

# Software Validation Practices for GxP Compliance

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# Scope

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FDA validation requirements apply to software:

- used as components in medical devices
- that is itself a medical device
- used in production of the device or in implementation of the device
- that supports a GxP Quality System

Validation requirements for medical device software are established within the context of design control requirements promulgated under 21 CFR § 820.30.

Validation requirements for software used in the production of a medical device or for support of a GxP quality system are based on the extent to which “predicate rules” are supported. Where the software maintains electronic records required under “predicate rules” then the requirements of 21 CFR part 11 apply.

# Definitions

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As defined by the FDA (*Quality System Regulation – 21 CFR § 820.3*)

**Validation** means confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use can be consistently fulfilled.

**Verification** means confirmation by examination and provision of objective evidence that specified requirements have been fulfilled.

As defined by the IEEE (*Std 610.12-1990 (R202)*)

**Validation** means the process of evaluating a system or component during or at the end of the development process to determine whether it satisfies specified requirements.

**Verification** means the process of evaluating a system or component to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase.

**Verification and Validation (V&V)** means the process of determining whether the requirements for a system or component are complete and correct, the products of each development phase fulfill the requirements or conditions imposed by the previous phase, and the final system or component complies with specified requirements.

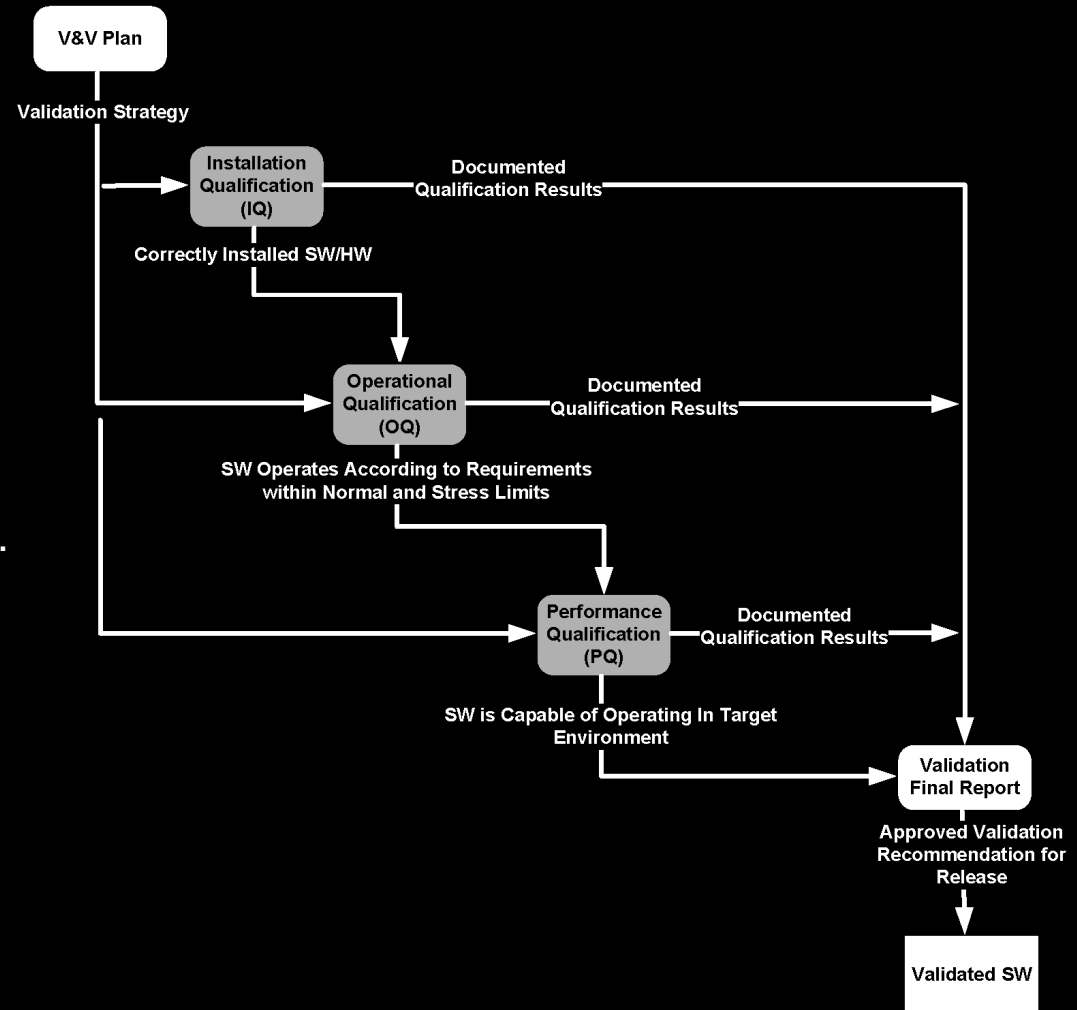
A **qualification** is the action of proving that the item under consideration (i.e., hardware or software component, a system or product ) works correctly and leads to the expected results. Validation is a process - qualifications are part of that process.

# IQ/OQ/PQ Activities

Qualifications that are part of a software validation have traditionally been defined within the context of process validation terminology.

Within this context ...

the **V&V Plan** defines the validation strategy and identifies the various qualifications that will be performed.



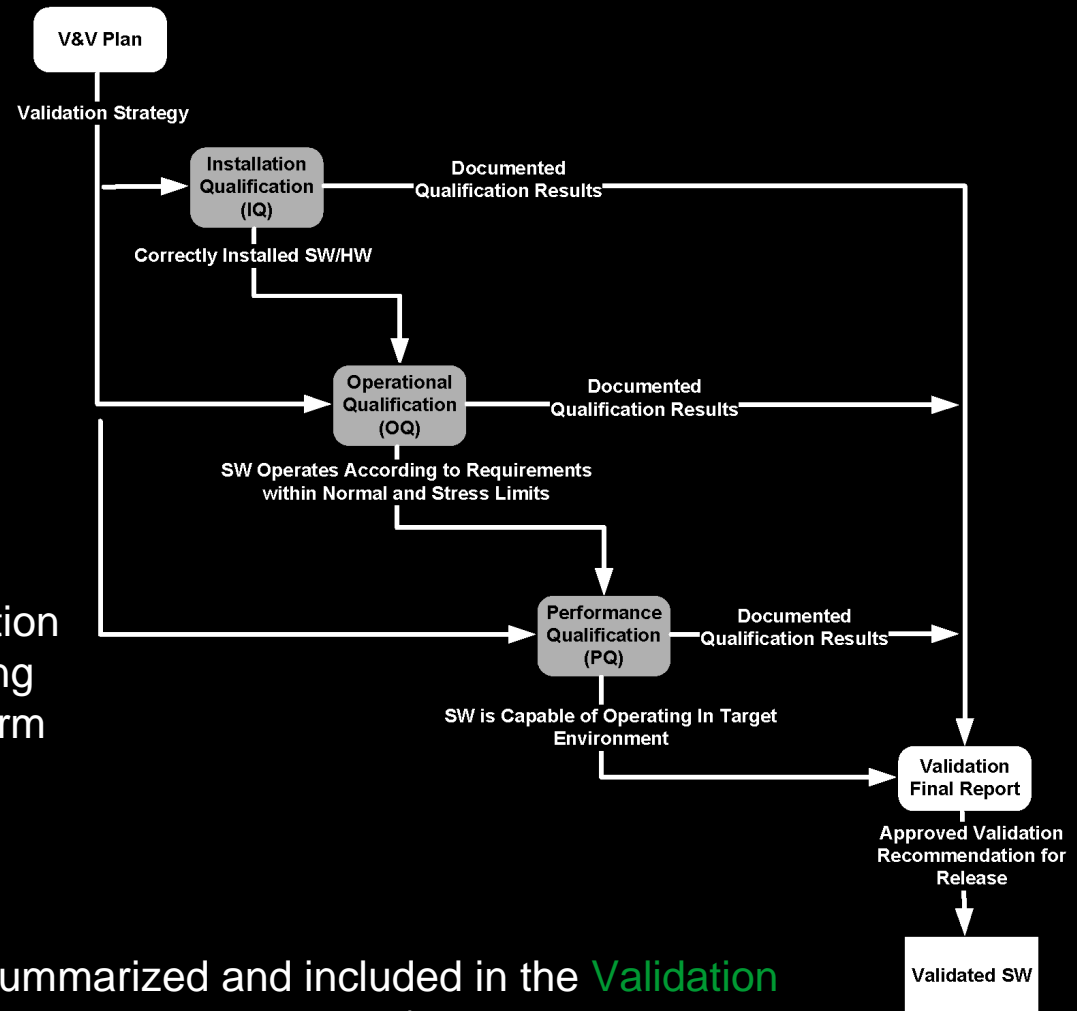
# IQ/OQ/PQ Activities

The **IQ** provides documented verification that the system (HW/SW) are installed according to written and pre-approved specifications.

The **OQ** provides documented evidence that the system operates according to written and pre-approved specifications through all specified operating ranges.

The **PQ** provides documented verification that the system is capable of performing the activities that it is required to perform according to written and pre-approved specifications while operating in its specified (or target) environment.

Documented qualification results are summarized and included in the **Validation Final Report**, which provides the recommendation to accept/not accept the system for production use (or product approval).



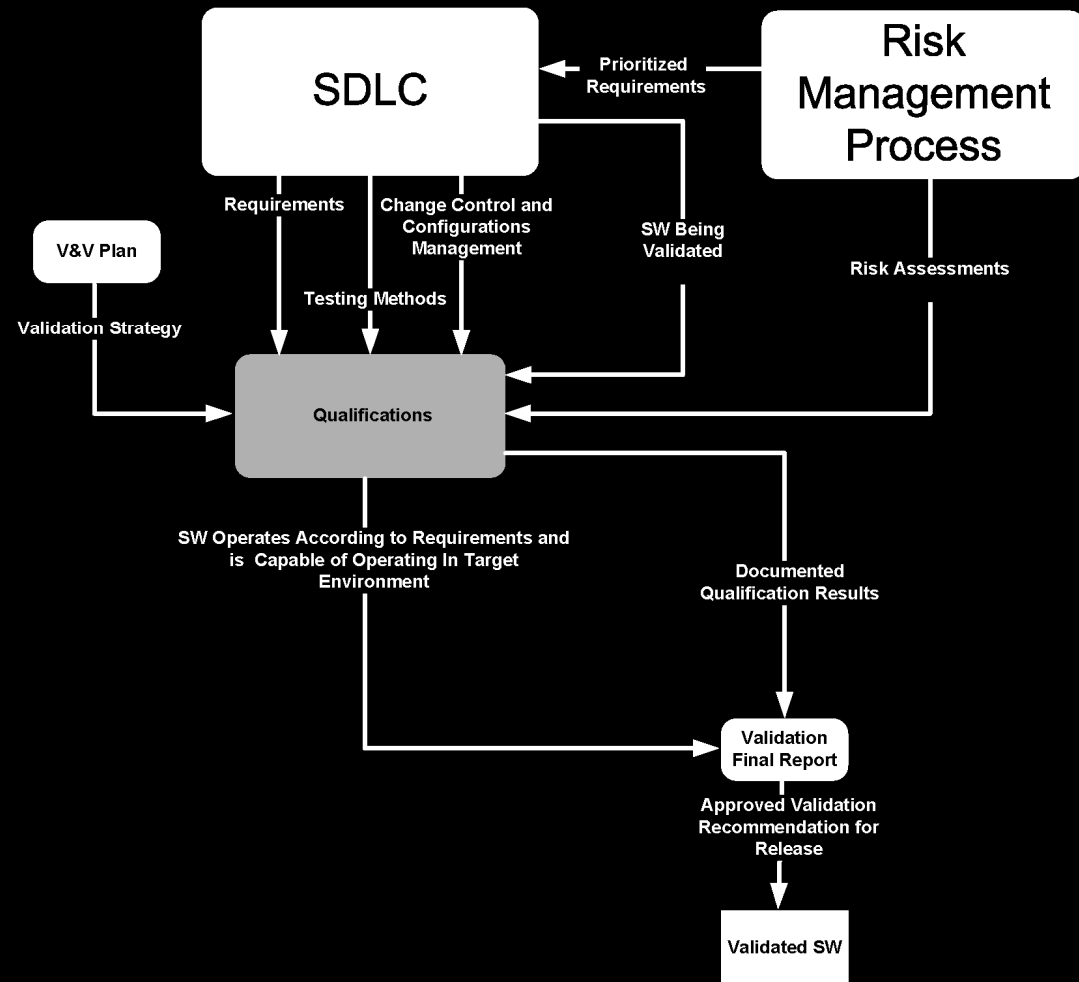
# Qualification Framework

Qualification activities are performed with a framework and integration with the Software Development Life Cycle (SDLC) used to develop or purchase the SW and a risk management process.

SDLC processes are often based on IEEE Software Engineering Standards and the IEEE Software Engineering Body of Knowledge (SWBOK).

ISO 14971 provides a basis for risk management processes.

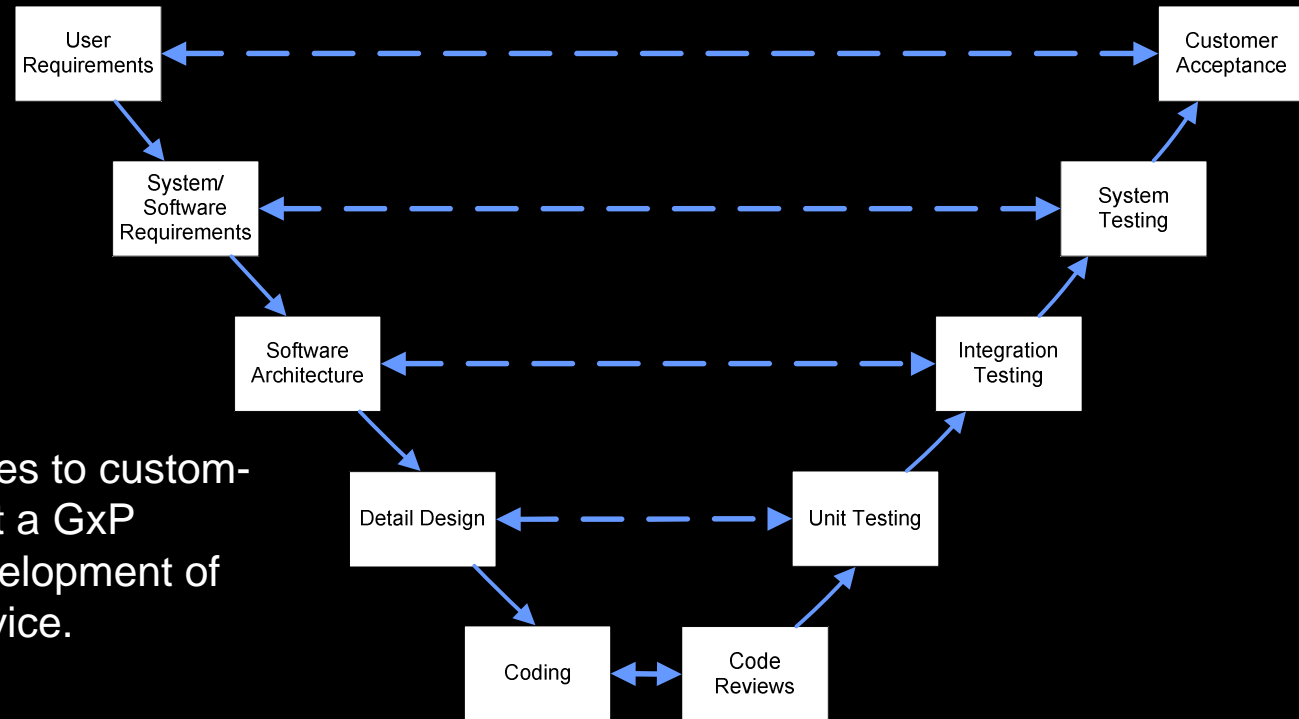
The SDLC also provides the processes for maintaining the validated state.



# SDLC Models

Any SDLC model can be used, as long as it provides the artifacts and methods required to validate the system. The FDA has identified the V-model as an accepted approach.

The complete SDLC applies to custom-build systems that support a GxP Quality System or the development of software for a medical device.



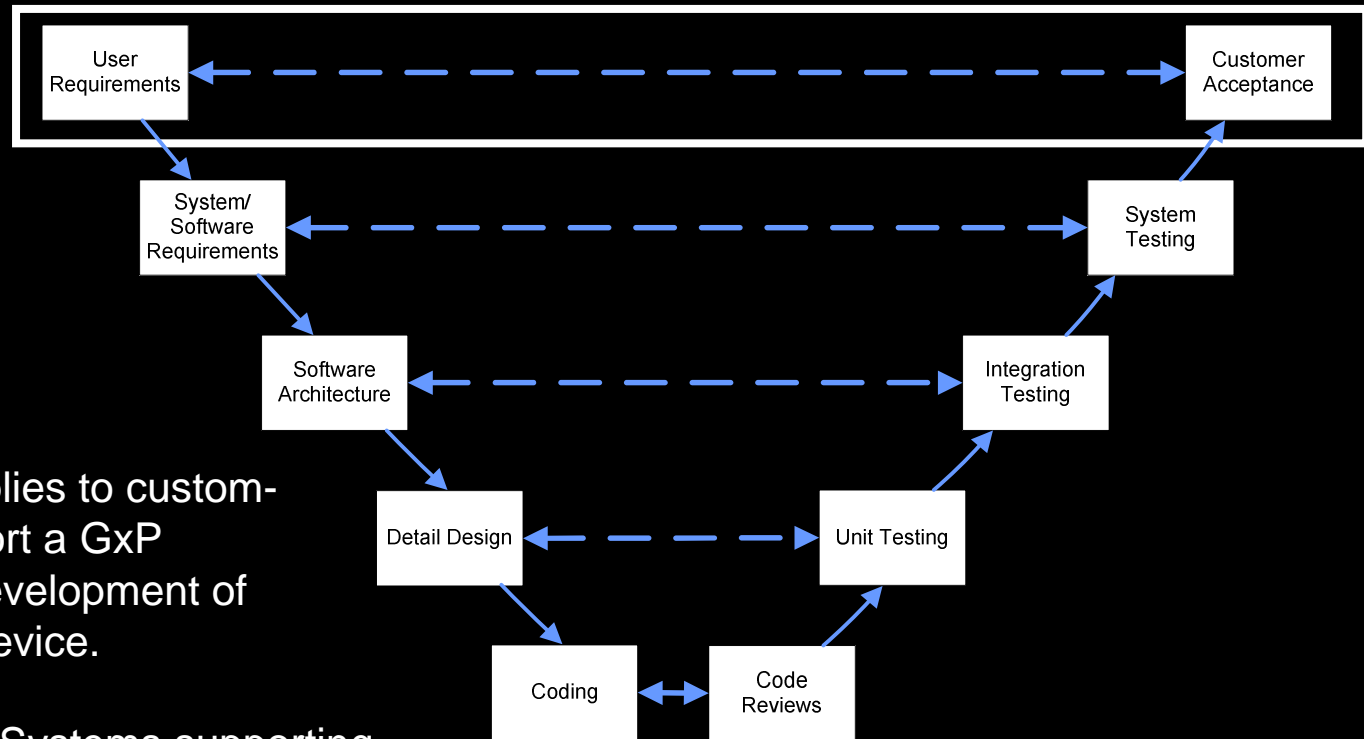
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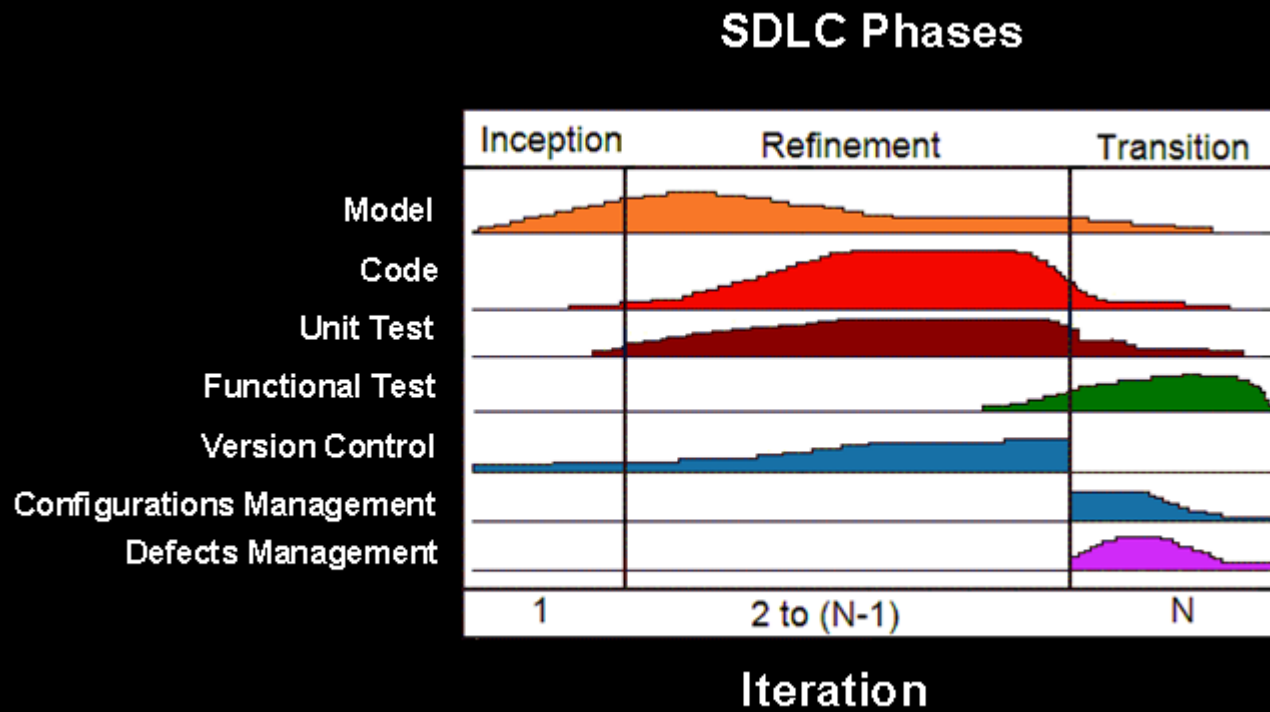
For Off-the-Shelf (OTS) Systems supporting GxP Quality Systems, only the top row applies. Other items are verified through due-diligence vendor audits.

For OTS Systems (software) used in medical devices, a hazard analysis and mitigations plan are required.



# SDLC Models

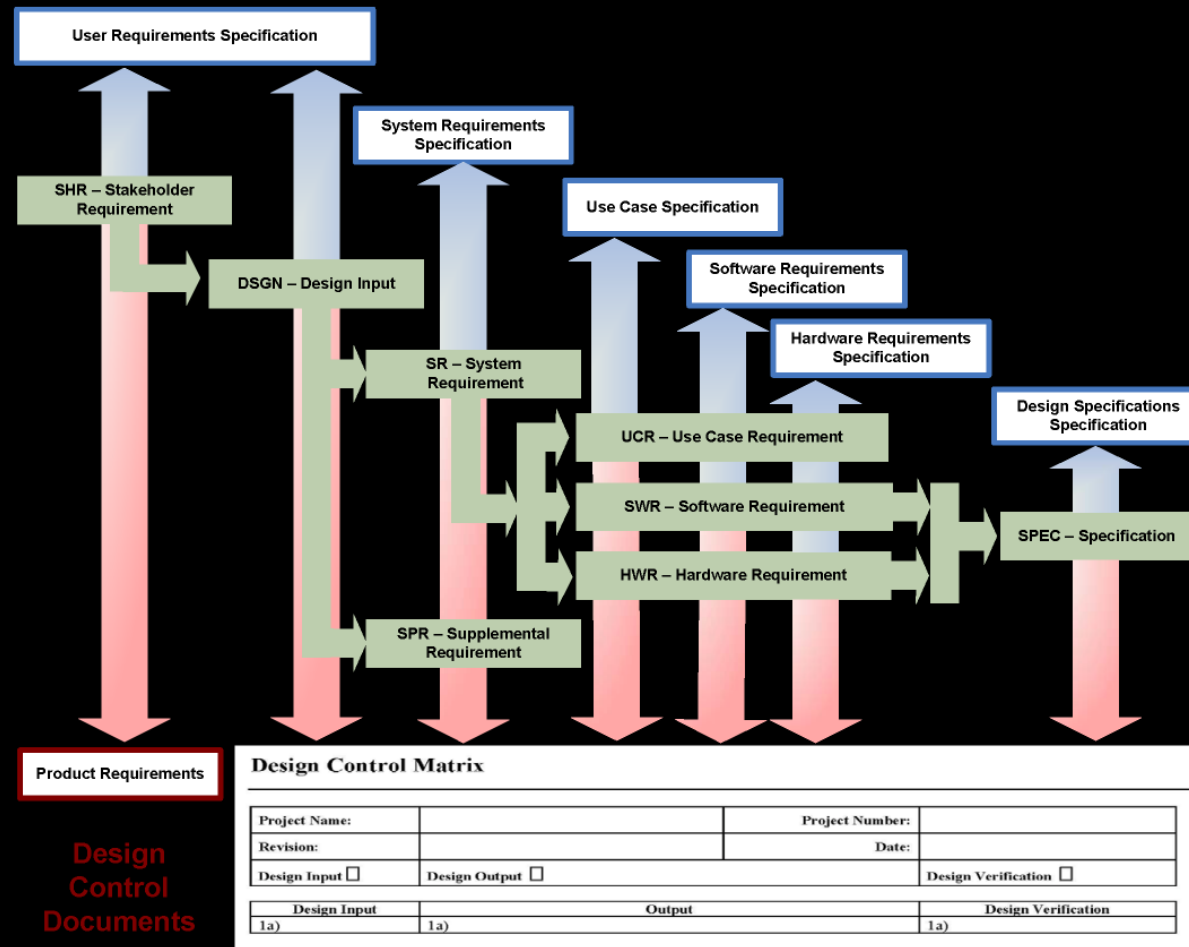
When more iterative SDLC approaches are used, requirement specifications are not finalized until at the end of the lifecycle, and testing is performed incrementally.



The SDLC process should be documented in either the product/system project management plan and/or in SOPs.

# SDLC Models

For medical devices, the SDLC should provide document deliverables that meet the requirements for design controls defined under 21 CFR § 820.30.



# IT Infrastructure Controls

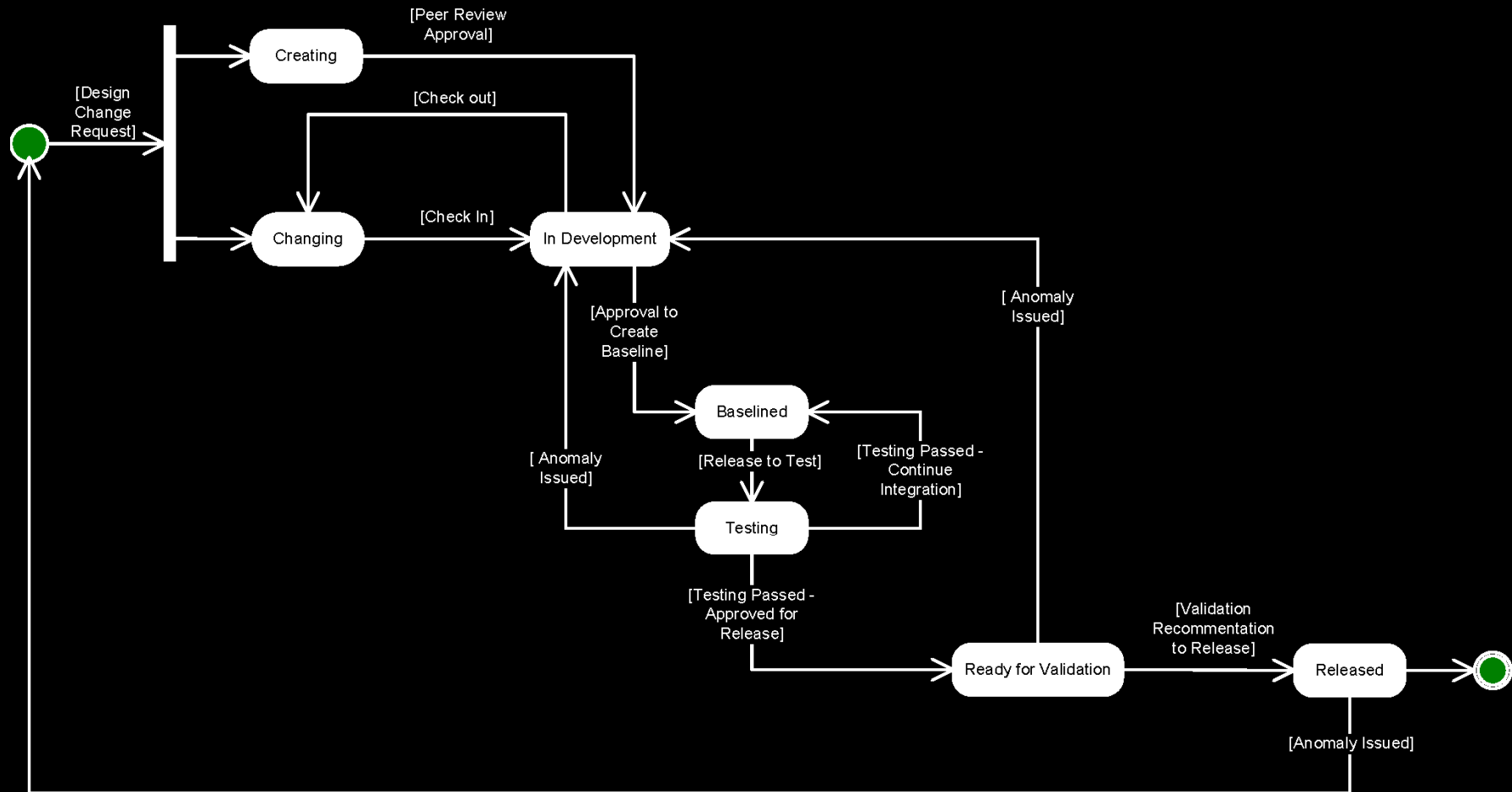
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For software applications supporting GxP Quality Systems, appropriate IT infrastructure controls must be in place to ensure that electronic GxP records are protected.

- Requirements for security and other controls are provided in 21 CFR part 11.
- ITIL standards provide details for implementing IT infrastructure controls.
- Controls should address:
  - ▶ physical security
  - ▶ data security
  - ▶ access security
  - ▶ data backup and recovery
  - ▶ contingency planning

# Configurations Management

To maintain the validated state of the software, a configurations management process must be implemented, particularly for medical devices.



# Validation Documents

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Documents that are generally required to support a validation include the following:

- System Project Management Plan (SPMP) - Generally only required for major system implementations.
- V&V Plan - Generally only required for major system implementations. SOPs can be used for simple (e.g., "spreadsheet") systems.
- Requirements Specifications - For simple systems that support a GxP process, these can be defined by the SOPs/work instructions for the process.
- Test Protocols - A formal document is required for major system implementations. Forms can be used for simple systems.
- Test Scripts - For simple systems, requirements can be stated in the test script to provide traceability of testing to requirements.
- Testing Final Report - A formal document is required for major system implementations. Forms can be used for simple systems.

# System Project Management Plans (SPMP)

The SPMP defines the managerial and technical processes that will be used to develop and validate the system (medical device software).

Use IEEE Std 1058 as a guide.

Define the SDLC or reference applicable SDLC SOPs .

Provide a high-level description of how the system will be validated.

## SPMP for the Commissioning of SW Engineering Tools

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# V&V Plan

The V&V Plan describes those activities that will be used to validate the system. Include as appropriate quality assurance activities, such as SDLC phase reviews.

Use IEEE Std 730, 1012, and 1028 as guides.

Identify the various qualifications that will be performed and any pre-requisite activities. Detail requirements for conducting the qualification are described in the Test Protocols.

ZDCP V&V/QA	ZDCP-400
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Revision: Original                      Attachments: None                      Page 2 of 15

# Requirements Specifications

The Requirement Specifications documents describe the various user, functional, and non-functional requirements of the system.

Use IEEE Std 830 as a guide.

Only include design requirements at a high level.

The functional requirements provide the basis for the OQ. Use cases provide the basis for the PQ. Non-functional requirements are evaluated during production use of the system.

Separate documents can be used for the various requirement types.

Requirements Specification for the Training System (Version 2.0)		
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# Test Protocol

The Test Protocols describe in detail the performance and content of the testing for the system.

Use IEEE Std 829 as a guide.

Developer white box testing (such as unit testing and code inspections) are described in SDLC procedures.

Detailed test scripts are referenced but are generally not included in the test protocol.

Test protocols for the qualifications that are identified in the V&V Plan can either be combined or developed as separate documents.

## PQ Test Protocol for Training System (Version 2.0)

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# Test Scripts

Test scripts describe specific test steps to be performed and the expected outcome. They are used during testing to document test results.

## CDCM-4413: Operational Qualification Test Case: Assign Control or Test Material

**Prerequisite Steps:**

1. From the appropriate database tables, obtain a hard copy listing of all possible materials.
2. OQ test studies (created during execution of CDCM-4411 Test Case).
3. OQ Study Setup Worksheet.
4. Triggers are enabled for creating the Audit Trails.

**Test Script Name:**

**CDCM-4413-1: Define Materials**

Ref #	Type	Description	Expected Action	Results	Initials	Date	P/F
1	Step	Log onto the CDCM Application. Select the Setup workflow and open an OQ test study (which has not had any materials defined).		study ID =			
2	Step	Click the Define Controls/Test tab.	The Define Controls/Test window displays.				
3	VP	Verify that the display format conforms to the GUI specifications in CDCM-2010.					
4	VP	Verify that no materials are displayed in the Materials in Study list box.					
5	VP	Verify that materials displayed in the Existing Materials list box correspond to those on the hard copy list of all possible materials (Prerequisite).					
6	Step	Select a material (by clicking on the item) listed in the Existing Materials list box.	The movement command buttons are enabled.	material (1) selected =			
7	Step	Click Select as Test.	The selected material is assigned as a test material.				
8	VP	Verify that material (1) appears in the Materials in Study list box as a test material and does not appear in the Existing Materials list box.					
9	Step	Select a material listed in the Existing Materials list box.		material (2) selected =			
10	Step	Click Select as Test.	The selected material is assigned as a test material.				

# Validation Final Report (VFR)

The VFR provides a summary of the testing that was performed to validate the system.

The VFR provides the "road map" to other SDLC documents, such as Requirement Specifications.

A recommendation, with rationale, is included to either accept the system for release into production, not accept the system, or accept and release the system with conditions.

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