Department of Homeland Security
DHS Directives System
Instruction Number: 102-01-103
Revision Number: 00
Issue Date: 11/05/2015

SYSTEMS ENGINEERING LIFE CYCLE

I. Purpose

This Instruction establishes a common Systems Engineering Life Cycle (SELC) Framework for the Department of Homeland Security (DHS) and supports efficient and effective delivery of DHS investment capabilities. The SELC Framework supports the Acquisition Lifecycle Framework (ALF) established in Directive 102-01.

The Instruction is designed to ensure appropriate activities are planned and implemented throughout the life cycle and is based on several key concepts:

A. This Instruction establishes nine major SELC activities (Solution Engineering, Planning, Requirements Definition, Design, Development, Integration and Test, Implementation, Operations and Maintenance, and Disposition) as the baseline SELC Framework.

B. The SELC incorporates technical reviews based on pre-defined exit criteria to assess progress and quality of the preceding activities. The scope, content, and schedule of the technical reviews may vary based on the chosen development methodology.

C. Program/project managers (PM) are responsible for tailoring to the requirements of the Department, Component, and their project's specific characteristics. Tailoring the implementation of the SELC to a project's unique characteristics (e.g., size, scope, complexity, risk, and security categorization) and development methodology is expected.

Note: Best practices for development change and evolve, and the SELC is meant to encourage programs to make use of contemporary approaches. The SELC represents a framework and a common language for SELC activities, but may be tailored to support emerging practices.

The SELC Guidebook implements this Instruction and includes details regarding processes, technical reviews, tailoring, SELC artifacts, and similar content.

II. Scope

This Instruction is applicable to all DHS programs, projects, or equivalent investments throughout Components or other DHS organizations whose purpose is to deliver a DHS capability.

This Instruction does not supersede other Directives/Instructions beyond its topic area, substitute for such Directives or Instructions, or provide alternatives to these Instructions unless specifically stated for unique cases.

The accompanying SELC Guidebook is developed and maintained within the confines of this Instruction and is subject to it and all other applicable Department Directives and Instructions.

Interpretation requests, recommendations, or issues with this Instruction or any associated guidebooks or manuals should be directed to the Office of Program Accountability and Risk Management (PARM). Change requests are adjudicated with the assistance of the Office of the Chief Information Officer (OCIO) and the Science & Technology Directorate.

III. References

A. Directive 102-01 and its implementing Instructions.

B. Clinger-Cohen Act of 1996.

C. Title 48, Code of Federal Regulation (CFR), Chapter 30, “Department of Homeland Security, Homeland Security Acquisition Regulation (HSAR)”

IV. Definitions

Definitions used in this Instruction or any associated guidebooks or manuals align with and conform to overall Directive 102-01 definition policy, or state they are provided only to aid in document understanding and do not establish policy. Definition clarification, misalignment, or recommendations for specific definitions to be applied across the Directive 102-01 implementing instructions or any associated guidebooks or manuals should be directed to PARM for interpretation, adjudication, or modification, as appropriate.

V. Responsibilities

Responsibilities applicable to this instruction include:

A. ***The DHS Chief Information Officer (CIO)*** is responsible for ensuring that Information Technology (IT) Investments are aligned with Department and Component Strategy and Missions. Relative to the SELC, the CIO reviews and approves (with the Executive Director, PARM) the program/project SELC Tailoring Plan.

B. ***The Office of Program Accountability and Risk Management (PARM)*** is within the Under Secretary for Management (MGMT) Directorate. PARM serves as the Management Directorate's executive office for acquisition policy, governance, and oversight. Relative to the SELC, PARM:

1. Reviews and approves (with the CIO) the Program/Project's SELC Tailoring Plan;

2. Assists programs/projects with understanding the purpose and intended outcomes of the SELC technical reviews;

3. Advises the Component Systems Engineer (SE), if required, on the conduct of SELC technical reviews as well as providing feedback and issues as part of the technical reviews.

4. Assists programs, as required, with their SELC tailoring.

C. ***The Enterprise Business Management Office (EBMO)*** is within the Office of the CIO. EBMO evaluates IT programs and provides recommendations to the DHS CIO that focus on aligned investment, sound technical approach, and enterprise architecture. Relative to the SELC, EBMO:

1. Provides assistance, as required, to the programs with their SELC tailoring;

2. Supports the DHS CIO in the review of the program/project's SELC Tailoring Plan and provides recommendation on its disposition;

3. Provides assistance to the IT programs with understanding the purpose and intended outcomes of the SELC technical reviews;

4. Advises the Component CIO, if required, on the SELC technical reviews as well as providing feedback and issues as part of the technical reviews.

D. ***The Component Acquisition Executive (CAE)*** is the senior acquisition official within a Component that is responsible for implementation, management, and oversight of the Component's acquisition processes. Relative to the SELC, the CAE:

1. Designates a Component SE or equivalent if there is none;

2. Approves the program/project SELC Tailoring Plan at the Component level;

3. Ensures, with support from the Lead Technical Authority, that processes are established that enable SELC technical reviews and that they are adhered to by programs/projects;

4. Ensures the Component has adequate functional lines of business (e.g., Systems Engineering, Logistics, etc.) and that they support the program/project SELC technical reviews;

5. Ensures the SELC Technical Review Completion Letter, along with any updates to the SELC Tailoring Plan or Project Management Plan, is submitted by the program/project to the DHS program reporting system of record within 30 days of the technical review completion.

E. ***The Program/Project Manager (PM)*** is responsible, with significant discretionary authority, for tailoring the SELC process for the program's/project's specific characteristics. The PM:

1. Establishes the program/project team;

2. Determines, with approval of the Lead Technical Authority and CAE, the development methodology and tailors appropriately;

3. Completes the tailored artifact set;

4. Presents the business case and status of the program/project through all phases of the technical review and approval process;

5. Schedules, conducts, and coordinates the SELC technical reviews;

6. Documents the outcomes of completed SELC technical reviews in Completion Letters;

7. Manages the performance of the program/project throughout the life cycle.

F. ***The Operational Test Agent (OTA)*** is responsible for conducting Operational Test and Evaluation (OT&E) and assesses operational effectiveness and suitability. The OTA plans, conducts, evaluates, and reports the results of independent OT&E to the PM, DHS Director of OT&E, and Acquisition Decision Authority.

G. ***The Lead Technical Authority (LTA)*** is responsible for the technical (e.g., Systems Engineering and domain-specific engineering) aspects of the program/project. The LTA is the empowered individual within the Component to represent agency-wide technical considerations and make recommendations to the program/project manager and CAE or Component Head. The LTA for IT programs/projects is the Component CIO. For non-IT programs/projects, the LTA is recommended to be the Component Systems Engineer (SE) or equivalent, as designated by the CAE or Component Head. The LTA:

1. Concurs with the program/project SELC Tailoring Plan;

2. Supports the CAE to ensure processes are established that enable SELC technical reviews and that they are adhered to by programs/projects;

3. Ensures that all SELC technical review exit criteria are satisfied;

4. Ensures the necessary SELC activities have been satisfactorily completed as planned;

5. Concurs with the SELC Technical Review Completion Letter.

H. ***The Component SE (functioning as Lead Technical Authority for non-IT Programs/Projects)*** is responsible for the Component's overall Systems Engineering. Systems Engineering is defined as an interdisciplinary approach and means to enable the realization of successful systems. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs. If the Component does not have a dedicated SE, then the organization (external to the Program Management Offices) with responsibilities closest to the definitions above should be substituted and so designated by the Component Acquisition Executive (CAE). For non-IT programs and projects, the Component SE is also the Lead Technical Authority with responsibilities defined in the LTA section above.

I. ***The Component CIO (functioning as Lead Technical Authority for IT Programs and Projects)*** is responsible for exercising leadership and authority over mission-unique IT policies, programs, services, solutions, and resources. The Component CIO acts to implement the policies of the DHS CIO in accordance with the unique needs of the Component. This includes ensuring IT programs/projects comply or are aligned with the DHS SELC, and establishing an SELC-aligned development lifecycle for Component level IT investments. In the case of IT programs/projects, the Component CIO is the Lead Technical Authority with responsibilities defined in the LTA section above.

J. ***The Lead Business (Operational) Authority (LBA)*** represents the user/operational community throughout the acquisition and development of the solution. The LBA provides continual feedback to the program/project on behalf of the user community and the operational requirements developers to ensure the requirements and guidance accurately reflect the needs of the users. The LBA is recognized and empowered by the Component Head to speak for the user community. Similar to the LTA, the LBA is also responsible for ensuring that event-based technical review exit criteria and necessary activities are satisfied as well as concurring with the Technical Review Completion Letter.

VI. Content and Procedures

A. ***DHS SELC Framework***:

The Systems Engineering Life Cycle Framework for DHS supports efficient and effective delivery of DHS investment capabilities and has been developed to be compliant with applicable federal regulations, laws, and policies.

The first major SELC activity focuses on the broader acquisition program and the remaining major SELC activities focus on projects and systems associated with the program. The framework consists of nine major SELC activities and a set of technical reviews that are intended to ensure that the development effort is progressing satisfactorily and meeting the business need.

Note: Although the SELC framework is routinely depicted sequentially, the SELC is development methodology neutral, and its activities may be conducted concurrently, in parallel, or sequentially, with multiple feedback loops and iterations, as appropriate. SELC activities and technical reviews may also be combined, modified, or omitted based on a program's specific characteristics and selected development methodology. Best practices change and evolve, and programs are encouraged to learn and adopt new practices that are in the government's best interests. For example, the SELC encourages IT programs to use best practices such as agile approaches (i.e. Scrum, Lean Software Development, Kanban, Continuous Delivery, etc.) intended to streamline processes, reduce costs, and provide the best fit to mission needs. The philosophy of the SELC is to encourage tailoring for specific engineering needs and accommodate all development methodologies.

B. ***DHS SELC Framework Components & Procedures***:

This section presents general information on the SELC Framework Components and Procedures as a preface to the detailed information on each of the major DHS SELC activities contained in the SELC Guidebook.

1. SELC Entry Criteria

The Component user operational community assisted by the PM (if established) establishes a baseline of its mission operational needs by assessing their existing operational capabilities prior to initiating the SELC. Clearly defined operational capability gaps are identified by determining mission risks/vulnerabilities from assessing potential threats, characterizing the mission standards and conditions necessary to minimize or reduce risks.

In addition to assisting in defining the operational capability gap(s), the PM initiates acquisition planning, which defines the program's/project's Systems Engineering activities, cost, and schedule for developing the new capabilities to close the defined gap(s).

2. Major SELC Activities

The following is a short description of the objectives/purpose of each of the nine major SELC activities and related technical reviews. While the technical reviews described below represent conceptual types of reviews that may be used, specific developmental methodologies employ unique reviews that correspond to the methods and processes applicable to that methodology and may be used if documented in the applicable SELC Tailoring Plan.

a. *Solution Engineering:* Conducted following the Acquisition Decision Event (ADE) - 1 of the ALF, the objective of *Solution Engineering* is to identify, analyze, and objectively select the preferred solution alternatives via a formal Analysis of Alternatives (AoA)/Alternatives Analysis (AA) to meet the approved mission needs. In addition, key acquisition artifacts are created to prepare the program to enter the *Obtain Phase* of the ALF.

Study Plan Review (SPR): Conducted at the overall program level for the purpose of reviewing ground rules and assumptions as well as the analyses plans, scope, criteria, and methods to be used for performance of the AoA/AA.

Solution Engineering Review (SER): Conducted towards the end of the *Analyze/Select Phase* of the ALF the SER evaluates the results of the AoA/AA and the completeness and content of related acquisition and technical artifacts to support formal program approval. The SER directly supports the ADE-2A Acquisition Review Board (ARB).

b. *Planning:* The purpose of *Planning* is to create plans in the appropriate level of detail for the chosen methodology. Facets of the program/project are analyzed to ensure that the cost, scope, and schedule are technically feasible and acceptable to stakeholders.

Project Planning Review (PPR): Looks at executability of program/project schedule and scope, along with the continuity and appropriateness of planning artifacts. The result of this review is an assessment of readiness to proceed into development of the solution. This review supports an ADE-2B decision.

c. *Requirements Definition:* The purpose of *Requirements Definition* is to gather, analyze, and document requirements including functional and non-functional performance and data requirements.

Systems Definition Review (SDR): Focuses on the value, priority, traceability, and continuity of the functional and non-functional requirements.

d. *Design:* The objective of *Design* is to make decisions that transform requirements into system designs and architectures to efficiently and effectively guide or contract for fabrication, assembly, and coding.

Preliminary Design Review (PDR): Reviews the preliminary design to ensure that the planned technical approach meets the requirements.

Critical Design Review (CDR): Assesses system detailed design and its ability to meet the anticipated requirements.

e. *Development:* The objective of *Development* is to build and begin testing the components, products, and functionality that make up the system/solution that delivers the capability defined in the Operational Requirements Document (ORD) and Acquisition Program Baseline (APB).

Integration Readiness Review (IRR): Assesses system development efforts and subsystem, component, or configuration item testing results to ensure the system is ready for integration and comprehensive developmental test and evaluation (DT&E). Ensures that DT&E planning has been completed and test planning and infrastructure is adequate to support comprehensive DT&E. If development is done by a single development contractor, by the government directly, or in a highly integrated government and contractor team, then the IRR may not be necessary or focused primarily on DT&E preparations and readiness.

f. *Integration and Test:* The purpose of *Integration and Test* is to integrate the configuration items that have been built and tested during *Development* and to demonstrate that the integrated system satisfies all defined requirements.

Production Readiness Review (PRR): Conducted to review the results of *Integration and Test* to validate that the system developed meets the defined requirements, and assesses system and manufacturing readiness for the move to limited production. This review supports an ADE-2C decision.

g. *Implementation:* The objective of *Implementation* is to prepare the system, operational environment, organization, and users for the intended use of the new solution and to conduct Operational Test & Evaluation (OT&E) to evaluate whether the system meets mission need and operational requirements.

Operational Test Readiness Review (OTRR): Conducted to ensure the program/project is ready to enter OT&E.

Operational Readiness Review (ORR): Assesses the system's operational effectiveness and suitability. The ORR also ensures that the system possesses the required manufacturing and logistics support capabilities and capacities, and is therefore ready to be moved into production, fielding, and operation. The ORR supports an ADE-3 decision.

h. *Operations and Maintenance:* The objective of *Operations and Maintenance* (*O&M*) is to operate and maintain the system, make minor enhancements to the system, and conduct periodic reviews (e.g., security, system performance, obsolescence, and mission gaps). *O&M* personnel monitor the current system, identify problems to be fixed, and identify ways to improve the system.

Post Implementation Review (PIR): Documents deployment/implementation and coordination issues, how they were resolved, and how they could be prevented in the future.

i. *Disposition:* The emphasis in *Disposition* is to ensure that the system (or parts of the system), data, procedures, and documentation are packaged and archived in an orderly fashion, making it possible to reinstall and bring the system back to an operational status if necessary. *Disposition* also includes systems that are transferred to another entity (Foreign Military Sale, another DHS Component, etc.). All data records are retained or disposed of in accordance with DHS and Federal policies regarding retention of electronic records, and any production equipment and or fixtures are permanently stored or excessed.

3. SELC Technical Reviews

SELC technical reviews (or equivalent reviews tailored to the program or project's chosen development methodology) provide the opportunity to assess program/project progress and provide a mechanism for management to determine if and how well a program/project has completed the necessary activities.

Technical reviews are led by the PMs for the LTA and LBA and may include participation from DHS headquarter organizations (e.g., PARM, CIO-EBMO, Director for Test & Evaluation, and DHS IT Portfolio Managers).

The PM is responsible for arranging, coordinating, and completing the technical reviews while the LTA and LBA are responsible for ensuring the project has satisfied the applicable exit criteria. However, it is expected that the LTA and LBA rely on the appropriate experts (e.g., Enterprise Architect, testing, security, Section 508, infrastructure, budget, operators, etc.) to evaluate the completion of activities and compliance with exit criteria.

In the specialized case of non-IT programs/projects obtaining IT systems (e.g., vehicle programs that include communication gear) the LTA should include the Component CIO in the SELC technical review process. Some key experts are identified in the lists of SELC technical review participants in the DHS Technical Review Guide. For major (Levels 1 and 2) and non-major (Level 3) acquisition level programs, within 30 days of completing the event-based technical reviews, the approved Technical Review Completion Letter along with any updates to the project's SELC Tailoring Plan or Project Management Plan (including program/project schedule) is provided to the DHS program reporting system of record.

Non-major programs should follow the intent of the SELC technical review process, but tailor the formality and size of the SELC technical reviews based on the specific needs of the program/project.

SELC Technical Reviews can be event or time based. SELC Framework event-based technical reviews are discussed in Section 2. Programs and projects should not rely solely on event-based technical reviews but should also conduct periodic time-based reviews. These periodic reviews ensure that issues are being identified, discussed, and actions to resolve are initiated throughout the execution of the program or project.

Some development methodologies, including methods employed in facilities/construction projects or in Agile development projects, employ unique reviews and processes for conducting those reviews that are specific to those methodologies. The program may utilize these methodology specific reviews in lieu of the technical reviews described in Section 2 provided the SELC Tailoring Plan:

- Reflects the addition of the new reviews and removal of the applicable reviews discussed in Section 2
- Includes a discussion describing how the intent of the reviews being tailored out is being met by the new reviews
- Demonstrates that the objectives of the overall technical review process are still being met

Some of these reviews may not be required to provide completion letters, or submit them within 30 days.

Factors critical to successful technical reviews include:

a. Satisfactory completion of all preceding activities (including required artifacts) and exit criteria, as tailored, for each technical review.

b. Evidence is provided that clearly substantiates the fulfillment of the exit criteria. For example, in testing requirements, tests successfully produce the required results in order to be used as evidence of “successfully” meeting exit criteria. The act of testing in itself is not sufficient evidence if tests fail to produce required results.

The PM reviews any significant issues identified, assesses the impact to the program/project, and following consultation with the LTA and LBA, determines if the program/project is ready to proceed.

4. SELC Technical Review Exit Criteria

Each technical review contains a minimal set of exit criteria that needs to be satisfied. These exit criteria are included in the DHS Technical Review Guide. Exit criteria are tailored for the specific approach and methodology of the program/project and documented in the SELC Tailoring Plan. The CAE, PM, Component SE, Component CIO, etc. may provide additional criteria based on the scope/risk of the program/project or results from previous reviews. It is critical to understand that the determination of program/project successful completion of the review is made by evidence of satisfactory compliance with the content of the exit criteria, not simply by the evidence of artifacts produced.

5. SELC Artifacts

SELC artifacts (e.g., planning documents, requirements documents, test reports, product backlogs, burndown charts, etc.) are evidence of critical thinking and analysis, and are evaluated based on their quality, appropriateness, and accuracy. Programs/projects develop a set of artifacts based on the tailored approach in their SELC Tailoring Plan.

The SELC artifacts are referenced in the SELC Guidebook. In addition, other artifacts may be used based on the program or project's selected development methodology.

6. SELC Tailoring

a. SELC Tailoring Concept

The DHS SELC represents the systems engineering lifecycle framework for the acquisition management process. The flexibility of the SELC derives from the ability to tailor based on the unique characteristics of a project (e.g., size, scope, complexity, risk, security categorization) and development methodology documented in the SELC Tailoring Plan.

It is important to note that artifacts are simply the final output of a knowledge process, and that evidence of sufficient knowledge is more the focus of oversight than format and length of the artifacts. Programs are encouraged to economize artifacts to best represent the knowledge gained from their processes. The objective of tailoring is to effectively apply the SELC Framework[1] to a specific acquisition program and its projects while balancing the need for documentation and technical reviews with programmatic and technical risks. Tailoring is the cornerstone of any life cycle process. Tailoring of the SELC Framework can take several forms and may include the following:

[1] or alternate component life cycle processes aligned with the DHS SELC.

(1) Combining SELC major activities and/or reviews.

(2) Combining SELC artifacts and documents.

(3) Scaling the size, formality, content of SELC artifacts and/or reviews (e.g., Agile, Modular, etc.)

(4) Incorporating additional SE processes, activities, and artifacts not required by the SELC guidance, but needed for a specific project, increment, or major activity.

(5) Adding or substituting new or methodology specific technical reviews.

(6) Substituting products of similar content for SELC artifacts.

(7) Deleting major SELC activities, technical reviews, or artifacts where the intent is covered elsewhere, or the activity is not required.

Note: Some documents identified in the SELC Guidebook are required by other (i.e., not related to MD 102-01) DHS policy, guidance, or governing authorities and may not be deleted in the SELC Tailoring Plan without coordination with the appropriate governing authorities.

b. SELC Tailoring Plan

SELC tailoring is applied in a manner appropriate to a program's/project's size, scope, complexity, risk, security categorization, and development methodology.

The program/project provides evidence proving successful completion of required SELC activities whether or not the SELC is tailored. The SELC Tailoring Plan (for IT and non-IT) is required to document the development approach for the program/project and is developed early during *Planning*, but no later than ADE-2B (Approve Supporting Acquisitions). Tailoring for *Solutions Engineering* is included in the Capability Development Plan approved at ADE-1.

For major programs (Level 1 and Level 2) (where not delegated), the SELC Tailoring Plan is approved at the Department level by the PARM Executive Director and DHS CIO not later than ADE-2B, and any subsequent changes to it are coordinated with the original approving authorities.

The SELC Tailoring Plan content and elements are defined in the SELC Guidebook.

7. SELC Guidebook

The SELC Guidebook implements this Instruction by providing specific details regarding requirements, templates, process descriptions, documentation, technical reviews, and tailoring. It also serves as a resource to manage lessons learned and provides a readily adaptable guide to implement the SELC methodology. Signed concurrence of the guide and each change is required by the DHS CIO and the Executive Director, PARM.

8. SELC Governance Roles and Responsibilities

Table 8-1 lists the recommended LTA(s) for each standard SELC technical review based on program/project type. The overall concept for the governance of Systems Engineering is a model whereby the PM retains responsibility for the overall outcome of the program/project, and the oversight stakeholders participate in the SELC technical reviews as a means to provide the PM with inputs on technical matters to help shape the PM's decisions and to inform Acquisition Review Boards.

In addition to the PM, Systems Engineering governance requires the participation of an LTA and LBA. At the completion of each standard SELC technical review, the combined concurrence of these three stakeholders (PM, LTA, LBA) is documented in an SELC Technical Review Completion Letter along with the resultant actions taken during the technical review from the other Component and Department participants as the formal record of the SELC technical review. The LTA and LBA are assigned as part of the program's initiation, but not later than the first SELC technical review (e.g., Study Plan Review).

Other development methodologies (e.g., Agile) may use different technical reviews and roles so long as they adhere to the general concept of each SELC technical review and role.

Table 8-1: DHS SELC Technical Reviews – Recommended Lead Technical Authorities

SELC Technical Reviews	Program/Project Type	
	Capital Asset Information Technology (IT)	Capital Asset Non IT
SPR	Component CIO	Component SE
SER	Component CIO	Component SE
PPR	Component CIO	Component SE
SDR	Component CIO	Component SE
PDR	Component CIO	Component SE
CDR	Component CIO	Component SE
IRR	Component CIO	Component SE
PRR	Component CIO	Component SE
OTRR	Component CIO and CAE	Component SE and CAE
ORR	Component CIO	Component SE
PIR	Component CIO and/or LBA	As directed by CAE

9. SELC Guidebook Transition

With this Instruction's approval, Management Directive 102-01-001 Appendix B Version 2.0 (Interim) is canceled as a Management Directive 102-01-001 appendix. However, until this Instruction's guidebook is developed and approved, Appendix B Version 2.0 (Interim) remains in effect and serves as the interim SELC Guidebook.

I. Questions

Address any questions regarding this Instruction to PARM.

Chip Fulghum
Deputy Under Secretary for Management

11/5/2015
Date