WHITEPAPER

Executive Order 14028: Complying with NIST SSDF Requirements

Security Compass

Contents

Introduction

Organizations that provide software to U.S. federal agencies face new requirements regarding software security. By early 2023, the Federal Acquisition Regulation (FAR) Council will require compliance with NIST's Secure Software Development Framework (SSDF). This paper helps readers understand the potential impact of SSDF compliance on their organizations and steps they can take to meet SSDF requirements.

Supply Chain Attacks Are Growing

In December 2020, FireEye researchers discovered "a supply chain attack trojanizing SolarWinds Orion business software updates". The backdoor in Orion – a platform for centralized monitoring and management of IT infrastructure – allowed the attackers full administrative access to Orion customers' infrastructure. The attack has been attributed to Russian nation state actors and affected over 100 private sector entities and at least nine federal agencies, including the departments of Defense, Commerce, Energy, Justice, Homeland Security, State, and Treasury and the National Institute of Health.

The SolarWinds attack was a supply chain compromise. A supply chain attack compromises software used by an organization, instead of targeting an organization directly. In this case, the attacker inserted back doors into legitimate software and waited for SolarWinds to distribute the attack through "trusted" updates. Shortly after the SolarWinds event, a back door that affected thousands of organizations was discovered in Microsoft Exchange (and attributed to China).

Supply chain attacks need not insert backdoors into the supply chain. They can just as effectively leverage coding errors, misconfigurations, and other security weaknesses in commercial and open source applications used by the targeted organizations. The end result is the same as in the SolarWinds breach - an attack vector through which attackers can compromise an application or system.

Executive Order 14028

In light of these events, and the Colonial Pipeline ransomware attack in early 2021, the Biden Administration issued Executive Order (EO) 14028 - "Improving the Nation's Cybersecurity." Included in the EO is the requirement that "the Federal Government must take action to rapidly improve the security and integrity of the software supply chain."

> **"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."**
>
> EO 14028, Section 4
> May 12, 2021

The EO comprises 11 sections covering topics from general policy declarations to information sharing to improving the U.S. federal government's investigative and remediation capabilities. In each, the EO requires various government agencies to produce plans, policies, and guidelines within specified timeframes "to identify, deter, protect against, detect, and respond to" threats against the public and private sectors. Section 4 – Enhancing Software Supply Chain Security – addresses the federal government's security requirements for software it uses.

Section 4 acknowledges that the government lacks sufficient information on the software it procures to resist attacks and a "pressing need to implement more rigorous and predictable mechanisms for ensuring that products function securely."

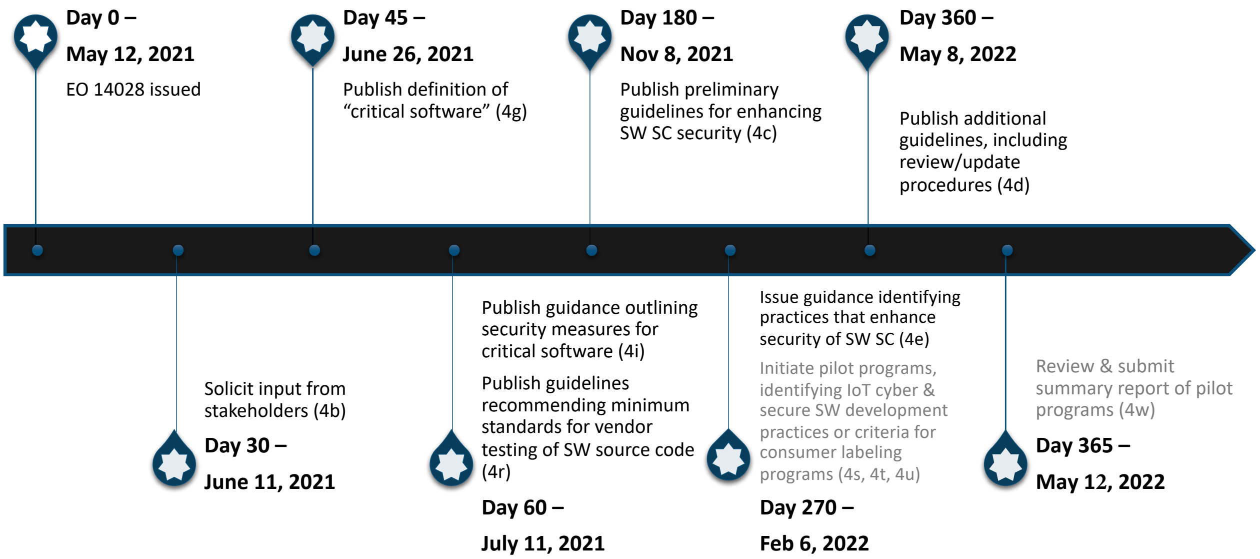
It includes orders to the Director of NIST to "Within 180 days…publish preliminary guidelines…drawing on existing documents as practicable, for enhancing software supply chain security."

The EO prioritizes "critical software" and requires the guidelines to include standards for several practices, including secure development environments, using automated tools to identify vulnerabilities, and "attesting to conformity with secure software development practices."

> "The [secure software] 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…"**
>
> Executive Order 14028
> May 12, 2021

EO Section 4 Tasks and Timelines

NIST CYBER



Day 0 –
May 12, 2021
EO 14028 issued

Day 30 –
June 11, 2021
Solicit input from stakeholders (4b)

Day 45 –
June 26, 2021
Publish definition of "critical software" (4g)

Day 60 –
July 11, 2021
Publish guidance outlining security measures for critical software (4i)
Publish guidelines recommending minimum standards for vendor testing of SW source code (4r)

Day 180 –
Nov 8, 2021
Publish preliminary guidelines for enhancing SW SC security (4c)

Day 270 –
Feb 6, 2022
Issue guidance identifying practices that enhance security of SW SC (4e)
Initiate pilot programs, identifying IoT cyber & secure SW development practices or criteria for consumer labeling programs (4s, 4t, 4u)

Day 360 –
May 8, 2022
Publish additional guidelines, including review/update procedures (4d)

Day 365 –
May 12, 2022
Review & submit summary report of pilot programs (4w)

Source: https://www.nist.gov/itl/executive-order-improving-nations-cybersecurity

The Executive Order and Authority to Operate (ATO)

The Federal Information Security Modernization Act already requires federal agencies to achieve Authority to Operate (ATO) by having systems in place to assess and monitor security and privacy risks. This includes compliance with NIST's Risk Management Framework.

Organizations selling software to government agencies should expect security requirements to change and align with the EO. Section 2 of the EO orders a review of the Federal Acquisition Regulation (FAR) and Defense Federal Acquisition Regulation (DFAR) Supplement and recommendations to the FAR Council to standardized contract language for cybersecurity requirements. At the request of the Department of Defense, General Services Administration, and NASA, legislation is also in process to amend the FAR's cybersecurity contractual requirements across Federal agencies for unclassified information systems.

Secure Software Development Framework

The Executive Order orders NIST to identify "existing or develop new standards, tools, and best practices for complying" with the security requirements. Fortunately, NIST had already started work on such a framework. In 2019, NIST published "Mitigating the Risk of Software Vulnerabilities by Adopting a Secure Software Development Framework (SSDF)" which defined secure software development practices and tasks for software producers. The white paper included most of the itemized requirements in the EO. An update in 2021 covered the remaining items, resulting in SP 800-218, Secure Software Development Framework (SSDF) Version 1.1: Recommendations for Mitigating the Risk of Software Vulnerabilities.

The SSDF builds from and references several other industry efforts, including the Cloud Native Computing Foundation's (CNCF) Software Supply Chain Best Practices, OWASP's Open Software Assurance Maturity Model (OpenSAMM), NIST's Guidelines on Minimum Standards for Developer Verification of Software, the Building Security In Maturity Model (BSIMM), and SAFECode's Fundamental Practices for Secure Software Development.

> "The SSDF presents an opportunity to measurably improve the cybersecurity posture of U.S. federal, state, and local government agencies. Security Compass embraces and contributes to this standard."
>
> Rohit Sethi
> CEO, Security Compass

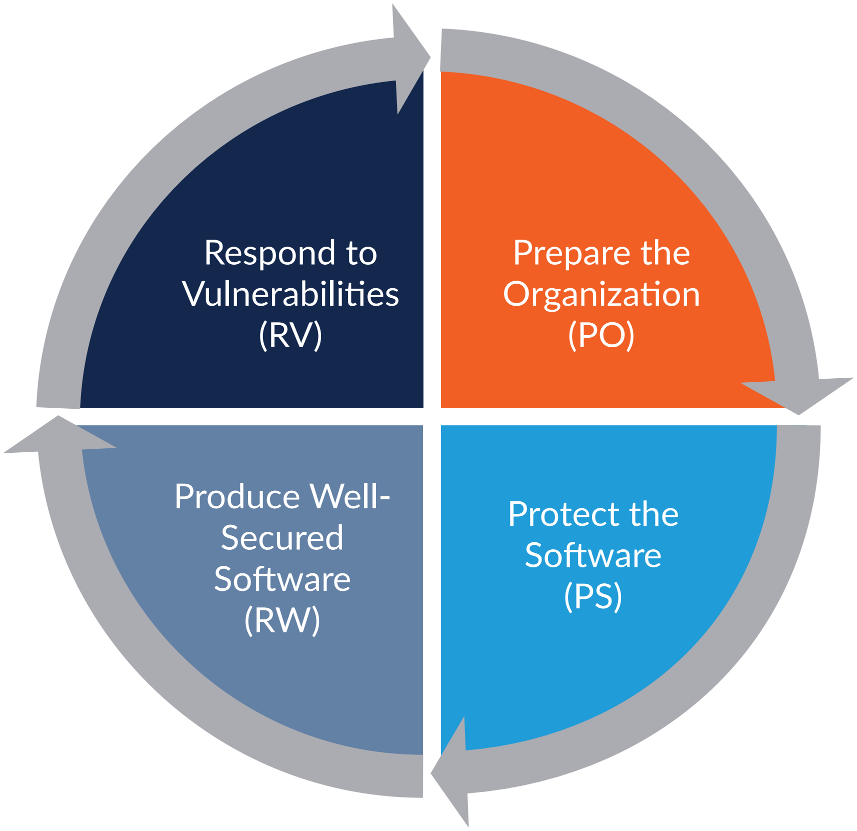
The SSDF is a set of high-level secure software development practices that can be integrated with an organization's development process. The practices are organized into four groups.

- **Prepare the Organization (PO):** Ensure that the organization's people, processes, and technology are prepared to perform secure software development at the organization level and, in some cases, for each individual project.

- **Protect the Software (PS):** Protect all components of the software from tampering and unauthorized access.

- **Produce Well-Secured Software (PW):** Produce well-secured software that has minimal security vulnerabilities in its releases.

- **Respond to Vulnerabilities (RV):** Identify vulnerabilities in software releases and respond appropriately to address those vulnerabilities and prevent similar vulnerabilities from occurring in the future.


Respond to Vulnerabilities (RV)
Prepare the Organization (PO)
Produce Well-Secured Software (RW)
Protect the Software (PS)

SSDF Implications on Existing Software Development Processes

The SSDF provides high-level secure software activities for integration into an organization’s software development life cycle (SDLC). The activities or practices are intended to minimize the number of vulnerabilities in software, mitigate the impact of exploits of undetected or unaddressed vulnerabilities, and “address the root causes of vulnerabilities to prevent future recurrences.”

The SSDF does not require a specific SDLC. Its activities can be applied in waterfall, agile, or DevOps models. It is not prescriptive in its recommendations, instead focusing on the outcome of the practices. This allows organizations of any size or security maturity to implement and benefit from the practices. The practices can be applied to traditional software development, IT, Internet of Things (IoT), or Industrial Control Systems (ICS) programs.

While applicable across any SDLC, the SSDF does include several themes.

Shift left

Meeting the goal of fewer vulnerabilities can be achieved in many ways. Traditionally, organizations would run automated scans later in the development process. This increases remediation costs and slows releases. The SSDF encourages organizations to “shift left” and implement security activities early in the SDLC.

Take a risk-based approach

Not all projects warrant the same level of security scrutiny. Each will have different requirements, scales, scopes, budgets, and problems. Bugs and flaws in some projects can result in devastating outcomes, while others may present “acceptable risk” for an organization. The SSDF acknowledges that risk, cost, and feasibility are considerations when deciding which practices to adopt for each project.

Adopt a common language

To improve communication between business owners, security teams, development, and operations, the SSDF provides a common vocabulary to describe secure software development practices. This common language also allows software acquirers to describe and define the required security characteristics of software in their acquisition process. Commercial software companies can use the vocabulary to describe their security practices to customers.

The SSDF provides mapping from the requirements in the EO to the practices in the SSDF to help business, development, and security resources better communicate why specific activities are required.

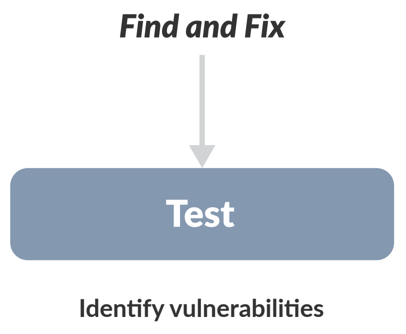
SSDF Practices Corresponding to Section 4e of EO 14028

EO 14028 Subsection	SSDF Practices and Tasks
4e(i)(A)	PO.5.1
4e(i)(B)(B)	PO.5.1
4e(i)(C)	PO.5.1, PO.5.2
4e(i)(D)	PO.5.1
4e(i)(E)	PO.5.2
4e(i)(F)	PO.3.2, PO.3.3, PO.5.1, PO.5.2
4e(ii)	PO.3.2, PO.3.3, PO.5.1, PO.5.2
4e(iii)	PO.3.1, PO.3.2, PO.5.1, PO.5.2, PS.1.1, PS.2.1, PS.3.1, PW.4.1, PW.4.4
4e(iv)	PO.4.1, PO.4.2, PS.1.1, PW.2.1, PW.4.4, PW.5.1, PW.6.1, PW.6.2, PW.7.1, PW.7.2, PW.8.2, PW.9.1, PW.9.2, RV.1.1, RV.1.2, RV.2.1, RV.2.2, RV.3.3
4e(v)	PO.3.2, PO.3.3, PO.4.1, PO.4.2, PO.5.1, PO.5.2, PW.1.2, PW.2.1, PW.7.2, PW.8.2, RV.2.2
4e(vi)	PO.1.3, PO.3.2, PO.5.1, PO.5.2, PS.3.1, PS.3.2, PW.4.1, PW.4.4, RV.1.1, RV.1.2
4e(vii)	PS.3.2
4e(viii)	RV.1.1, RV.1.2, RV.1.3, RV.2.1, RV.2.2, RV.3.3
4e(ix)	All practices and tasks consistent with a risk-based approach
4e(x)	PS.2.1, PS.3.1, PS.3.2, PW.4.1, PW.4.4

Source: https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-218.pdf

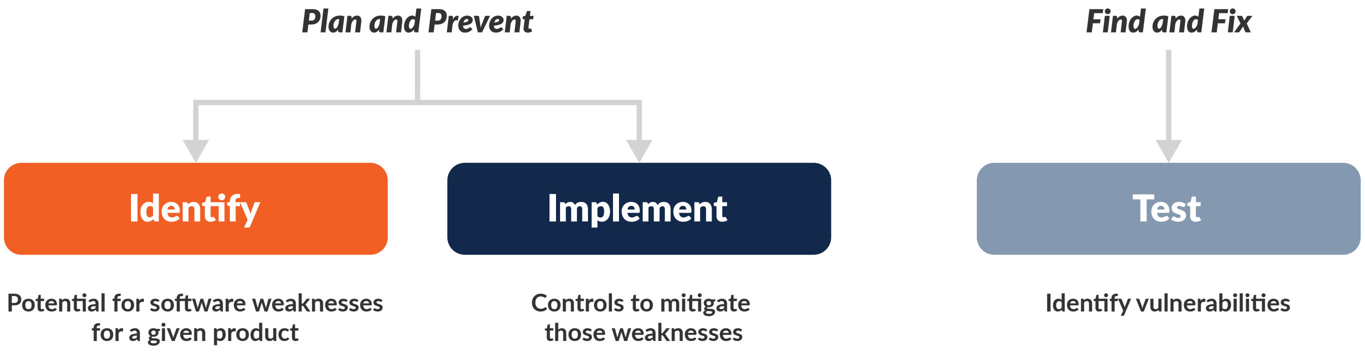
SD Elements Helps You Follow SSDF Recommendations

As mentioned earlier, most organizations test for security by running automated scans late in the SDLC to identify coding errors and design flaws that could be exploited by an attacker. This "Find and Fix" approach is reactive and slows down developers.



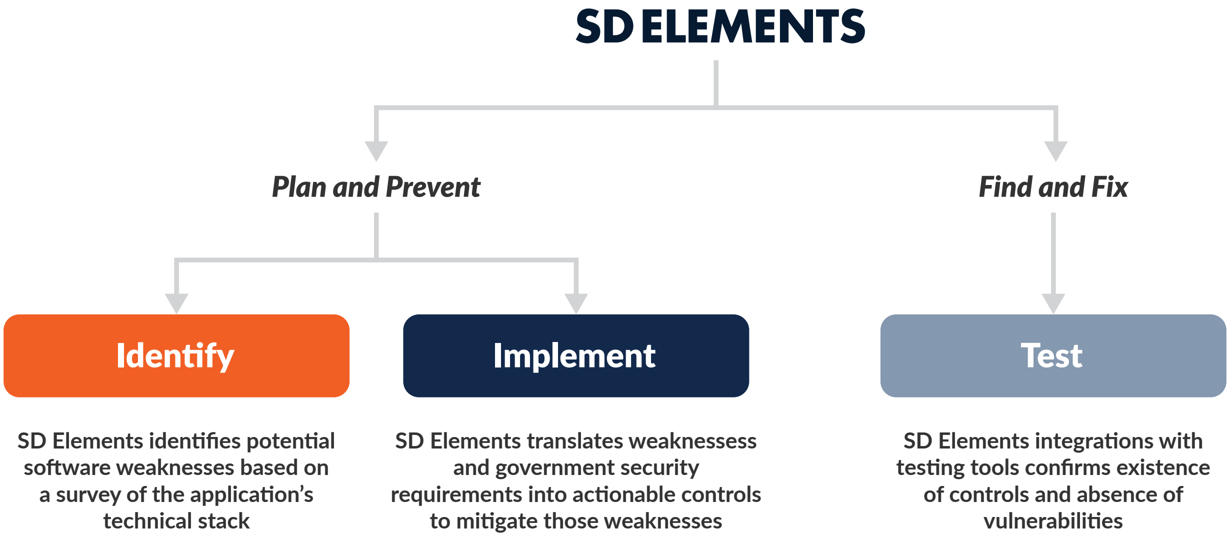
A better approach is “Plan and Prevent.” In this approach, teams anticipate and identify weaknesses in the software, frameworks, and deployment environment (plan) then implement mitigation controls for those weaknesses during the normal development process (prevent).

By adopting a “Plan and Prevent” strategy, teams proactively *avoid* vulnerabilities. Security testing truly becomes a validation exercise to confirm all required mitigation controls are properly implemented.


Plan and Prevent
Find and Fix
Identify
Implement
Test
Potential for software weaknesses for a given product
Controls to mitigate those weaknesses
Identify vulnerabilities

In many organizations, the “Plan and Prevent” exercise consists of lengthy security requirements maintained on spreadsheets. Others may create manual threat models. Threat modeling teams can spend days mapping an application’s data flow, diagramming trust boundaries, and prescribing mitigations for implementation by development teams. The investment in time from scarce security and development resources limits manual threat models to a few critical applications.

SD Elements automates the “Plan and Prevent” exercise. A brief survey provides information on the application’s technology stack, including programming languages, frameworks, deployment environment, and applicable regulatory requirements. SD Elements enumerates potential weaknesses from this then translates these and other federal government security requirements into actionable tasks to be implemented by development, security, and operations. Its integrations with development and DevOps tooling, issue trackers, security testing tools validates that all controls are properly implemented and provides near real-time reporting on the status of each item.



SD ELEMENTS

Plan and Prevent

Find and Fix

Identify

SD Elements identifies potential software weaknesses based on a survey of the application's technical stack

Implement

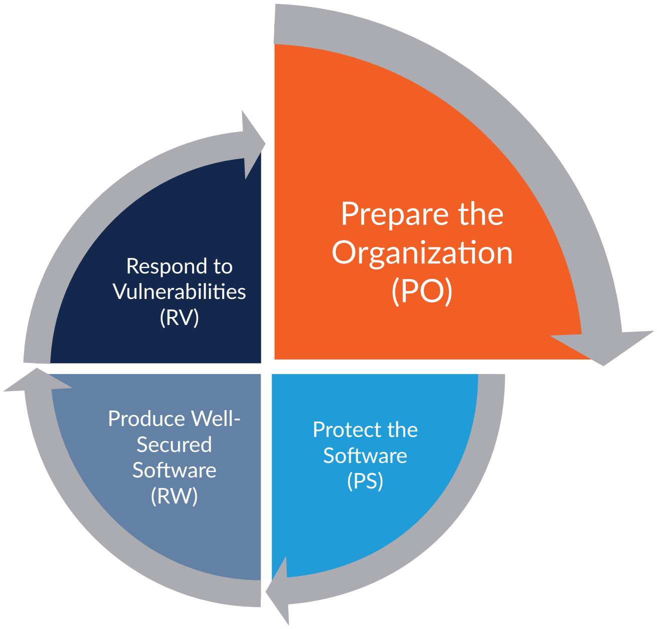
SD Elements translates weaknessess and government security requirements into actionable controls to mitigate those weaknesses

Test

SD Elements integrations with testing tools confirms existence of controls and absence of vulnerabilities

SD Elements scales a "Plan and Prevent" strategy across the organization's entire software portfolio. Its extensive content library supports a broad range of technologies, platforms, programming languages, and regulatory standards. Just-in-Time Training (JITT) delivered directly to developers' desktops provides brief, informative guidance on secure coding practices.

Examples: Prepare the Organization (PO)


Prepare the Organization (PO)
Respond to Vulnerabilities (RV)
Produce Well-Secured Software (RW)
Protect the Software (PS)

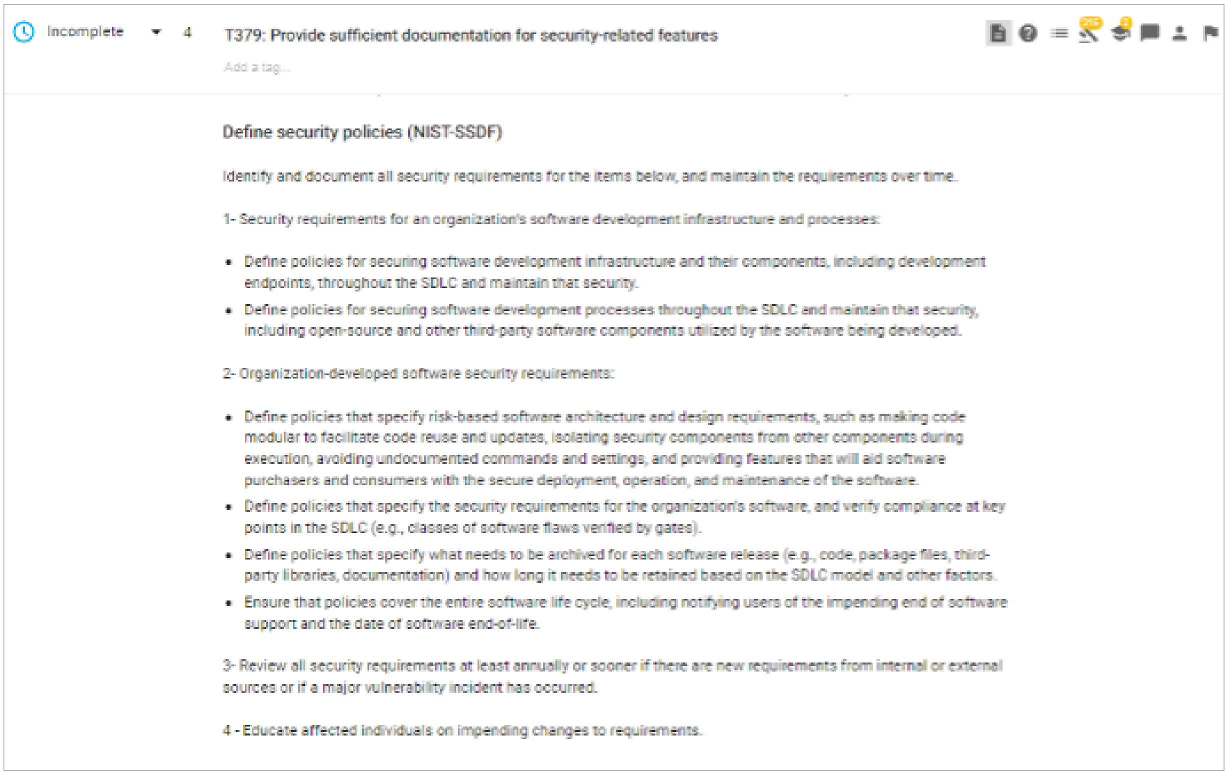
PO.1: Define Security Requirements for Software Development

The first practice in the Prepare the Organization group (PO.1) is *"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)."*

SD Elements supports all of the tasks within PO.1.

- **PO.1.1: Identify and document all security requirements for the organization's software development infrastructures and processes, and maintain the requirements over time.** Examples include defining policies for securing software development infrastructures and their components, including development endpoints, throughout the SDLC and maintaining that security.

    » SD Elements transfers this SSDF control into an actionable task that helps organizations fulfill the requirements of this control. For example, the task includes a list of policies that needs to be defined to satisfy PO.1.1.



T379: Provide sufficient documentation for security-related features

Define security policies (NIST-SSDF)

Identify and document all security requirements for the items below, and maintain the requirements over time.

1- Security requirements for an organization's software development infrastructure and processes:

- Define policies for securing software development infrastructure and their components, including development endpoints, throughout the SDLC and maintain that security.
- Define policies for securing software development processes throughout the SDLC and maintain that security, including open-source and other third-party software components utilized by the software being developed.

2- Organization-developed software security requirements:

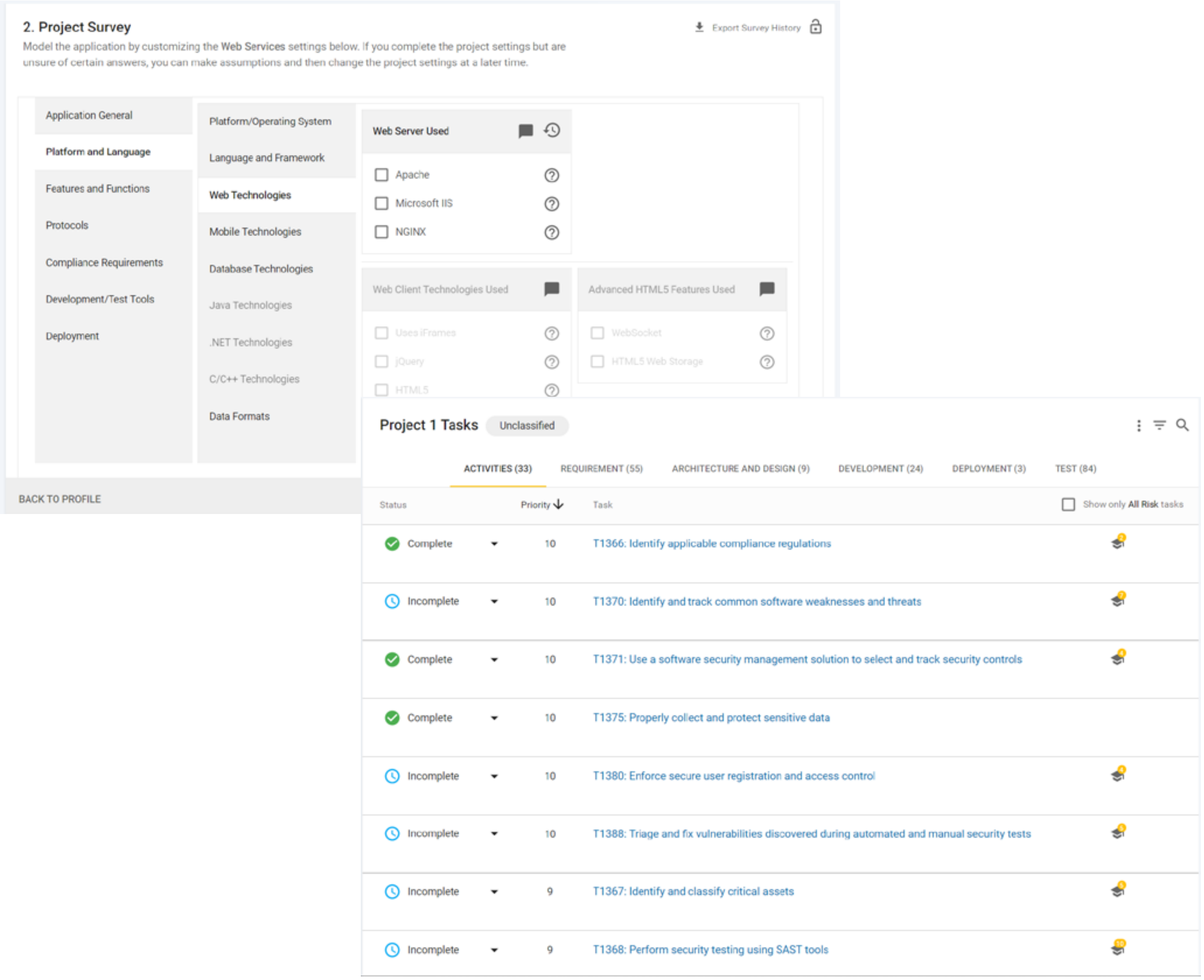
- Define policies that specify risk-based software architecture and design requirements, such as making code modular to facilitate code reuse and updates, isolating security components from other components during execution, avoiding undocumented commands and settings, and providing features that will aid software purchasers and consumers with the secure deployment, operation, and maintenance of the software.
- Define policies that specify the security requirements for the organization's software, and verify compliance at key points in the SDLC (e.g., classes of software flaws verified by gates).
- Define policies that specify what needs to be archived for each software release (e.g., code, package files, third-party libraries, documentation) and how long it needs to be retained based on the SDLC model and other factors.
- Ensure that policies cover the entire software life cycle, including notifying users of the impending end of software support and the date of software end-of-life.

3- Review all security requirements at least annually or sooner if there are new requirements from internal or external sources or if a major vulnerability incident has occurred.

4 - Educate affected individuals on impending changes to requirements.

- **PO.1.2: Identify and document all security requirements for organization-developed software to meet and maintain the requirements over time.** Examples include defining policies that specify risk-based software architecture and design requirements, analyzing the risk of applicable technology stacks, and defining policies that specify the security requirements for the organization's software, and verify compliance at key points in the SDLC

    » SD Elements automatically enumerates security requirements for an application based on a survey of the application's technical stack including its deployment environment and applicable regulatory standards. It then translates those requirements into actionable tasks for development, security, and operations. Tasks are communicated through integrations with issue trackers and other common development tools.



2. Project Survey

Model the application by customizing the **Web Services** settings below. If you complete the project settings but are unsure of certain answers, you can make assumptions and then change the project settings at a later time.

Web Server Used

□ Apache
□ Microsoft IIS
□ NGINX

Web Client Technologies Used

□ Uses iFrames
□ jQuery
□ HTML5

Advanced HTML5 Features Used

□ WebSocket
□ HTML5 Web Storage

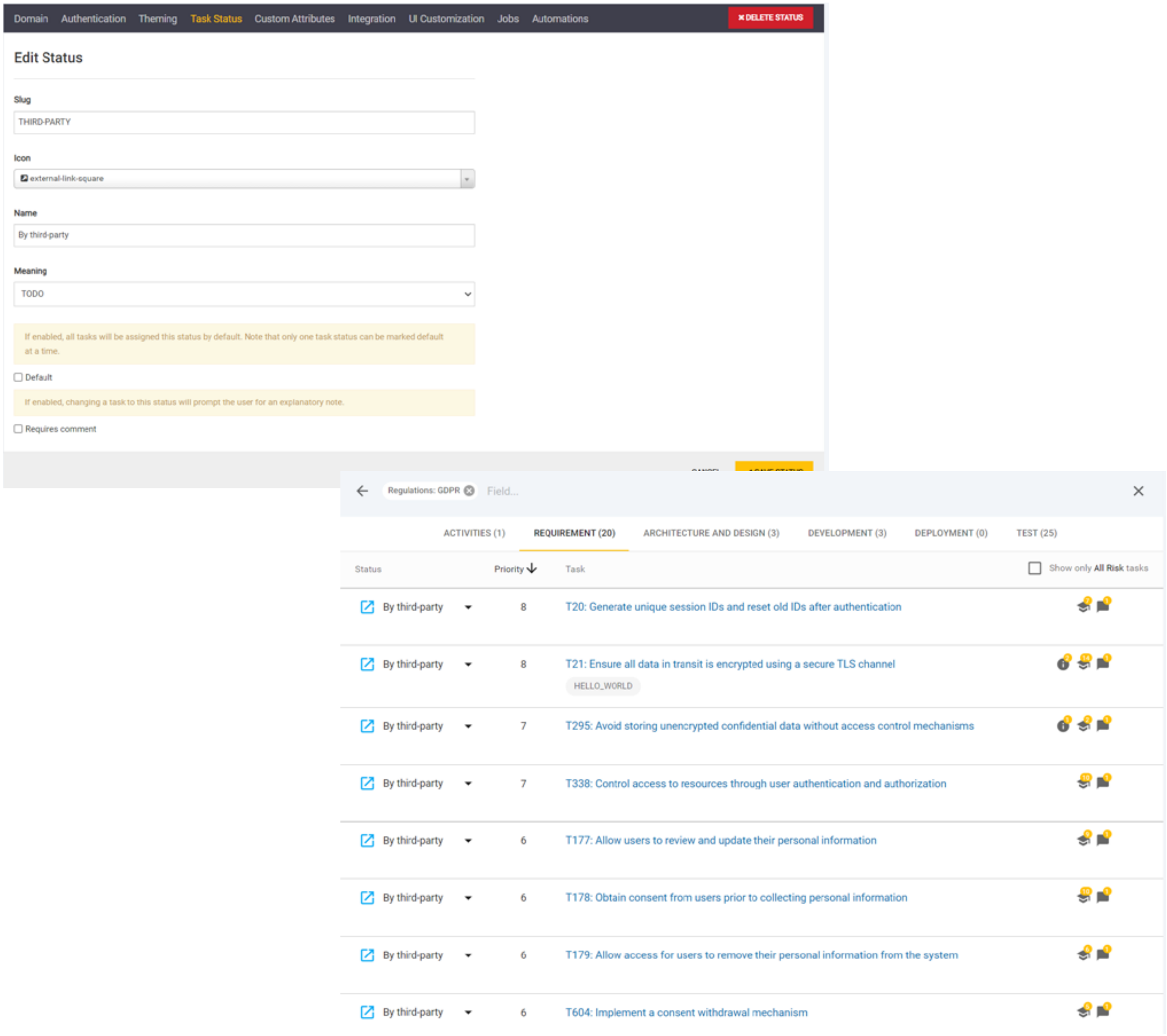
Project 1 Tasks Unclassified

□ Show only **All Risk** tasks

Status	Priority ↓	Task
✓ Complete	10	T1366: Identify applicable compliance regulations
Incomplete	10	T1370: Identify and track common software weaknesses and threats
✓ Complete	10	T1371: Use a software security management solution to select and track security controls
✓ Complete	10	T1375: Properly collect and protect sensitive data
Incomplete	10	T1380: Enforce secure user registration and access control
Incomplete	10	T1388: Triage and fix vulnerabilities discovered during automated and manual security tests
Incomplete	9	T1367: Identify and classify critical assets
Incomplete	9	T1368: Perform security testing using SAST tools

- **PO.1.3: Communicate requirements to all third parties who will provide commercial software components to the organization for reuse by the organization's own software.** Organizations should define a core set of security requirements for software components and ensure that the requirements are included in all contracts. These should include vulnerability disclosure policies and incident response capabilities.

  » For software that requires third-party libraries, organizations can mandate the software vendors comply with a list of controls. This can be done with an export model of selected controls from the survey, direct integration into the third party's Jira workflow, or through a shared Jira instance.



Edit Status

Slug: THIRD-PARTY

Icon: external-link-square

Name: By third-party

Meaning: TODO

If enabled, all tasks will be assigned this status by default. Note that only one task status can be marked default at a time.

□ Default

If enabled, changing a task to this status will prompt the user for an explanatory note.

□ Requires comment

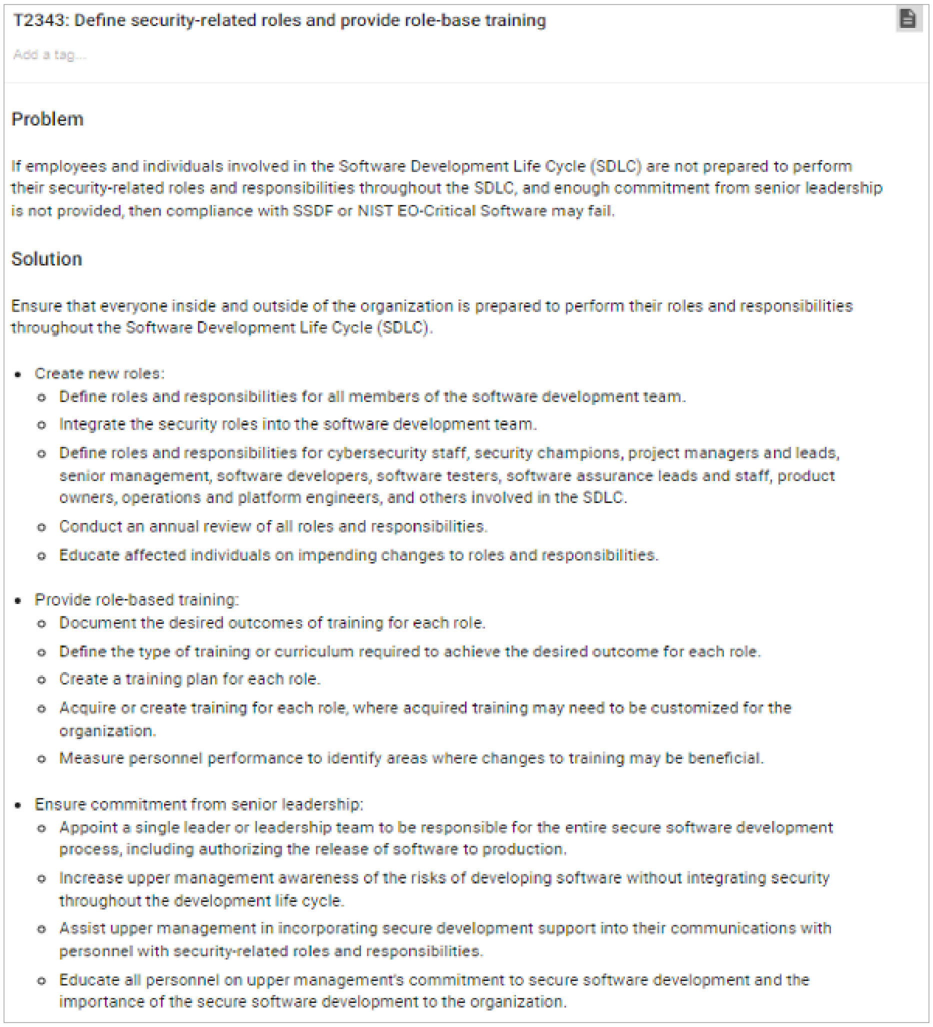
Status	Priority ↓	Task
By third-party	8	T20: Generate unique session IDs and reset old IDs after authentication
By third-party	8	T21: Ensure all data in transit is encrypted using a secure TLS channel HELLO_WORLD
By third-party	7	T295: Avoid storing unencrypted confidential data without access control mechanisms
By third-party	7	T338: Control access to resources through user authentication and authorization
By third-party	6	T177: Allow users to review and update their personal information
By third-party	6	T178: Obtain consent from users prior to collecting personal information
By third-party	6	T179: Allow access for users to remove their personal information from the system
By third-party	6	T604: Implement a consent withdrawal mechanism

PO.2: Prepare the Organization: Implement Roles and Responsibilities

The second practice in Prepare the Organization (PO.2) requires “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.”

- **PO.2.1: Create new roles and alter responsibilities for existing roles as needed to encompass all parts of the SSDF. Periodically review and maintain the defined roles and responsibilities, updating them as needed.** This task requires organizations to define security roles and responsibilities for all the members involved in SDLC.
  - » SD Elements provides a detailed task that helps organizations towards satisfying this requirement. This task provides examples of users that require role definition like security champions, project managers, senior management, software developers, software testers, software assurance staff, product owners, and platform engineers. It also guides organizations to ensure commitment from senior leadership.



T2343: Define security-related roles and provide role-base training

Problem

If employees and individuals involved in the Software Development Life Cycle (SDLC) are not prepared to perform their security-related roles and responsibilities throughout the SDLC, and enough commitment from senior leadership is not provided, then compliance with SSDF or NIST EO-Critical Software may fail.

Solution

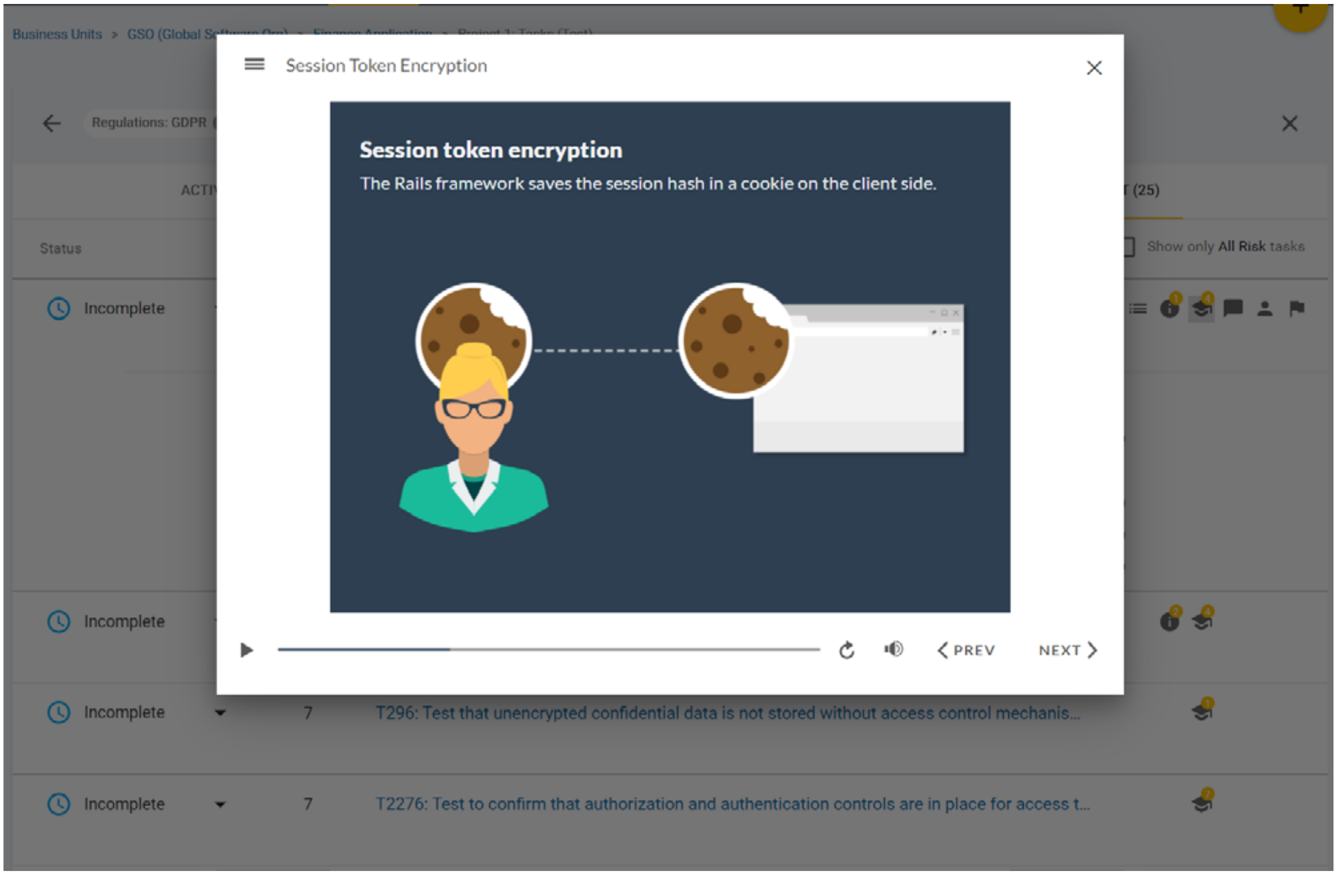
Ensure that everyone inside and outside of the organization is prepared to perform their roles and responsibilities throughout the Software Development Life Cycle (SDLC).

- Create new roles:
  - Define roles and responsibilities for all members of the software development team.
  - Integrate the security roles into the software development team.
  - Define roles and responsibilities for cybersecurity staff, security champions, project managers and leads, senior management, software developers, software testers, software assurance leads and staff, product owners, operations and platform engineers, and others involved in the SDLC.
  - Conduct an annual review of all roles and responsibilities.
  - Educate affected individuals on impending changes to roles and responsibilities.
- Provide role-based training:
  - Document the desired outcomes of training for each role.
  - Define the type of training or curriculum required to achieve the desired outcome for each role.
  - Create a training plan for each role.
  - Acquire or create training for each role, where acquired training may need to be customized for the organization.
  - Measure personnel performance to identify areas where changes to training may be beneficial.
- Ensure commitment from senior leadership:
  - Appoint a single leader or leadership team to be responsible for the entire secure software development process, including authorizing the release of software to production.
  - Increase upper management awareness of the risks of developing software without integrating security throughout the development life cycle.
  - Assist upper management in incorporating secure development support into their communications with personnel with security-related roles and responsibilities.
  - Educate all personnel on upper management's commitment to secure software development and the importance of the secure software development to the organization.

- **PO.2.2: Provide role-specific training for all personnel with responsibilities that contribute to secure development. Periodically review role-specific training and update it as needed.** This task requires organizations to document the desired outcome of training, define the curriculum, and create a training plan for each role in the development process.

  - » Security Compass offers an extensive on-demand eLearning library that supports every role in software development and deployment. Courses for software developers, software architects, QA engineers, and project managers cover fundamental elements of software security and language-specific secure coding practices. Our Software Security Practitioner (SSP) Suites are pre-selected sets of courses for specific coding languages or specific roles within the development team.

  - » To reinforce secure coding training, SD Elements Just-In-Time Training (JITT) provides short videos that support the implementation of software security and privacy requirements during development.



Session token encryption

The Rails framework saves the session hash in a cookie on the client side.

Incomplete

Incomplete

Incomplete 7 T296: Test that unencrypted confidential data is not stored without access control mechanis...

Incomplete 7 T2276: Test to confirm that authorization and authentication controls are in place for access t...

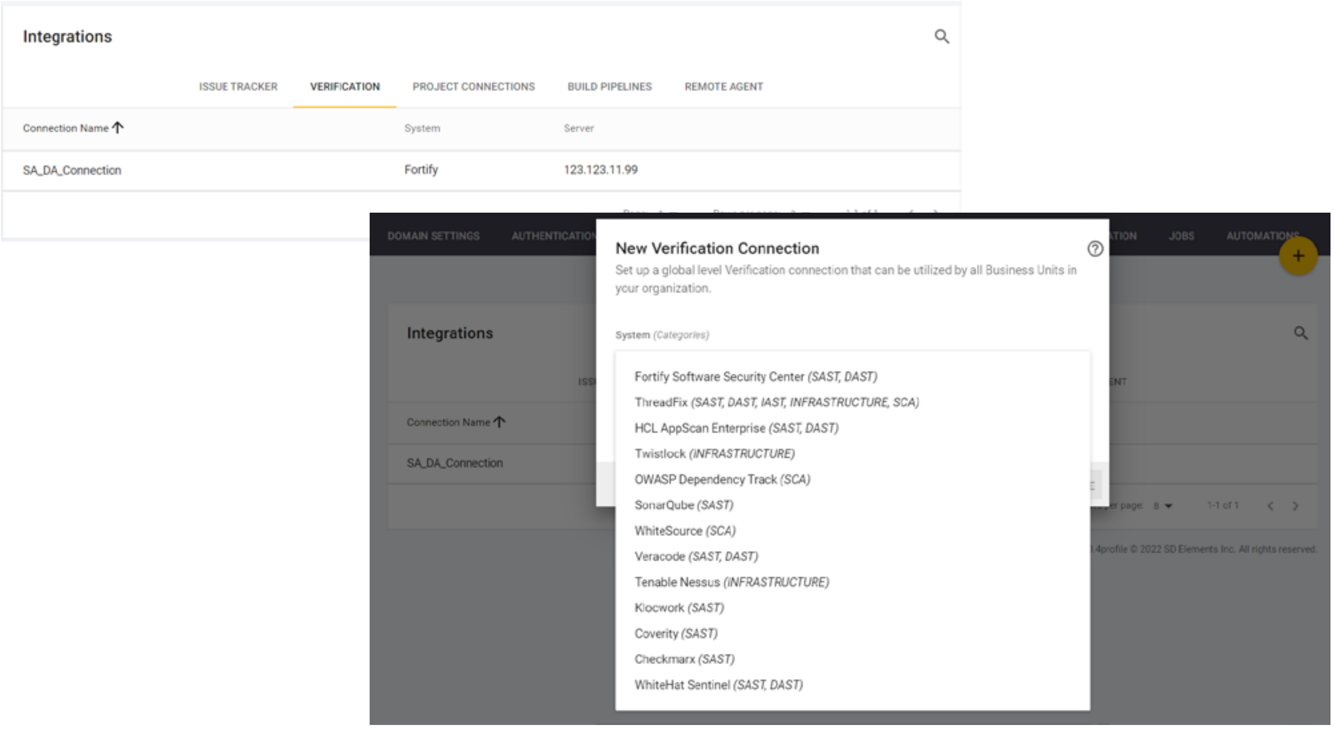
PO.3: Prepare the Organization: Implement Supporting Toolchains

PO.3 advocates for automation across the SDLC:

"Use automation to reduce human effort and improve the accuracy, consistency, 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. "

- **PO.3.3: Configure tools to collect evidence and artifacts of their support of the secure software development practices as defined by the organization.** Organizations will want traceability of all activity, including issue tracking and validation of controls. This is useful for internal use and can also provide evidence of compliance with SSDF to auditors and customers.

  - » Unlike spreadsheet-based models that are subject to error and lack traceability, SD Elements provides a centralized repository for all activity and full, evidentiary quality auditing for all actions. Teams have near real-time reporting on the status of each project with granularity to individual controls. Integrations with issue trackers allows organizations to assign and track each task for completion. Integrations with security testing tools like static application security testing (SAST) and dynamic application security testing (DAST) tools enable fast, consistent validation of security control implementation status and sharing of results directly with developers.



Connection Name ↑	System	Server
SA_DA_Connection	Fortify	123.123.11.99

New Verification Connection

Set up a global level Verification connection that can be utilized by all Business Units in your organization.

System *(Categories)*

Fortify Software Security Center *(SAST, DAST)*
ThreadFix *(SAST, DAST, IAST, INFRASTRUCTURE, SCA)*
HCL AppScan Enterprise *(SAST, DAST)*
Twistlock *(INFRASTRUCTURE)*
OWASP Dependency Track *(SCA)*
SonarQube *(SAST)*
WhiteSource *(SCA)*
Veracode *(SAST, DAST)*
Tenable Nessus *(INFRASTRUCTURE)*
Klocwork *(SAST)*
Coverity *(SAST)*
Checkmarx *(SAST)*
WhiteHat Sentinel *(SAST, DAST)*

Examples: Protect the Software (PS)

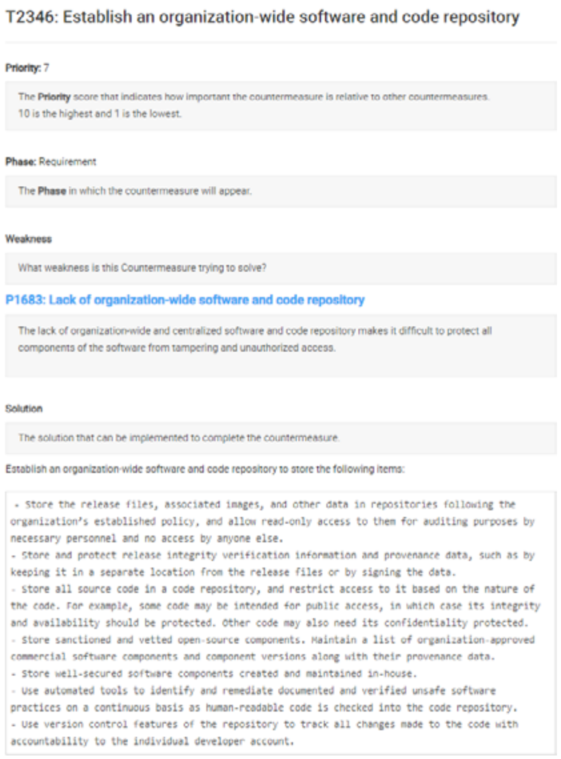
Respond to Vulnerabilities (RV)
Prepare the Organization (PO)
Produce Well-Secured Software (RW)
Protect the Software (PS)

PS.1: Protect All Forms of Code from Unauthorized Access and Tampering

PS.1 acknowledges that building secure applications requires organizations to protect their development and build environments. Recent attacks on SolarWinds and CodeCov demonstrated the disastrous impact of poor practices.

> *"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."*

- PS1.1: Store all forms of code, including source code and executable code, based on the principle of least privilege so that only authorized personnel, tools, services, etc. have the necessary forms of access. This includes maintaining repositories that are protected for confidentiality and integrity, the use of code and commit signing.
  - SD Elements' risk mitigation controls include recommendations for strict access control and secure storage rules, as well as the use of obfuscation and checksum or digitally signed certificates to ensure that code is not tampered with or replaced by malicious attackers during update cycles. It provides controls for using cryptographic functions to protect software code, files, and business logic, and the use of back-out positions so applications can recover from failed changes or unexpected results.



T2346: Establish an organization-wide software and code repository

Priority: 7

The **Priority** score that indicates how important the countermeasure is relative to other countermeasures.
10 is the highest and 1 is the lowest.

Phase: Requirement

The **Phase** in which the countermeasure will appear.

Weakness

What weakness is this Countermeasure trying to solve?

P1683: Lack of organization-wide software and code repository

The lack of organization-wide and centralized software and code repository makes it difficult to protect all components of the software from tampering and unauthorized access.

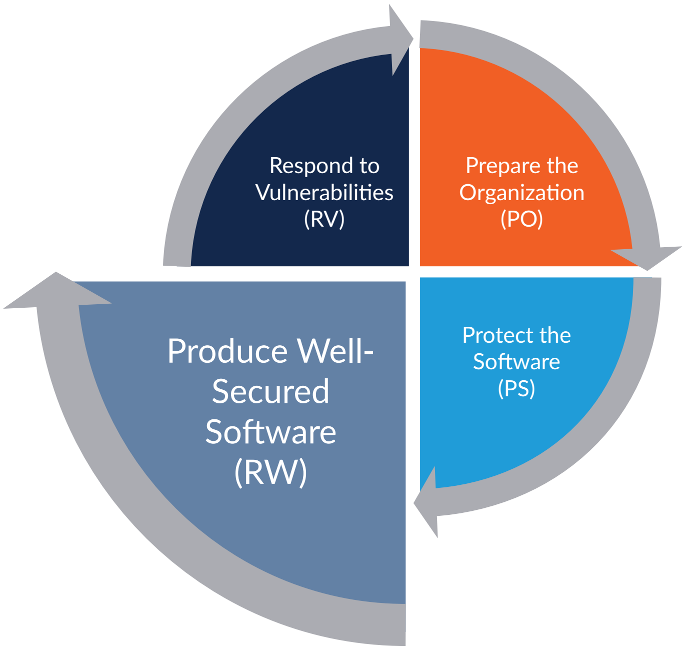
Solution

The solution that can be implemented to complete the countermeasure.

Establish an organization-wide software and code repository to store the following items:

```
 - Store the release files, associated images, and other data in repositories following the
organization's established policy, and allow read-only access to them for auditing purposes by
necessary personnel and no access by anyone else.
- Store and protect release integrity verification information and provenance data, such as by
keeping it in a separate location from the release files or by signing the data.
- Store all source code in a code repository, and restrict access to it based on the nature of
the code. For example, some code may be intended for public access, in which case its integrity
and availability should be protected. Other code may also need its confidentiality protected.
- Store sanctioned and vetted open-source components. Maintain a list of organization-approved
commercial software components and component versions along with their provenance data.
- Store well-secured software components created and maintained in-house.
- Use automated tools to identify and remediate documented and verified unsafe software
practices on a continuous basis as human-readable code is checked into the code repository.
- Use version control features of the repository to track all changes made to the code with
accountability to the individual developer account.
```

Examples: Produce Well-Secured Software (PW)


Respond to Vulnerabilities (RV)
Prepare the Organization (PO)
Produce Well-Secured Software (RW)
Protect the Software (PS)

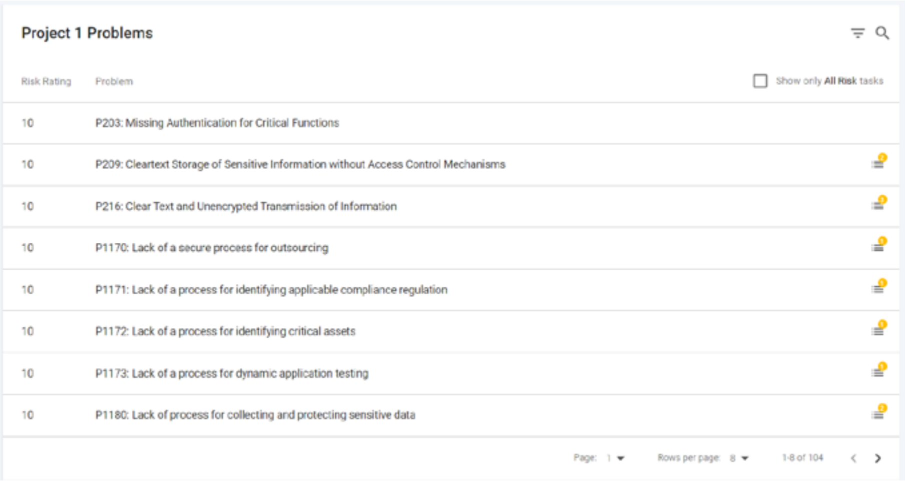
PW.1: Design Software to Meet Security Requirements and Mitigate Security Risks

PW.1 requires organizations to adopt a "Plan and Prevent" strategy to anticipate weaknesses in an application and proactively adopt risk mitigation controls.

"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 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) helps make software development more efficient."

- **PW.1.1: Use forms of risk modeling, such as threat modeling, attack modeling, or attack surface mapping, to help assess the security risk for the software.** This includes identifying potential weaknesses and using a risk-based approach to address the risks and implement mitigations.

  » SD Elements automates threat modeling, reducing the time required from weeks to hours. After the completion of a project survey, SD Elements identifies weaknesses that threats target and enables the delivery of mitigation controls directly to those responsible in development, security, and operations. By anticipating threats and building mitigations as part of the normal development process, security testing is simplified, more proactively, and easily scaled across an entire software portfolio.



Project 1 Problems

□ Show only **All Risk** tasks

Risk Rating	Problem
10	P203: Missing Authentication for Critical Functions
10	P209: Cleartext Storage of Sensitive Information without Access Control Mechanisms
10	P216: Clear Text and Unencrypted Transmission of Information
10	P1170: Lack of a secure process for outsourcing
10	P1171: Lack of a process for identifying applicable compliance regulation
10	P1172: Lack of a process for identifying critical assets
10	P1173: Lack of a process for dynamic application testing
10	P1180: Lack of process for collecting and protecting sensitive data

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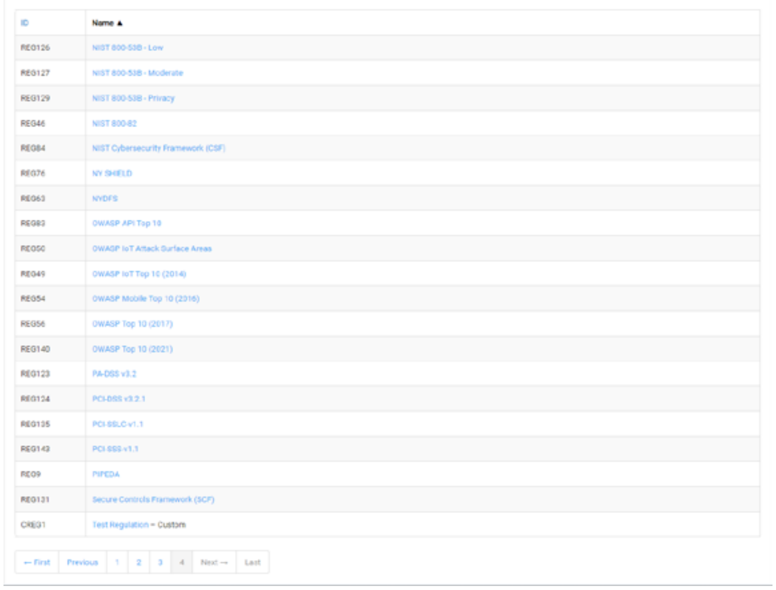
- **PW.1.2: Document the software's security requirements, risks, and design decisions.** This includes the requirement to document the response to each risk, including how mitigations are to be achieved.
  - » SD Elements' content library includes dozens of regulatory standards and best practices frameworks and translates these into easy-to-follow instructions for development, assurance, and deployment teams. It can be customized to accommodate secure coding policies of an individual company or project.



ID	Name ▲
REG126	NIST 800-53B - Low
REG127	NIST 800-53B - Moderate
REG129	NIST 800-53B - Privacy
REG46	NIST 800-82
REG84	NIST Cybersecurity Framework (CSF)
REG76	NY SHIELD
REG63	NYDFS
REG83	OWASP API Top 10
REG50	OWASP IoT Attack Surface Areas
REG49	OWASP IoT Top 10 (2014)
REG54	OWASP Mobile Top 10 (2016)
REG56	OWASP Top 10 (2017)
REG140	OWASP Top 10 (2021)
REG123	PA-DSS v3.2
REG124	PCI-DSS v3.2.1
REG135	PCI-SSLC-v1.1
REG143	PCI SSS-v1.1
REG9	PIPEDA
REG131	Secure Controls Framework (SCF)
CREG1	Test Regulation – Custom

PW.4: Reuse Existing, Well-Secured Software When Feasible Instead of Duplicating Functionality

PW.4 encourages organizations to identify and reuse "known-good" components and microservices.

"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."

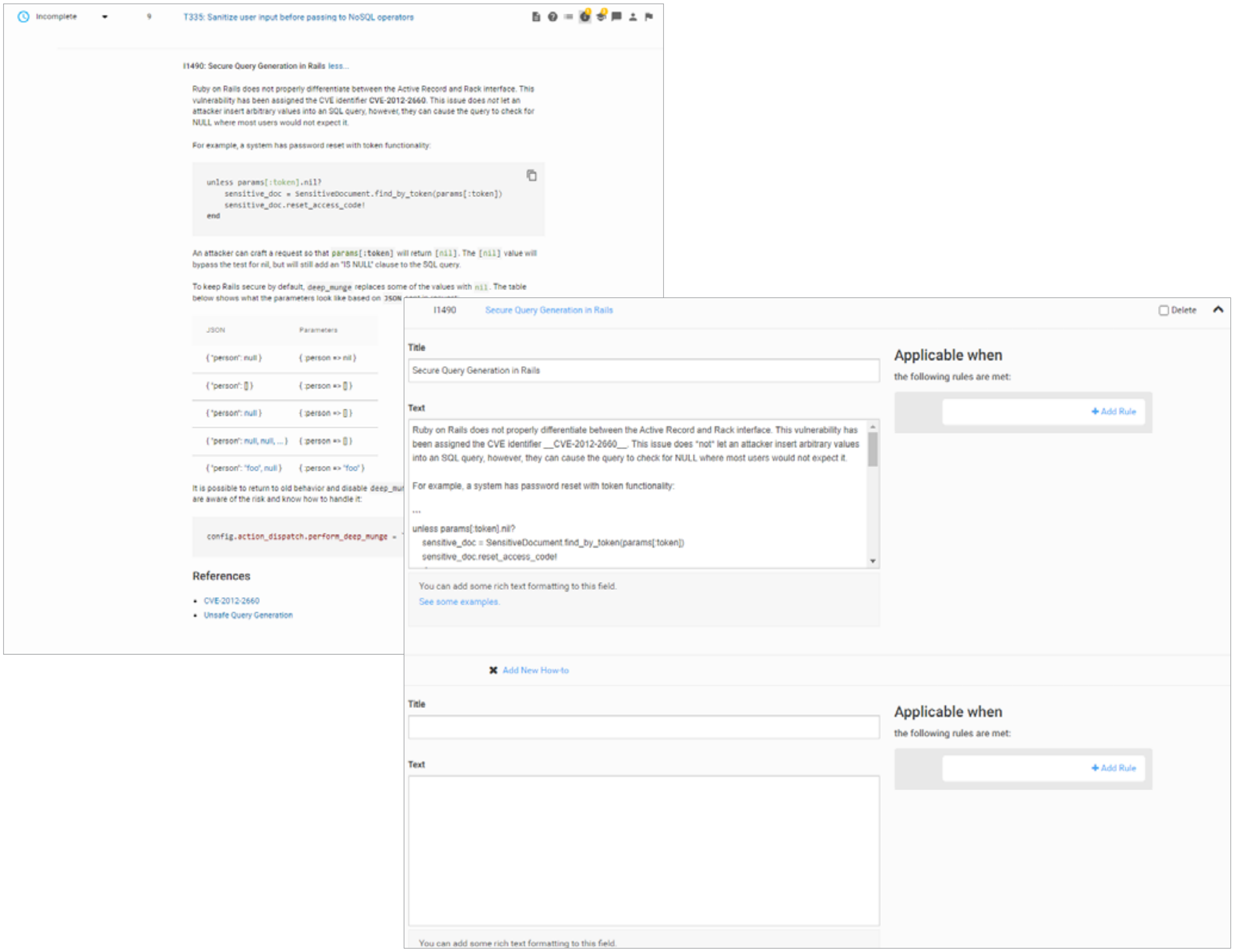
- **PW.4.2: Create well-secured software components in-house following SDLC processes to meet common internal software** development needs that cannot be better met by third-party software. Secure development requirements apply equally to applications and reusable components or micro-services.
  - » SD Elements can be used on projects of any size. As a project evolves, updates to the survey will update any required controls.

PW.5: Create Source Code by Adhering to Secure Coding Practices

PW.5 covers the core practices of building secure software. It requires organizations to consider weaknesses that may be inherent to specific programming languages and deployment environments.

- **PW.5.1: Follow all secure coding practices that are appropriate to the development languages and environment.** This task covers all secure coding best practices, including input validation, avoiding unsafe functions and calls, ensuring complete logging, and code reviews.

  » SD Elements enables secure development by translating language and platform specific secure development policies into specific tasks. A team of security experts continuously updates security controls, including coding samples and test plans, to ensure that teams apply consistent and effective controls. Extensive secure coding policies are included with SD Elements, or organizations can add their own policies.



I1490: Secure Query Generation in Rails less...

Ruby on Rails does not properly differentiate between the Active Record and Rack interface. This vulnerability has been assigned the CVE identifier **CVE-2012-2660**. This issue does *not* let an attacker insert arbitrary values into an SQL query, however, they can cause the query to check for NULL where most users would not expect it.

For example, a system has password reset with token functionality:

```
unless params[:token].nil?
    sensitive_doc = SensitiveDocument.find_by_token(params[:token])
    sensitive_doc.reset_access_code!
end
```

An attacker can craft a request so that `params[:token]` will return `[nil]`. The `[nil]` value will bypass the test for nil, but will still add an 'IS NULL' clause to the SQL query.

To keep Rails secure by default, `deep_munge` replaces some of the values with `nil`. The table below shows what the parameters look like based on `JSON`

JSON	Parameters
{ "person": null }	{ :person => nil }
{ "person": [] }	{ :person => [] }
{ "person": null }	{ :person => [] }
{ "person": null, null, ... }	{ :person => [] }
{ "person": "foo", null }	{ :person => "foo" }

It is possible to return to old behavior and disable deep_mu
are aware of the risk and know how to handle it:

```
config.action_dispatch.perform_deep_munge =
```

References

- CVE-2012-2660
- Unsafe Query Generation

Title: Secure Query Generation in Rails

Text:

Ruby on Rails does not properly differentiate between the Active Record and Rack interface. This vulnerability has been assigned the CVE identifier __CVE-2012-2660__. This issue does *not* let an attacker insert arbitrary values into an SQL query, however, they can cause the query to check for NULL where most users would not expect it.

For example, a system has password reset with token functionality:

```
unless params[:token].nil?
  sensitive_doc = SensitiveDocument.find_by_token(params[:token])
  sensitive_doc.reset_access_code!
```

You can add some rich text formatting to this field.
See some examples.

Applicable when
the following rules are met:

Title:

Text:

You can add some rich text formatting to this field.

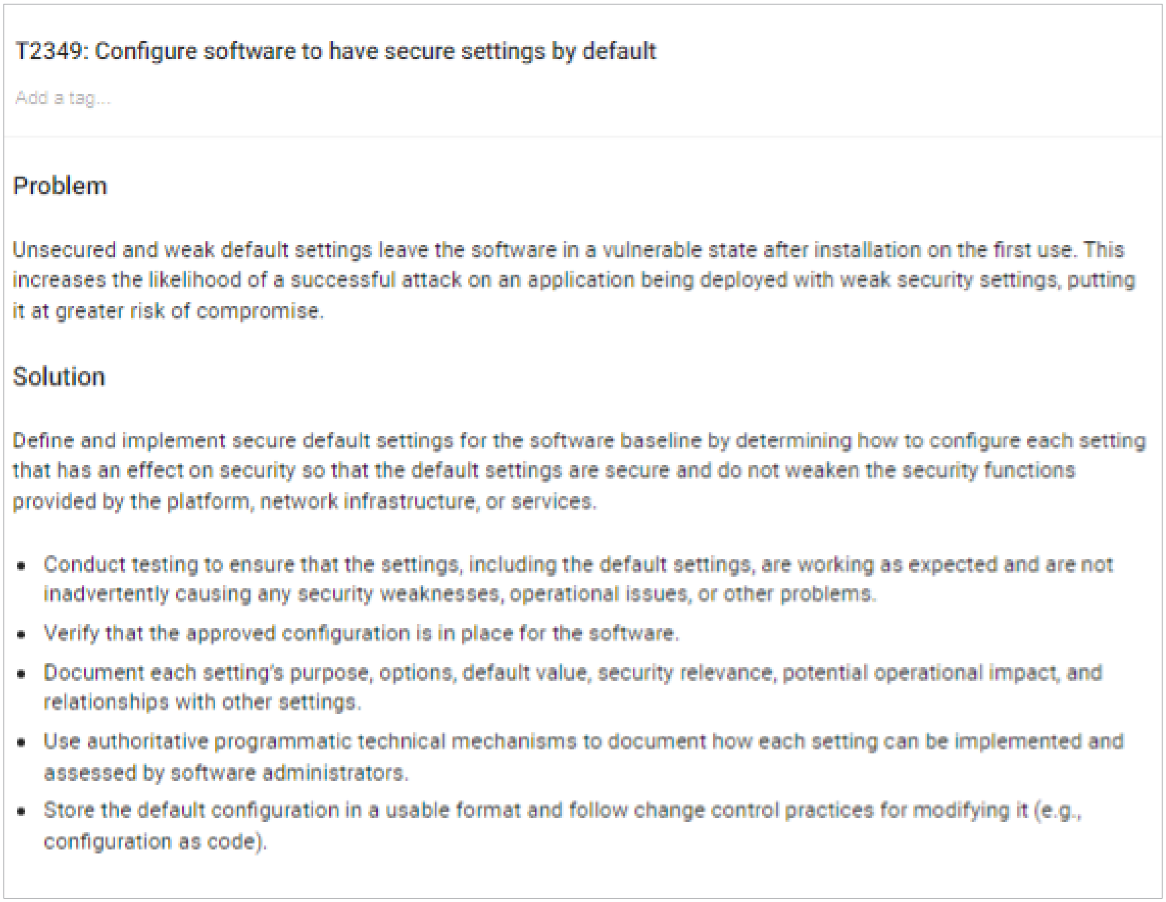
Applicable when
the following rules are met:

PW.9: Configure Software to Have Secure Settings by Default

PW.9 recognizes that weaknesses can enter an application from multiple points.

"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."

- **PW.9.1: Define a secure baseline by determining how to configure each setting that has an effect on security so that the default settings are secure and do not weaken the security functions provided by the platform, network infrastructure, or services.** Misconfigurations of servers and storage can result in data leakage and provide simple attack vectors to attackers. These settings are often missed by automated scanners and must be explicitly confirmed by security and/or operations.
  - » SD Elements offers tasks that facilitate configuring software with secure settings. For example, one of the tasks advises on the steps that need to be implemented during the development phase to ensure a secure configuration.



T2349: Configure software to have secure settings by default

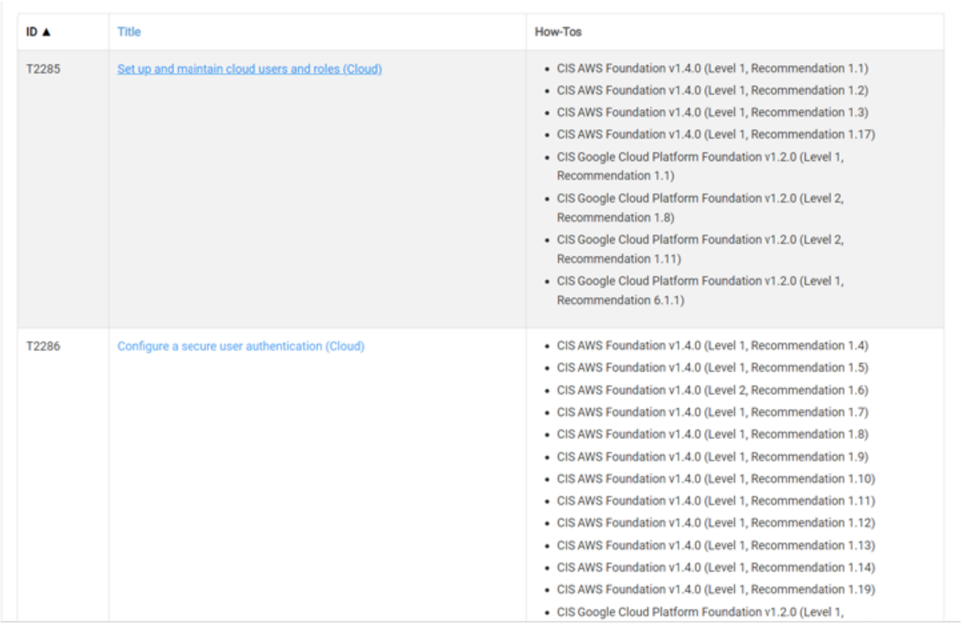
Problem

Unsecured and weak default settings leave the software in a vulnerable state after installation on the first use. This increases the likelihood of a successful attack on an application being deployed with weak security settings, putting it at greater risk of compromise.

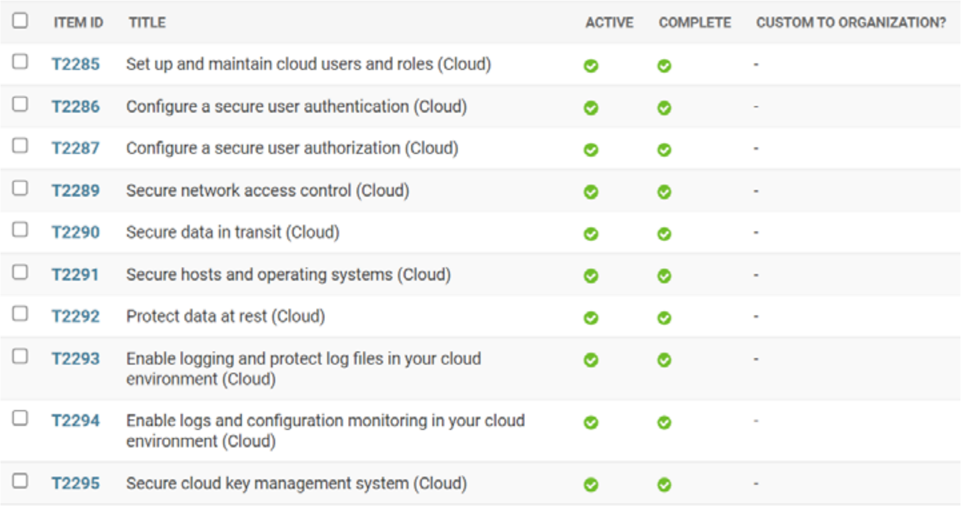
Solution

Define and implement secure default settings for the software baseline by determining how to configure each setting that has an effect on security so that the default settings are secure and do not weaken the security functions provided by the platform, network infrastructure, or services.

- 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.
- Verify that the approved configuration is in place for the software.
- Document each setting's purpose, options, default value, security relevance, potential operational impact, and relationships with other settings.
- Use authoritative programmatic technical mechanisms to document how each setting can be implemented and assessed by software administrators.
- Store the default configuration in a usable format and follow change control practices for modifying it (e.g., configuration as code).



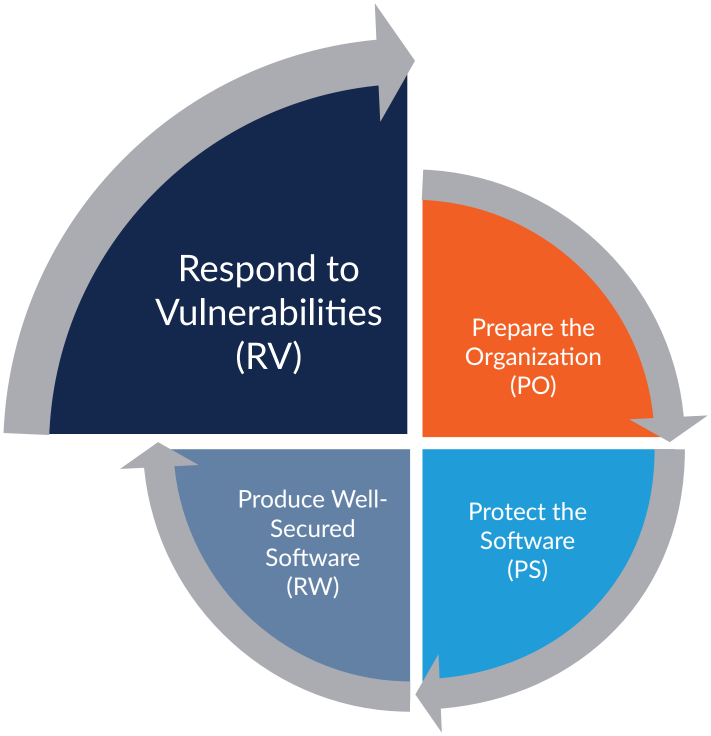
ID ▲	Title	How-Tos
T2285	Set up and maintain cloud users and roles (Cloud)	• CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.1) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.2) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.3) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.17) • CIS Google Cloud Platform Foundation v1.2.0 (Level 1, Recommendation 1.1) • CIS Google Cloud Platform Foundation v1.2.0 (Level 2, Recommendation 1.8) • CIS Google Cloud Platform Foundation v1.2.0 (Level 2, Recommendation 1.11) • CIS Google Cloud Platform Foundation v1.2.0 (Level 1, Recommendation 6.1.1)
T2286	Configure a secure user authentication (Cloud)	• CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.4) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.5) • CIS AWS Foundation v1.4.0 (Level 2, Recommendation 1.6) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.7) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.8) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.9) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.10) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.11) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.12) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.13) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.14) • CIS AWS Foundation v1.4.0 (Level 1, Recommendation 1.19) • CIS Google Cloud Platform Foundation v1.2.0 (Level 1,



□	ITEM ID	TITLE	ACTIVE	COMPLETE	CUSTOM TO ORGANIZATION?
□	T2285	Set up and maintain cloud users and roles (Cloud)	✓	✓	-
□	T2286	Configure a secure user authentication (Cloud)	✓	✓	-
□	T2287	Configure a secure user authorization (Cloud)	✓	✓	-
□	T2289	Secure network access control (Cloud)	✓	✓	-
□	T2290	Secure data in transit (Cloud)	✓	✓	-
□	T2291	Secure hosts and operating systems (Cloud)	✓	✓	-
□	T2292	Protect data at rest (Cloud)	✓	✓	-
□	T2293	Enable logging and protect log files in your cloud environment (Cloud)	✓	✓	-
□	T2294	Enable logs and configuration monitoring in your cloud environment (Cloud)	✓	✓	-
□	T2295	Secure cloud key management system (Cloud)	✓	✓	-

» SD Elements' content library includes secure configurations as well as security standards for cloud deployments from the Cloud Security Alliance.

Examples: Respond to Vulnerabilities (RV)


Respond to Vulnerabilities (RV)
Prepare the Organization (PO)
Protect the Software (PS)
Produce Well-Secured Software (RW)

RV.1: Identify and Confirm Vulnerabilities on an Ongoing Basis

RV.1 highlights the importance of threat awareness. It requires organizations to monitor public sources for newly disclosed vulnerabilities and adjust security controls accordingly.

"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."

RV.1.1: Gather information from purchasers, consumers, and public sources on potential vulnerabilities in the software and third-party components that the software uses, and investigate all credible reports. Thousands of new vulnerabilities are disclosed publicly each year. Teams should monitor vulnerability mailing lists and other public disclosures to avoid adding simple attack vectors to their code base.

- SD Elements' research team monitors multiple sources to maintain timely and accurate content on vulnerabilities and attack patterns, including CIS Benchmarks and databases for weaknesses and vulnerabilities like CVE and CAPEC. As new vulnerabilities are disclosed (e.g., Log4shell), the research team immediately acts and provides the necessary tasks to mitigate the vulnerability in subsequent releases.

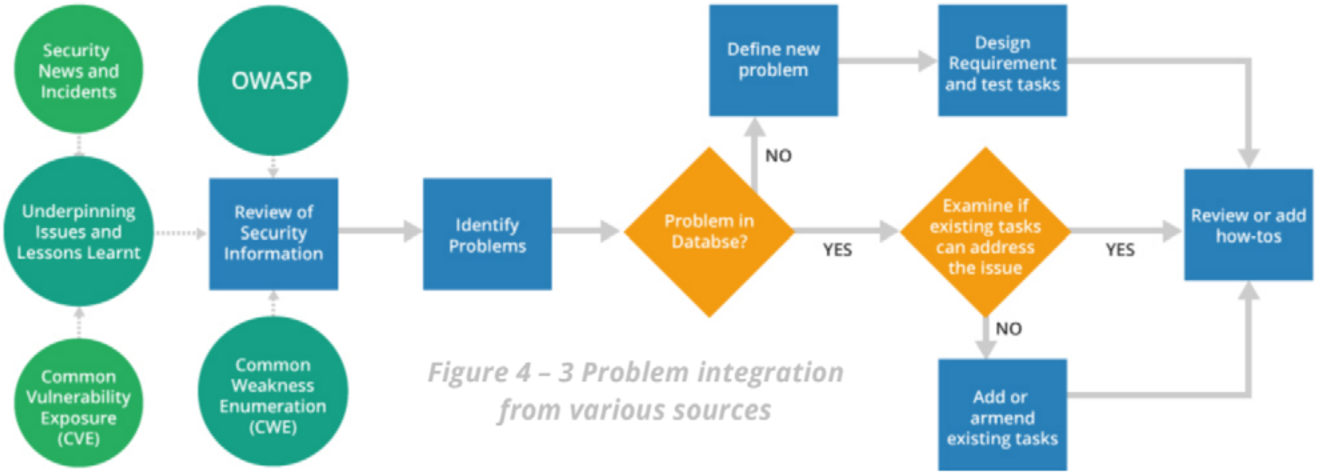

Security News and Incidents
OWASP
Underpinning Issues and Lessons Learnt
Review of Security Information
Common Vulnerability Exposure (CVE)
Common Weakness Enumeration (CWE)
Identify Problems
Problem in Databse?
NO
YES
Define new problem
Design Requirement and test tasks
Examine if existing tasks can address the issue
YES
NO
Review or add how-tos
Add or armend existing tasks

Figure 4 – 3 Problem integration from various sources

RV.2: Assess, Prioritize, and Remediate Vulnerabilities

RV.2 emphasizes the need to prioritize vulnerabilities using a risk-based approach. This includes remediating vulnerabilities, risk mitigation, and risk acceptance.

"Help ensure that vulnerabilities are remediated in accordance with risk to reduce the window of opportunity for attackers."

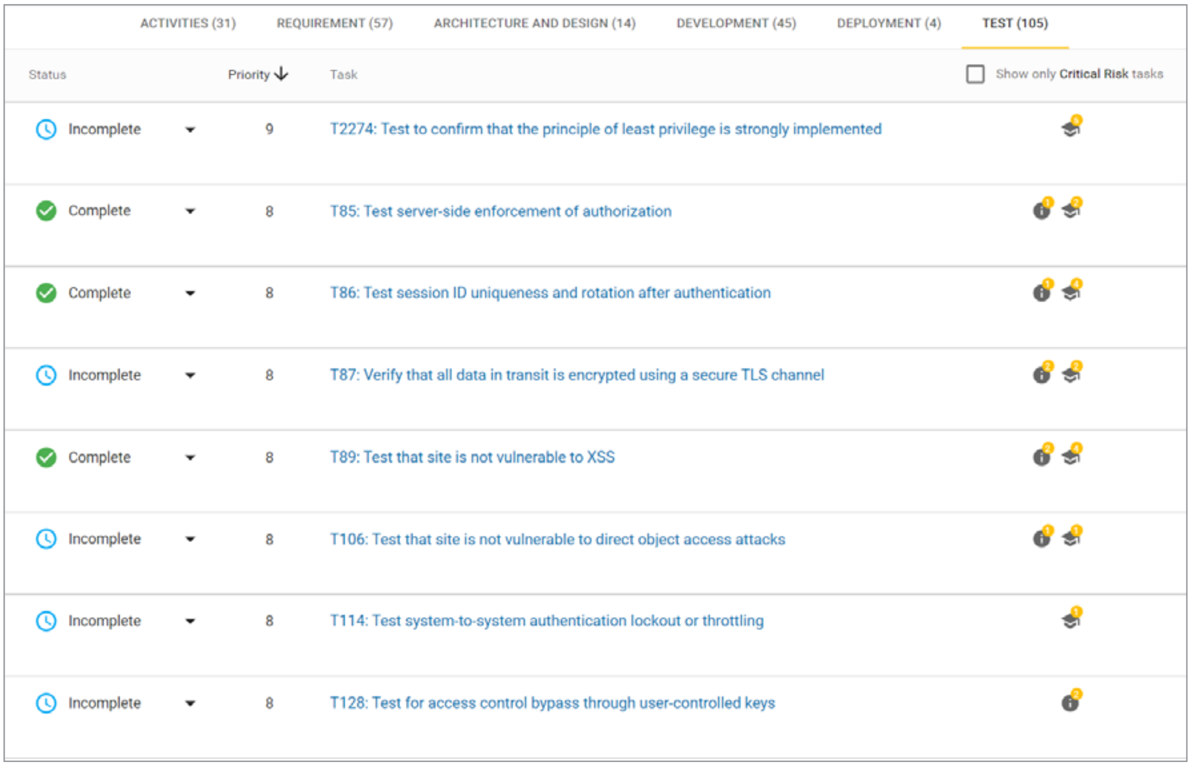
- RV.2.2: Plan and implement risk responses for vulnerabilities. Appropriate controls can mitigate the risk of most vulnerabilities. Having consistent, effective controls improves security and makes software maintenance simpler.
  - » SDE identifies and prioritizes vulnerabilities based on the technical stack to inform risk-based decisions (e.g., risk acceptance, risk transference). When a permanent mitigation is unavailable, mitigations are provided to reduce the attack risk.

RV.3: Analyze Vulnerabilities to Identify Their Root Causes

RV.3 cites the importance of continuous improvement through observation. By identifying the root cause of vulnerabilities, teams can improve their secure coding skills.

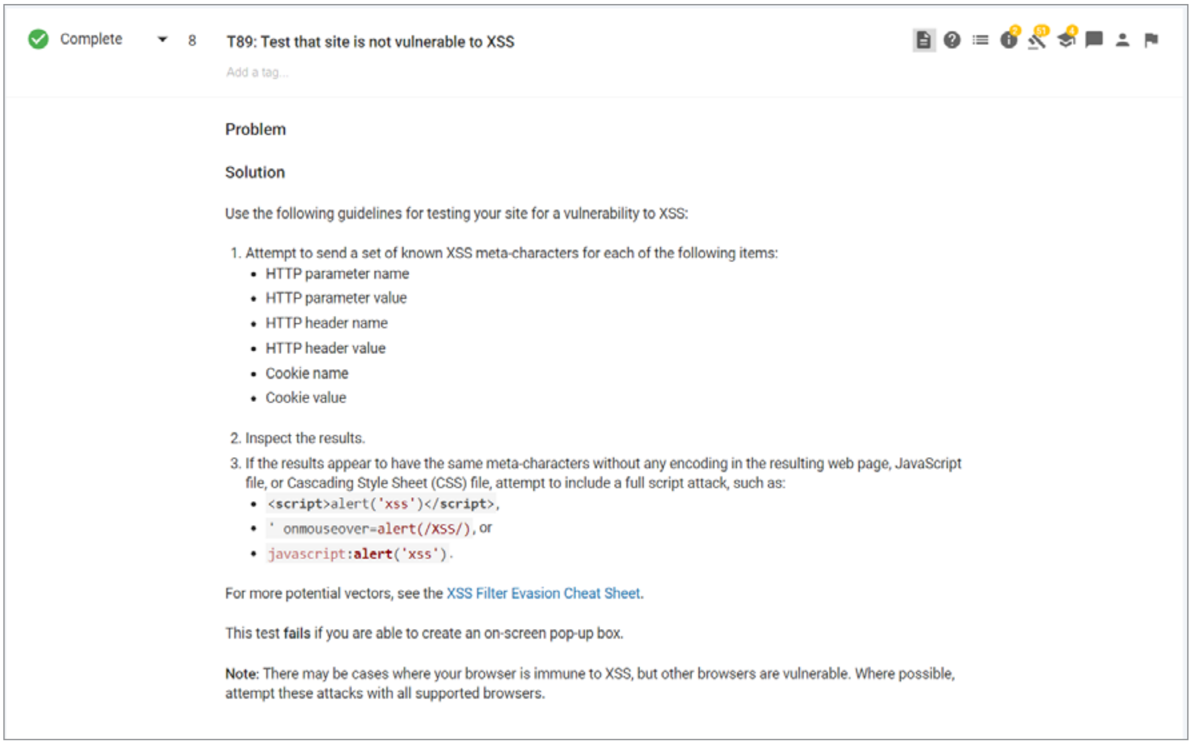
"Help reduce the frequency of vulnerabilities in the future."

- RV.3.3: Review the software for similar vulnerabilities, and proactively fix them rather than waiting for external reports. The guidance for RV.3.3 references practices 7 and 8: Test Executable Code to Identify Vulnerabilities and Verify Compliance with Security Requirements.
  - » SD Elements provides guidelines and instructions for building processes that ensure applications meet security verification requirements. It integrates with security testing tools like SAST, DAST, and SCA to import the results of scanning, verify results, and automatically close some tasks.



Status	Priority ↓	Task
Incomplete	9	T2274: Test to confirm that the principle of least privilege is strongly implemented
Complete	8	T85: Test server-side enforcement of authorization
Complete	8	T86: Test session ID uniqueness and rotation after authentication
Incomplete	8	T87: Verify that all data in transit is encrypted using a secure TLS channel
Complete	8	T89: Test that site is not vulnerable to XSS
Incomplete	8	T106: Test that site is not vulnerable to direct object access attacks
Incomplete	8	T114: Test system-to-system authentication lockout or throttling
Incomplete	8	T128: Test for access control bypass through user-controlled keys

R.V.3.3 (1) is a list of test tasks that "provides guidelines and instructions... that ensure applications meet security verification requirements."



T89: Test that site is not vulnerable to XSS

Problem

Solution

Use the following guidelines for testing your site for a vulnerability to XSS:

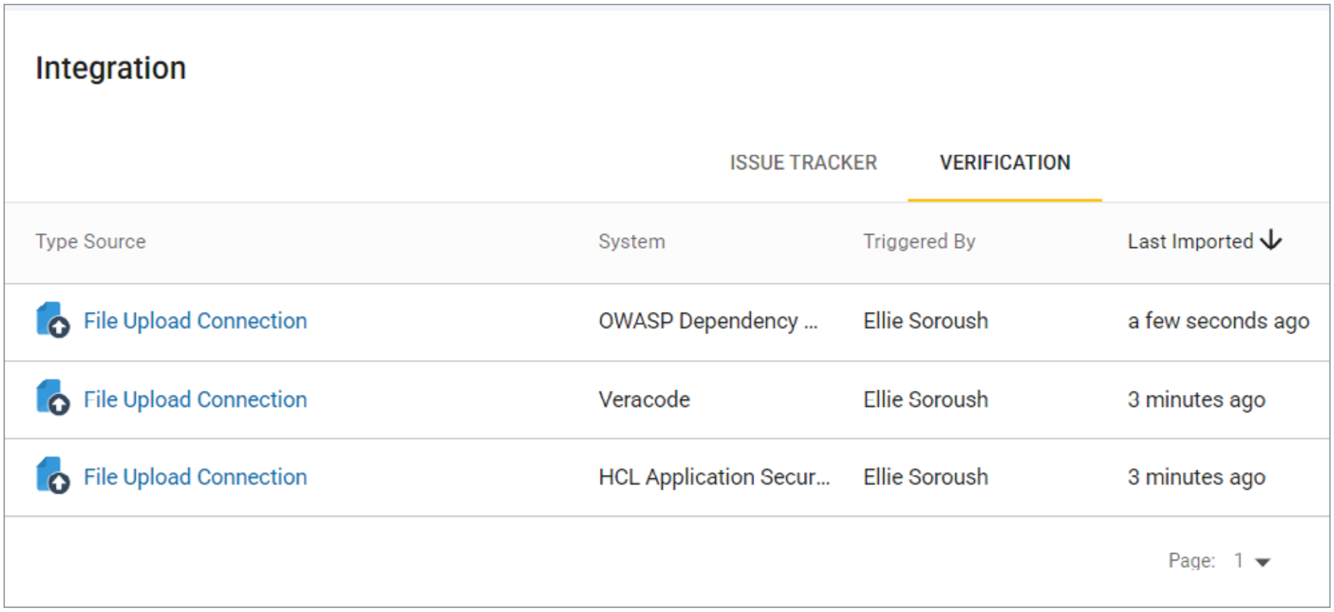
1. Attempt to send a set of known XSS meta-characters for each of the following items:
   - HTTP parameter name
   - HTTP parameter value
   - HTTP header name
   - HTTP header value
   - Cookie name
   - Cookie value
2. Inspect the results.
3. If the results appear to have the same meta-characters without any encoding in the resulting web page, JavaScript file, or Cascading Style Sheet (CSS) file, attempt to include a full script attack, such as:
   - `<script>alert('xss')</script>`,
   - `' onmouseover=alert(/XSS/)`, or
   - `javascript:alert('xss')`.

For more potential vectors, see the XSS Filter Evasion Cheat Sheet.

This test **fails** if you are able to create an on-screen pop-up box.

Note: There may be cases where your browser is immune to XSS, but other browsers are vulnerable. Where possible, attempt these attacks with all supported browsers.

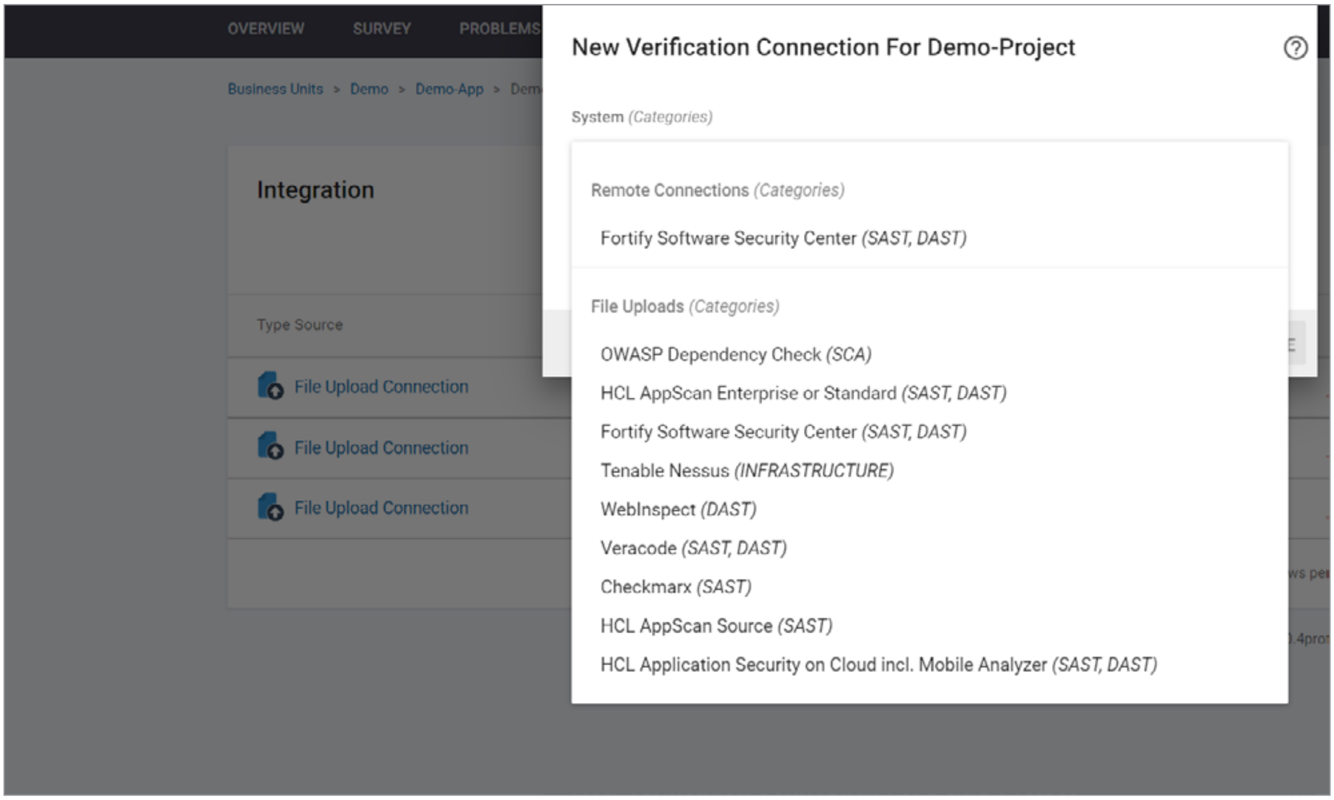
R.V.3.3 (2) is the instruction in one of the test tasks.



Integration

Type Source	System	Triggered By	Last Imported ↓
File Upload Connection	OWASP Dependency ...	Ellie Soroush	a few seconds ago
File Upload Connection	Veracode	Ellie Soroush	3 minutes ago
File Upload Connection	HCL Application Secur...	Ellie Soroush	3 minutes ago

R.V.3.3 (3) shows the integration of SDE with three verification tools.



New Verification Connection For Demo-Project

System *(Categories)*

Remote Connections *(Categories)*

- Fortify Software Security Center *(SAST, DAST)*

File Uploads *(Categories)*

- OWASP Dependency Check *(SCA)*
- HCL AppScan Enterprise or Standard *(SAST, DAST)*
- Fortify Software Security Center *(SAST, DAST)*
- Tenable Nessus *(INFRASTRUCTURE)*
- WebInspect *(DAST)*
- Veracode *(SAST, DAST)*
- Checkmarx *(SAST)*
- HCL AppScan Source *(SAST)*
- HCL Application Security on Cloud incl. Mobile Analyzer *(SAST, DAST)*

R.V.3.3 (4) shows the list of verification tools that can be integrated with SDE.

Next Steps

EO 14028 applies specifically to organizations providing software to U.S. government agencies and Authority to Operate. As commercial sector demand grows for improved security in software supply chains, it also provides a useful framework for improving software security for any organization building applications .

You can learn more about the EO and how to begin aligning to the best practices by watching our two-part on-demand webinar series:

- Part 1: Executive Order 14028: Guidelines for Enhancing Software Supply Chain Security
- Part 2: Using SD Elements to Comply with US Executive Order 14028 Secure Software Development Recommendations

You can also speak to us about how SD Elements can organizations building software for U.S. federal, state, and local government agencies adhere to SSDF recommendations.

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Security Compass, a pioneer in application security, enables organizations to shift left and build secure applications by design, integrated directly with existing DevSecOps tools and workflows. Its flagship product, SD Elements, helps organizations accelerate software time to market and reduce cyber risks by taking an automated, developer-centric approach to threat modeling, secure development, and compliance. Security Compass is the trusted solution provider to leading financial and technology organizations, the U.S. Department of Defense, government agencies, and renowned global brands across multiple industries. For more information, please visit www.securitycompass.com.

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