intersects With	Pre-Established Secure Configurations	TDA-02.4	Mechanisms exist to ensure vendors / manufacturers: ▪ Deliver the system, component, or service with a pre-established, secure configuration		
			Functional	Intersects With	Secure Settings By Default	TDA-09.6	Mechanisms exist to implement secure configuration settings by default to reduce the likelihood of software being deployed with weak security settings that would put		
RV.1	Identify and Confirm Vulnerabilities on an Ongoing Basis	Help ensure that vulnerabilities are identified more quickly so that they can be remediated more quickly in accordance with risk, reducing the window of opportunity for attackers.	Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
			Functional	Intersects With	Cybersecurity & Data Privacy Representatives For Product Changes	TDA-02.7	Mechanisms exist to include appropriate cybersecurity & data privacy representatives in the product feature and/or functionality change control review process.		
			Functional	Intersects With	Software Design Review	TDA-06.5	Mechanisms exist to have an independent review of the software design to confirm that all cybersecurity & data privacy requirements are met and that any identified risks are		
			Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		
			Functional	Intersects With	Continuous Monitoring Plan	TDA-09.1	Mechanisms exist to require the developers of systems, system components or services to produce a plan for the continuous monitoring of cybersecurity & data privacy		
RV.1.1	N/A	Gather information from software acquirers, users, and public sources on potential vulnerabilities in the software and third-party components that the software uses, and investigate all credible reports.	Functional	Intersects With	Documentation Requirements	TDA-04	Mechanisms exist to obtain, protect and distribute administrator documentation for systems that describe: ▪ Secure configuration, installation and		Example 1: Monitor vulnerability databases , security mailing lists, and other sources of vulnerability reports through manual or automated means. Example 2: Use threat intelligence sources to better understand
			Functional	Intersects With	Functional Properties	TDA-04.1	Mechanisms exist to require software developers to provide information describing the functional properties of the security controls to be utilized within systems, system		
			Functional	Intersects With	Software Bill of Materials (SBOM)	TDA-04.2	Mechanisms exist to generate a Software Bill of Materials (SBOM) for systems, applications and services that lists software packages in use, including versions and applicable		
			Functional	Intersects With	Developer Architecture & Design	TDA-05	Mechanisms exist to require the developers of systems, system components or services to produce a design specification and security architecture that:		
RV.1.2	N/A	Review, analyze, and/or test the software's code to identify or confirm the presence of previously undetected vulnerabilities.	Functional	Subset Of	Software Design Review	TDA-06.5	Mechanisms exist to have an independent review of the software design to confirm that all cybersecurity & data privacy requirements are met and that any identified risks are		Example 1: Configure the toolchain to perform automated code analysis and testing on a regular or continuous basis for all supported releases. Example 2: See PW.7 and PW.8.
RV.1.3	N/A	Have a policy that addresses vulnerability disclosure and remediation, and implement the roles, responsibilities, and processes needed to support that policy.	Functional	Equal	Vulnerability Disclosure Program (VDP)	THR-06	Mechanisms exist to establish a Vulnerability Disclosure Program (VDP) to assist with the secure development and maintenance of products and services that receives		Example 1: Establish a vulnerability disclosure program, and make it easy for security researchers to learn about your program and report possible vulnerabilities. Example 2: Have a Product Security Incident Response Team
RV.2	Assess, Prioritize, and Remediate Vulnerabilities	Help ensure that vulnerabilities are remediated in accordance with risk to reduce the window of opportunity for attackers.	Functional	Intersects With	Development Methods, Techniques & Processes	TDA-02.3	Mechanisms exist to require software developers to ensure that their software development processes employ industry-recognized secure practices for secure		
			Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		
RV.2.1	N/A	Analyze each vulnerability to gather sufficient information about risk to plan its remediation or other risk response.	Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		Example 1: Use existing issue tracking software to record each vulnerability. Example 2: Perform risk calculations for each vulnerability based on estimates of its exploitability, the potential impact if
RV.2.2	N/A	Plan and implement risk responses for vulnerabilities.	Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		Example 1: Make a risk-based decision as to whether each vulnerability will be remediated or if the risk will be addressed through other means (e.g., risk acceptance, risk transference), and prioritize any actions to be taken.
			Functional	Intersects With	Threat Modeling	TDA-06.2	Mechanisms exist to perform threat modelling and other secure design techniques, to ensure that threats to software and solutions are identified and		
			Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: ▪ Create and implement a Security Test and		
			Functional	Intersects With	Vulnerability Remediation Process	VPM-02	Mechanisms exist to ensure that vulnerabilities are properly identified, tracked and remediated.		
RV.3	Analyze Vulnerabilities to Identify	Help reduce the frequency of vulnerabilities in the future	Functional	Subset Of	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		

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RV.3	Their Root Cause	Help reduce the frequency of vulnerabilities in the future.	Functional	Intersects With	Root Cause Analysis (RCA) & Lessons Learned	IRO-13	Mechanisms exist to incorporate lessons learned from analyzing and resolving cybersecurity & data privacy incidents to reduce the likelihood or impact of future		
RV.3.1	N/A	Analyze identified vulnerabilities to determine their root causes.	Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: • Create and implement a Security Test and		Example 1: Record the root cause of discovered issues. Example 2: Record lessons learned through root cause analysis in a wiki that developers can access and search.
RV.3.2	N/A	Analyze the root causes over time to identify patterns, such as a particular secure coding practice not being followed consistently.	Functional	Subset Of	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: • Create and implement a Security Test and		Example 1: Record lessons learned through root cause analysis in a wiki that developers can access and search. Example 2: Add mechanisms to the toolchain to automatically detect future instances of the root cause.
RV.3.3	N/A	Review the software for similar vulnerabilities to eradicate a class of vulnerabilities, and proactively fix them rather than waiting for external reports.	Functional	Subset Of	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		Example 1: See PW.7 and PW.8.
			Functional	Intersects With	Cybersecurity & Data Privacy Testing Throughout Development	TDA-09	Mechanisms exist to require system developers/integrators consult with cybersecurity & data privacy personnel to: • Create and implement a Security Test and		
RV.3.4	N/A	Review the SDLC process, and update it if appropriate to prevent (or reduce the likelihood of) the root cause recurring in updates to the software or in new software that is created.	Functional	Subset Of	Technology Development & Acquisition	TDA-01	Mechanisms exist to facilitate the implementation of tailored development and acquisition strategies, contract tools and procurement methods to meet unique		Example 1: Record lessons learned through root cause analysis in a wiki that developers can access and search. Example 2: Plan and implement changes to the appropriate SDLC practices.
			Functional	Intersects With	Product Management	TDA-01.1	Mechanisms exist to design and implement product management processes to update products, including systems, software and services, to improve functionality and correct		
			Functional	Intersects With	Cybersecurity & Data Privacy Representatives For Product Changes	TDA-02.7	Mechanisms exist to include appropriate cybersecurity & data privacy representatives in the product feature and/or functionality change control review process.		
			Functional	Intersects With	Secure Coding	TDA-06	Mechanisms exist to develop applications based on secure coding principles.		