Overview of

MIL-STD-498

and its

Data Item Descriptions (DIDs)

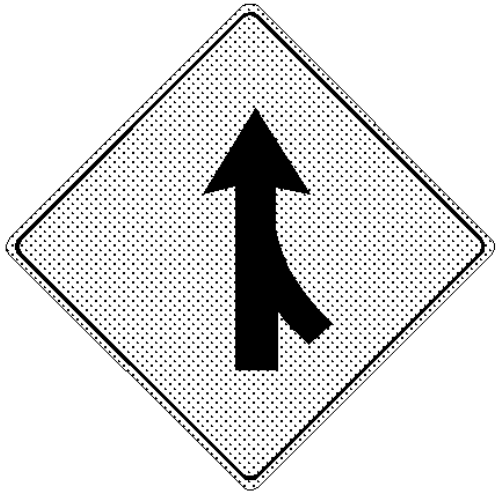
Topics to be Discussed

- What is MIL-STD-498?
- Significant new terms and definitions
- MIL-STD-498's general requirements (Section 4)
- MIL-STD-498's detailed requirements (Section 5)
- Overview of the Data Item Descriptions (DIDs)
- Planned aids for applying MIL-STD-498

What is MIL-STD-498?

A new DoD software development standard designed to:

- "Harmonize" (merge):
  - DOD-STD-2167A, Defense System Software Development
  - DOD-STD-7935A, DoD Automated Information System Documentation



- Resolve issues identified in applying DOD-STD-2167A and its DIDs

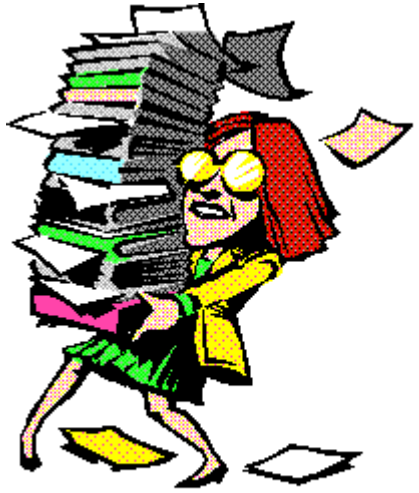
- Ensure compatibility with recent changes in DOD directives, instructions, standards, and handbooks

Harmonizing DOD-STD-2167A with DOD-STD-7935

- DOD-STD-2167A:
  - Designed for mission critical/weapon system software
  - Specifies a set of software development activities
  - Offers 16 DIDs that define documentation
- DOD-STD-7935A
  - Designed for automated information systems
  - Defines the format and content of 11 documents
  - Provides guidance for applying the documents
- Objective: Combine the best of both to create a single standard for DoD

Key Issues Identified in Applying 2167A

1. Remove perceived preference for "waterfall" development model
2. Improve compatibility with Ada/object-oriented methods
3. Remove emphasis on preparing documents
4. Accommodate use of CASE tools
5. Improve links to systems engineering
6. Support use of management indicators
7. Provide pre-tailoring by categories of software
8. Improve coverage of modification, reuse, and reengineering
9. Put more emphasis on software supportability
10. Improve evaluation and review criteria



Key Issues Identified in Applying 2167A (cont.)

11. Improve distinction between requirements and design
12. Improve coverage of database development
13. Improve the criteria used for software product evaluations
14. Eliminate confusion between software quality assurance and software product evaluation
15. Improve use in data intensive systems
16. Clarify applicability to more types of projects
17. Extend configuration management concepts to in-process work products
18. Eliminate inconsistencies and holes in the DIDs
19. Decrease dependence on formal reviews and audits
20. Improve compatibility with incremental/evolutionary development methods

Compatibility with DODD, DODI, Standards, Handbooks

- Several DODD, DODI, standards, handbooks, etc. were issued, changed, or in transition since DOD-STD-2167A and 7935A, e.g.,:
  - DODD 5000.1 and DODD 5000.2, Defense Acquisition Management
  - DODD 8120.1 and DODI 8120.2, AIS Life Cycle Management
  - MIL-STD-499B, Systems Engineering
  - MIL-STD-973, Configuration Management
  - MIL-HDBK-347, MCCR Software Support

- Challenge: Ensure compatibility with the new policy, requirements, and guidance

The MIL-STD-498 Package

Completed:

- MIL-STD-498: Software Development and Documentation
- 22 Data Item Descriptions (DIDs)
- A "Quick" guidebook explaining key concepts and tailoring of the standard

Planned:

- MIL-Guidebook 498 providing more detailed guidance
- Other aids

Format of MIL-STD-498 (and all MIL-STDs)

1. Scope

2. Referenced Documents

3. Definitions

4. General Requirements

5. Detailed Requirements

- Appendixes

Significant New Terms and Definitions (1)

Acquirer and **developer** as the parties involved in the standard

(Replaces "contracting agency" and "contractor." Supports non-contract SW development, such as Government in-house development)

Build: a version of software that meets a specified subset of a requirements that the completed software will meet.

(Supports incremental and evolutionary development -- MIL-STD-498 is oriented to developing software in a series of builds)

Document: A data medium and the data recorded on it, that generally has permanence and that can be read by humans or machines.

(Supports alternatives to traditional documents, e.g., data in CASE tools. MIL-STD-498 is about natural work products, not documentation)

Software: Computer programs and computer databases.

(Supports application of MIL-STD-498 to database systems)

Significant New Terms and Definitions (2)

Software product: Software or associated information created, modified, or incorporated to satisfy a contract.

(Provides a generic term for talking about the natural work products generated during SW development; need not be traditional documents)

Software system: A system consisting solely of software and possibly the computer equipment on which the software runs.

(Supports application of MIL-STD-498 to software-only systems (such as payroll systems) as well as to software-hardware systems)

Software unit: A logical element of the design of a CSCI; for example, major subdivision of a CSCI, a component of that subdivision, a class, object, module, function, routine, or database.

(Replaces both CSU and CSC. Provides greater flexibility in expressing software design. More compatible with object-oriented design)

MIL-STD-498

General

Requirements

Software Development Process

- Establish a SW development process consistent with contract requirements
- Include the following activities:

Project planning and oversight
Establish SW devel environment
System requirements analysis
System design
SW requirements analysis
SW design
SW implementation and unit testing
Unit integration and testing
CSCI testing
CSCI/HWCI integration and testing
System testing
Preparing for software use
Preparing for software transition

Software configuration management
Software product evaluations
Software quality assurance
Corrective action
Jt technical and management reviews
Other (miscellaneous) activities
- Risk management
- Software management indicators
- Security and Privacy
- Subcontractor Management
- Interface with IV&V agents
- Coordination with assoc. developers
- Improvement of project processes

General Req’ts for SW Development (1)

- Use systematic, documented methods

- Develop and apply standards for representing requirements, design, code, and test information

- Evaluate reusable SW products for use in fulfilling contract requirements; incorporate those that meet the criteria in the SW Development Plan

- Identify opportunities for developing SW products for reuse; notify the acquirer of those that have cost benefits

General Req’ts for SW Development (2)

- Establish and apply strategies for handling critical requirements, such as those with safety, security, or privacy implications

- Analyze and fulfill the computer hardware resource utilization requirements (such as memory reserves)

- Record rationale for key decisions, for use by the support agency

- Provide the acquirer access to developer and subcontractor facilities

MIL-STD-498

Detailed

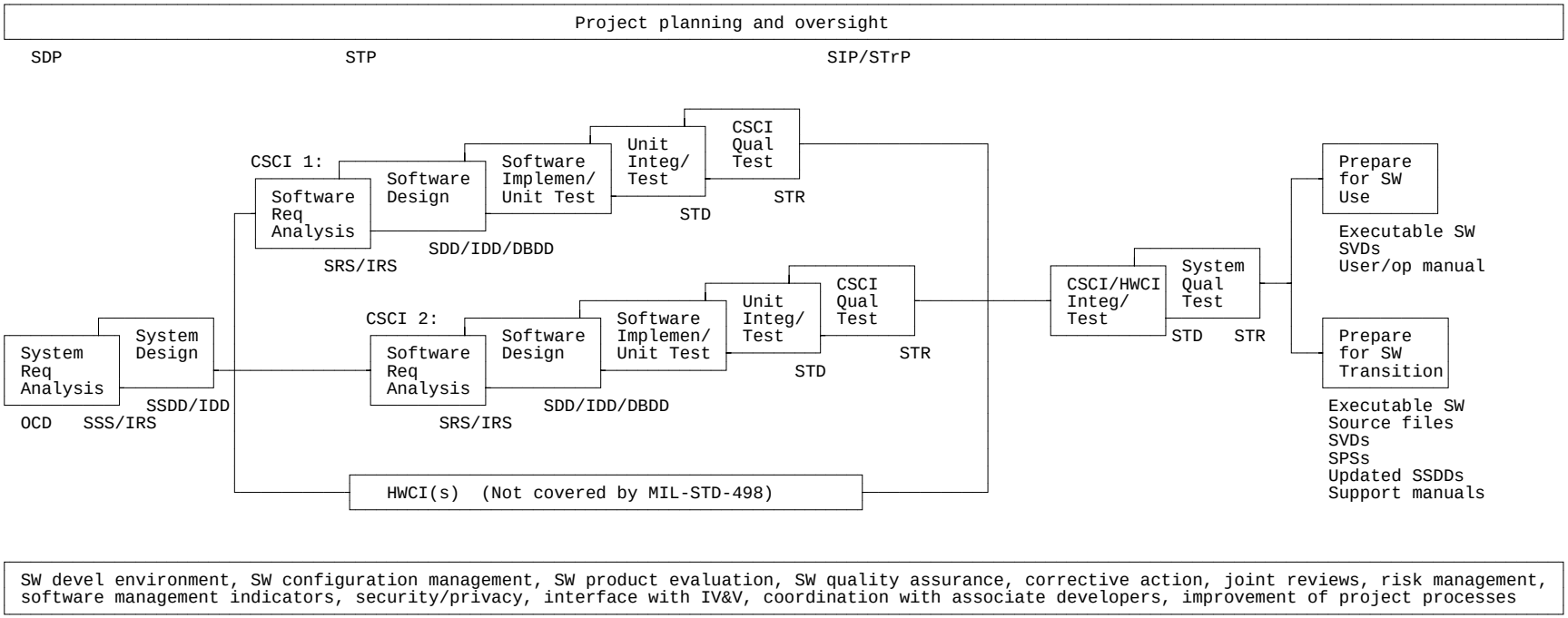
Requirements

MIL-STD-498 Activities and the Build Framework

Activity	Build 1	Build 2	Build 3	Build 4 ...
5.1 Project planning and oversight	x	x	x	x
5.2 Establishing a SW development environment	x	x	x	x
5.3 System requirements analysis	x	x		
5.4 System design	x	x	x	
5.5 Software requirements analysis	x	x	x	x
5.6 Software design	x	x	x	x
5.7 Software implementation and unit testing	x	x	x	x
5.8 Unit integration and testing	x	x	x	x
5.9 CSCI qualification testing		x	x	x
5.10 CSCI/HWCI integration and testing		x	x	x
5.11 System qualification testing			x	x
5.12 Preparing for software use	x	x	x	x
5.13 Preparing for software transition				x
5.14 Software configuration management	x	x	x	x
5.15 Software product evaluation	x	x	x	x
5.16 Software quality assurance	x	x	x	x
5.17 Corrective action	x	x	x	x
5.18 Joint technical and management reviews	x	x	x	x
5.19 Other activities	x	x	x	x

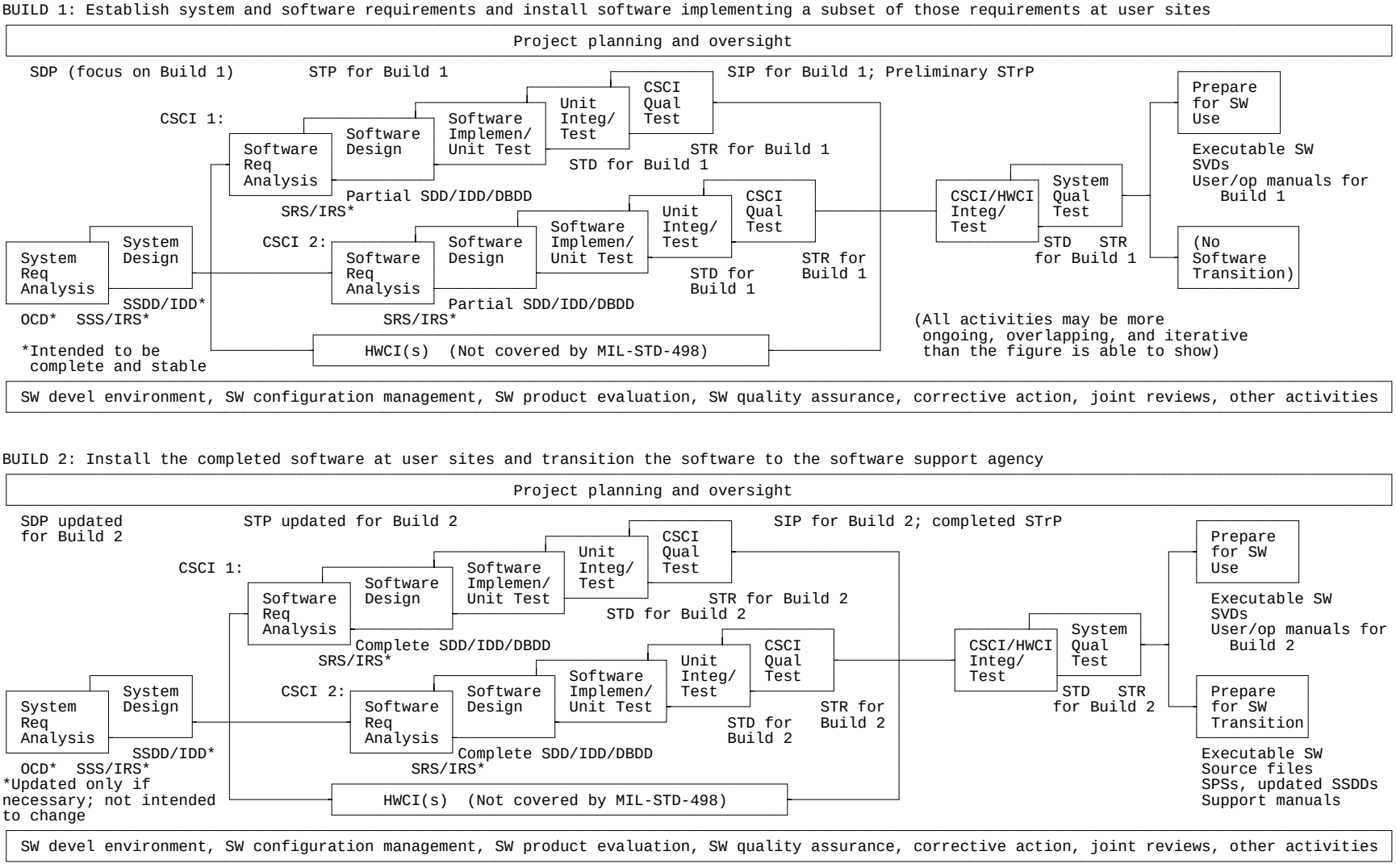
- 19 activities; each may be performed in one or more builds on a project
- Activities may be concurrent, sequential, iterative, ..., as appropriate

Example Showing One Build

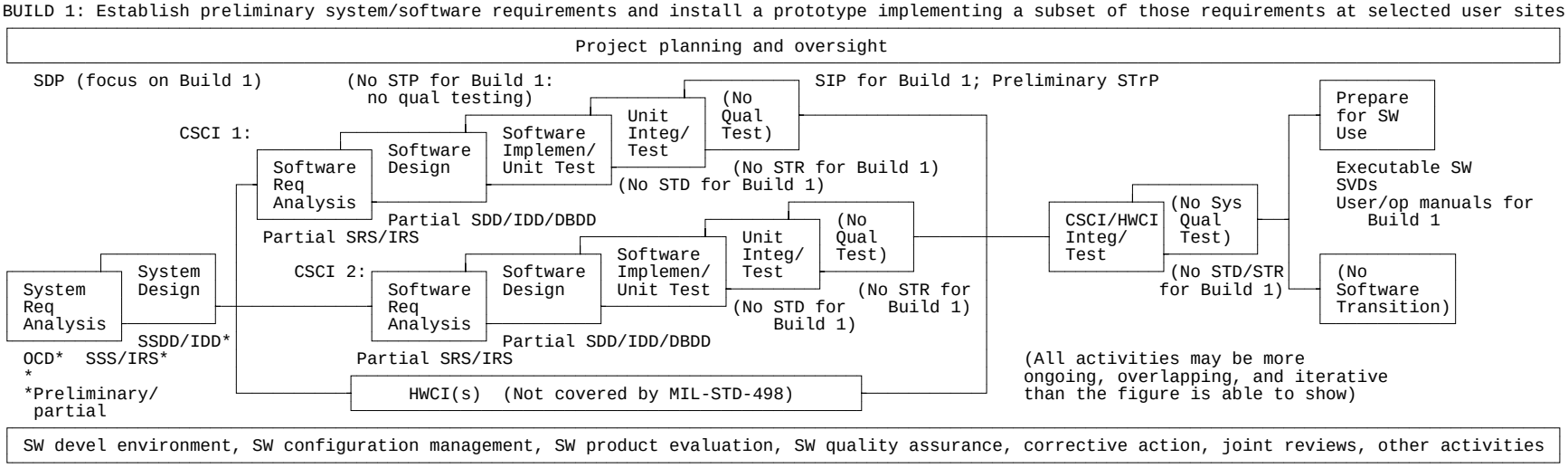


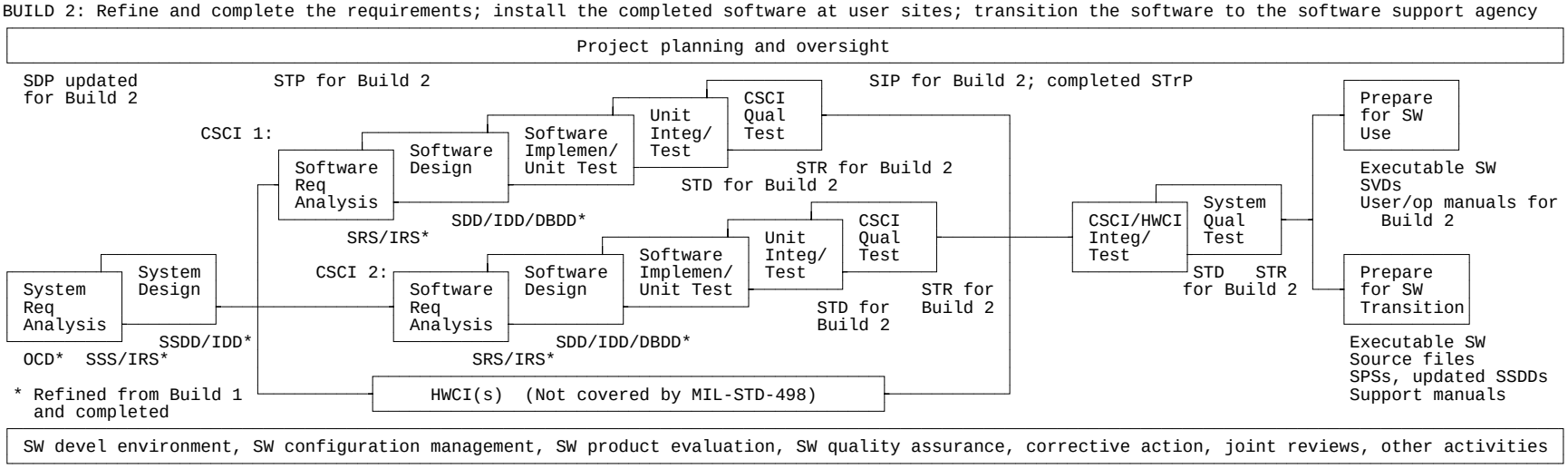
Note: All activities may be more ongoing, overlapping, and iterative than the figure is able to show.

Example Showing Incremental Development in 2 Builds

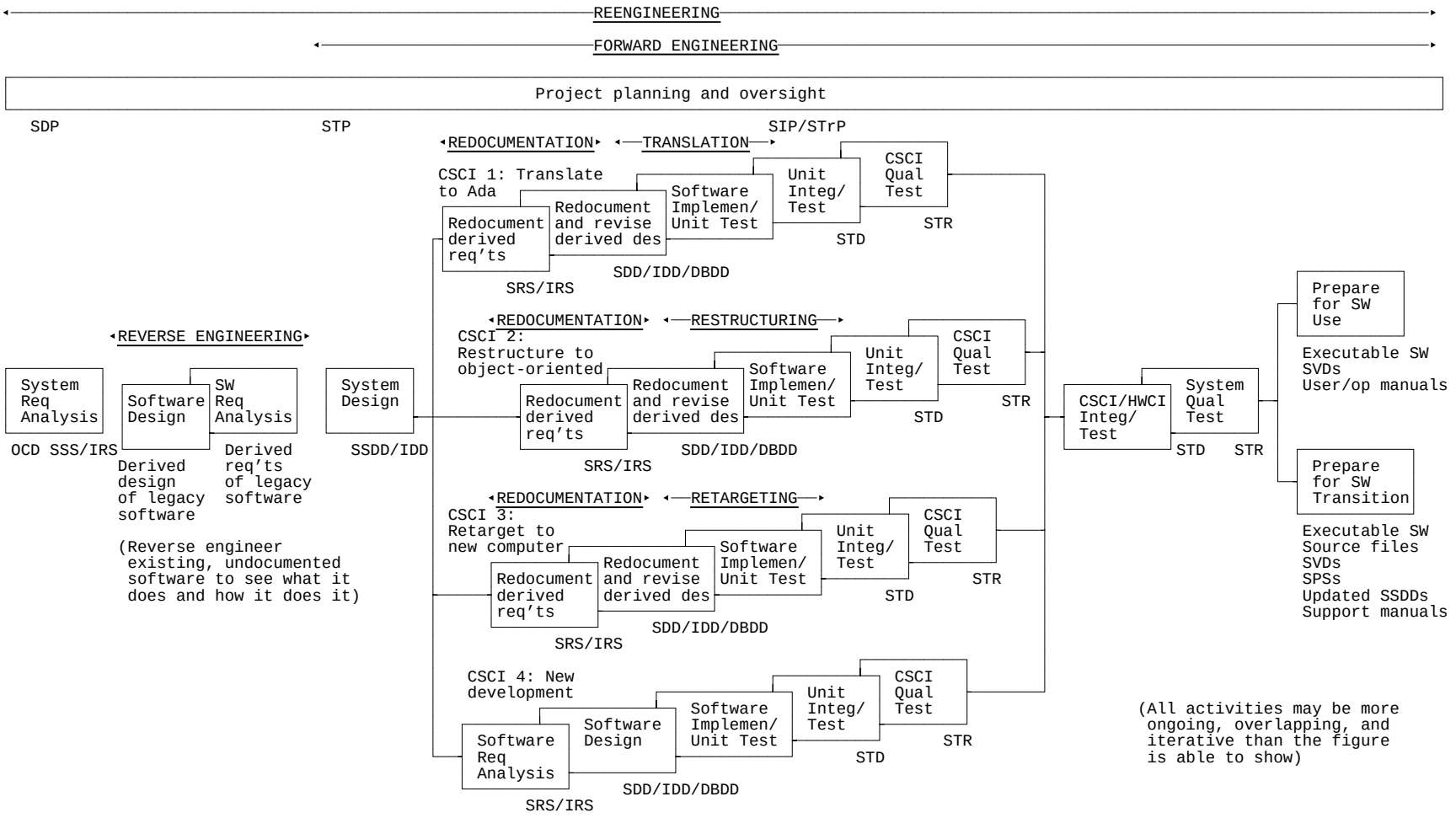


Example Showing Evolutionary Development in 2 Builds





Example Showing MIL-STD-498 Applied to Reengineering



Project Planning and Oversight

Tasks:	Include all applicable items in this DID*:
- Plan the software development effort	SW Development Plan (SDP)
- Plan for CSCI qualification testing	SW Test Plan (STP)
- Participate in system test planning	SW Test Plan (for SW sys)
- Plan for installing SW at user sites	SW Installation Plan (SIP)
- Plan for transitioning SW to support agency	SW Transition Plan (STrP)

- Follow approved plans; conduct management reviews; get approval for updates

* DIDs are used as checklists of items to be included in the task;
no deliverables or traditional documents are implied;
such requirements would be imposed via the CDRL

Establishing a Development Environment

- Establish, control, and maintain:
  - A software engineering environment
  - A software test environment
  - A software development library
  - Software development files

- Use non-deliverable software only if:
  - Operation/support of the deliverable SW do not depend on it, or
  - The acquirer has or can obtain the same software

System Requirements Analysis

Tasks:

Include all applicable items in this DID:

- Analyze user input provided by the acquirer

- Participate in defining and recording the system operational concept . . . . . Operational Concept Description (OCD)

- Participate in defining and recording system requirements . . . . . System/Subsystem Specification (SSS)

  (Include those characteristics of the system that are conditions for acceptance; defer to design descriptions those characteristics that the acquirer is willing to leave up to the developer)

  (If deliverable, system interface requirements may be in the SSS or in Interface Requirements Specifications (IRSs))

System Design

Tasks: Include all applicable items in this DID:

- Participate in defining and recording the system-wide design decisions . . . . . System/Subsystem Design Description (SSDD)

  (Decisions about the system's behavior, ignoring internal implementation, and other decisions affecting selection and design of system components)

  (Design decisions remain at the discretion of the developer unless formally converted to requirements. Design decisions act as developer-internal "requirements," to be implemented, imposed on subcontractors, if applicable, and confirmed by developer-internal testing.)

- Participate in defining and recording the system architectural design . . . . . System/Subsystem Design Description (SSDD)

  (System components (HWCIs, CSCIs, manual operations), their interfaces, and a concept of execution among them)

  (If deliverable, interface design may be in SSDDs or in Interface Design Descriptions (IDDs); database design may be in SSDDs or in Database Design Descriptions (DBDDs))

Software Requirements Analysis

Task:	Include all applicable items in this DID:
- Define and record the SW requirements to be met by each CSCI	Software Requirements Specification (SRS)

(Include those characteristics of the CSCI that are conditions for CSCI acceptance; defer to design descriptions those characteristics that the acquirer is willing to leave up to the developer)

(If deliverable, CSCI interface requirements may be included in SRSs or in Interface Requirements Specifications)

Software Design

Tasks: Include all applicable items in this DID:

- Define and record CSCI-wide design decisions . . . . . Software Design Description (SDD)

  (Decisions about the CSCI's behavior, ignoring internal implementation, and other decisions affecting selection and design of SW units)

- Define and record the architectural design of each CSCI . . . . . Software Design Description (SDD)

  (SW units, their interfaces, and a concept of execution among them)

  (Software units may be made up of other software units and may be organized into as many levels as are needed to represent the CSCI architecture)

- Define and record the detailed design of each CSCI . . . . . Software Design Description (SDD)

  (Design of each software unit)

  (If deliverable, interface design may be in SDDs or in IDDs; database design may be in SSDDs or in DBDDs

Software Implementation and Unit Testing

- Develop and record software corresponding to each software unit, using an approved programming language for deliverable software

  (Includes coding computer programs, building databases, populating databases, and any other activity needed to implement the design)

  (Resulting code and data entities need not be in 1-to-1 relationship with the software units in the design)

Unit testing:

- Prepare unit test cases, procedures, and data (record in SDFs)
- Perform unit testing
- Revise and retest as needed
- Analyze the results and record in software development files (SDFs)

Unit Integration and Testing

- Prepare unit integration test cases, procedures, data (record in SDFs)

- Perform unit integration testing

- Revise and retest as needed

- Analyze the results and record in software development files (SDFs)

Notes:

- Since units may consist of other units, some of this testing may have been accomplished during unit testing and need not be repeated

- The last stage of this testing, with all units in a CSCI integrated, is developer-internal CSCI testing

CSCI Qualification Testing

Tasks: Include all applicable items in this DID:

- Prepare test cases, procedures, data for CSCI qualification testing . . . . . Software Test Description (STD)

- Dry run the test cases if testing is to be witnessed by the acquirer

- Perform CSCI qualification testing

- Revise and retest as needed

- Analyze and record test results . . . . . Software Test Report (STR)

- Assign responsibility to persons who did not perform detailed design or implementation of the CSCI(s) being tested

- Include testing on the target computer or an approved alternative

CSCI/HWCI Integration and Testing

- Prepare CSCI/HWCI integration test cases, procedures, data (record in SDFs)

- Perform CSCI/HWCI integration testing

- Revise and retest as needed

- Analyze the results and record in software development files (SDFs)

Notes:

- This testing includes integrating CSCI's with interfacing CSCIs and HWCIs and testing the results; it is developer-internal testing

- The last stage of this testing, with all CIs integrated, is developer-internal system testing

System Qualification Testing

Tasks--participate in:

For a software system, include applicable items in this DID:

- Developing and recording test cases, procedures, data for system testing . . . . . SW Test Description (STD)

- Dry run of the test cases if testing is to be witnessed by the acquirer

- Performing system qualification testing

- Revising and retesting as needed

- Analyzing and recording test results . . . . . Software Test Report (STR)

- Assign responsibility to persons who did not perform detailed design or implementation of the software in the system being tested

- Include testing on the target computer or an approved alternative

Preparing for Software Use

Tasks:	Include all applicable items in this DID:
- Prepare the executable software for user sites	Software Product Specification (SPS)
- Identify and record the exact version of SW to be sent to each site	Software Version Description (SVD)
- Prepare information needed for:	
- Hands-on use of the software	SW User Manual (SUM)
- Submitting (batch) inputs and interpreting outputs	Software Input/Output Manual (SIOM)
- Operating the SW in software centers or networked environments	Software Center Operator Manual (SCOM)
- Operating the computers	Computer Operation Manual (COM)
- Install at user sites; provide training and other assistance as required	

Preparing for Software Transition (1)

Tasks:	Include all applicable items in this DID:
- Prepare the executable software for the support site	Software Product Specification (SPS)
- Prepare the source files for the support site	Software Product Specification (SPS)
- Identify and record the exact version of SW to be sent to support site	Software Version Description (SVD)
- Update the CSCI design descriptions and prepare other info needed for support	Software Product Specification (SPS)
- Update the system design descriptions . . .	System/Subsystem Design Description (SSDD)

Preparing for Software Transition (2)

Tasks: Include all applicable items in this DID:

- Prepare information needed to:
  - Program the host and target computers . . . . . Computer Programming Manual (CPM)
  - Program/reprogram the firmware devices . . . . . Firmware Support Manual (FSM)
- Install the software at the support site; demonstrate that it can be regenerated from source; provide training and other assistance as required

Software Configuration Management

- Identify all entities to be controlled during development: CSCIs, computer files, documents, other software products, elements of the SW environments

- Establish and implement procedures for controlling each entity

- Prepare and maintain records of the status of all entities under project-level or higher control

- Support acquirer-conducted configuration audits as specified in the contract

- Establish and implement procedures for packaging, storage, handling, and delivery

Software Product Evaluation

- Perform in-process and final evaluations of software products
  - Focus is on the natural output of the software development process
  - Criteria are given in Appendix D of the standard
- Prepare records of the evaluations, and:
  - For software products under project-level or higher control, prepare problem/change reports for the corrective action system
- Assign responsibility for each evaluation to persons other than those who developed the product being evaluated
  - Those who developed the product can take part

Software Quality Assurance

- Perform on-going evaluations to assure that:
  - Activities required by the contract or described in the SDP are being performed in accordance with the contract and SDP
  - Required software products exist and have undergone software product evaluation, testing, and corrective action as required by the standard and other contract provisions
- Prepare records of the evaluations, and:
  - For software products under project-level or higher control, prepare problem/change reports for the corrective action system
- Assign responsibility for each evaluation to persons other than those who developed the product, performed the activity, or are responsible for them
  - (And other fine print about resources, authority, etc.)

Corrective Action

- Prepare problem/change reports for problems found in:
  - Software products under project-level or higher control
  - Activities required by the contract or described in the software development plan
- Implement a corrective action system for handling these problems
  - Make sure system is closed loop, including reporting problems, initiating action, achieving resolution, tracking status
  - Classify problems by category and priority
  - Perform analysis to detect trends
  - Evaluate corrective actions

Joint Technical & Management Reviews

- Plan and participate in joint (acquirer/developer) technical reviews
  - Include persons with technical knowledge of the work
  - Review evolving software products (focus is on natural work products)
  - Surface and resolve technical issues/risks
  - Identify issues/risks to be raised at joint management reviews

- Plan and participate in joint management reviews
  - Include persons with authority to make cost/schedule decisions
  - Resolve issues/risks not resolved at technical reviews

Other Activities

- Identify project risks; develop/implement strategies to manage them
- Identify and apply software management indicators
- Comply with the security and privacy requirements in the contract
- Include in subcontracts all requirements necessary to ensure that software products are developed in accordance with the prime contract
- Interface with IV&V agents as specified in the contract
- Coordinate with associate developers, working groups, and interface groups as specified in the contract
- Periodically assess the processes used on the project; identify improvements; propose in SDP updates; implement if approved

Appendices

A. Acronyms and abbreviations

B. Interpreting MIL-STD-498 for incorporation of reusable software products

C. Classification schemes for problem reports

D. Requirements for software product evaluations

E. Candidate joint management reviews

F. Candidate management indicators

G. Guidance on program strategies, tailoring, and build planning

H. Guidance on ordering deliverables

I. Conversion guide from DOD-STD-2167A and DOD-STD-7935A

Data Item Descriptions (1)

MIL-STD-498 DID	DOD-STD-2167A and DOD-STD-7935A Source DIDs
Software Development Plan (SDP)	2167A Software Development Plan (SDP) 7935A Functional Description (FD), section 7
Software Installation Plan (SIP)	7935A Implementation Procedures (IP)
Software Transition Plan (STrP)	2167A Computer Resources Integ Sup Doc (CRISD) - planning info 7935A Maintenance Manual (MM) - planning info
Operational Concept Description (OCD)	2167A System/Segment Design Doc (SSDD), section 3 7935A Functional Description (FD), section 2
System/Subsystem Specification (SSS)	2167A System/Segment Specification (SSS) 7935A Functional Description (FD) - system req't info 7935A System/Subsystem Spec (SS) - system req't info
Software Requirements Specification (SRS)	2167A Software Requirements Specification (SRS) 7935A Software Unit Specification (US) - req't info
Interface Requirements Specification (IRS)	2167A Interface Requirements Specification (IRS) 7935A SW Unit Specification (US) - interface req't info
System/Subsystem Design Description (SSDD)	2167A System/Segment Design Document (SSDD) 7935A System/Subsystem Spec - system design info
Software Design Description (SDD)	2167A Software Design Document (SDD) 7935A Software Unit Specification (US) - design info 7935A Maintenance Manual (MM) - "as built" design info
Interface Design Description (IDD)	2167A Interface Design Document (IDD) 7935A SW Unit Specification (US) - interface design info
Database Design Description (DBDD)	7935A Database Specification (DS)

Data Item Descriptions (2)

MIL-STD-498 DID	DOD-STD-2167A and DOD-STD-7935A Source DIDs
Software Test Plan (STP)	2167A Software Test Plan (STP) 7935A Test Plan (PT) - high-level information
Software Test Description (STD)	2167A Software Test Description (STD) 7935A Test Plan (PT) - detailed information
Software Test Report (STR)	2167A Software Test Report (STR) 7935A Test Analysis Report (RT)
Software User Manual (SUM)	2167A Software User's Manual (SUM) 7935A End User Manual (EM)
Software Center Operator Manual (SCOM)	7935A Computer Operation Manual (OM)
Software Input/Output Manual (SIOM)	7935A Users Manual (UM)
Computer Operation Manual (COM)	2167A Computer System Operator's Manual (CSOM)
Computer Programming Manual (CPM)	2167A Software Programmer's Manual (SPM)
Firmware Support Manual (FSM)	2167A Firmware Support Manual (FSM)
Software Product Specification (SPS)	2167A Software Product Specification (SPS) 2167A CRISD - modification procedures 7935A MM - maintenance procedures
Software Version Description (SVD)	2167A Version Description Document (VDD)

Planned Aids

- A "quick guidebook" -- available now in draft -- providing an overview of the standard and the basics of tailoring it

- A "detailed guidebook" on:

  - How an acquirer applies the standard

  - Detailed information regarding topics in the standard

- Other methods of accessing the standard and guidebooks:

  - Hypertext versions of the standard, DIDs, and guidebooks (CD-ROM version of 498 and DIDS available now from STSC, guidebooks to follow).

  - Other word processing versions: WP5.1 (DOS) and Word 6.0 of the standard and DIDs available now, Word 2.0 to follow soon. Others planned.

  - On-line access to softcopy for downloading via SPAWAR and DISA servers (details on following page).

HOW DO I GET A COPY OF MIL-STD-498 AND GUIDES?

Electronic files: Available in WP5.1 and Word 6.0 formats

- Files with the suffix .EXE indicate self-extracting zip formats for PC users only
- Files with the suffix .ZIP indicate PKZIP 2.04 compressed files -- use UNZIP

- DISA Center for Standards:
  WWW: http://www.itsi.disa.mil
  ITSI BBS Help Desk: (703) 735-8338 DSN 653-8338
  helpdesk@itsi.disa.mil

- SPAWAR:
  ftp: diamond.spawar.navy.mil (directory MIL498)
  LCDR Dana Majors: (703) 602-9188
  e-mail . . . . . majors@smtp-gw.spawar.navy.mil

- Logicon
  ftp: glider.logicon.com (directory /pub/standards
  help -- (619) 455-7663 x-4001 or
  MIL-STD-498@logicon.com

- Hardcopies:
  Defense Printing Service Detachment Office
  (ATTN: Customer Service)
  700 Robbins Avenue, Bldg. 4D
  Philadelphia, PA 19111-5094 Fax request 215/697-1462

Conclusion

- MIL-STD-498 merges DOD-STD-2167A and DOD-STD-7935A, creating a single software development standard for DoD

- MIL-STD-498 addresses and resolves the issues raised during use of DOD-STD-2167A

- MIL-STD-498 provides the flexibility needed to cover:
  - Large and small projects
  - Projects using a wide variety of methodologies
  - Projects using a wide variety of software development approaches

- MIL-STD-498 provides the basis for the joint EIA/IEEE project now underway to develop a commercial software development standard