

CMII-105C

CMII Standard

for

Product

Configuration Management



CMII Research Institute — Institute of Configuration Management
www.cmiiresearch.com — www.icmhq.com — info@icmhq.com — (888) 816-2644

Notice

**This standard was developed by a group of configuration management (CM) subject matter experts who are also certified CMII professionals (CMIIPs).
— CMII Group A —**

**This revision (rev C) serves to align its format and content with
CMII-100D *CMII Standard for Enterprise CM*
with
CMII-200C *CMII Standard for Business Process Certification***

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About this Standard

This standard defines the requirements for applying configuration management to products in the same manner that CMII-100 defines the requirements for applying configuration management to the business enterprise and its core business processes.

Product baselines are the cornerstone to this standard as an enterprise baseline is the cornerstone to the CMII-100 standard.

Physical item hierarchies provide the framework for product baselines as the hierarchy of administrative requirements provides the framework for an enterprise baseline.

Both standards utilize the same configuration management process which is enabled by the same business process infrastructure.

This is not an ANSI-sanctioned consensus standard, but its contributors include the most highly recognized experts in the field.

They are the CMII instructors who train the subject-matter experts from businesses and government agencies world-wide in how to build and utilize a CM-based business process infrastructure.

The CM process requirements defined herein are at a high level, yet sufficiently detailed such that those who implement and conform to this standard should achieve similar results.

The existing CM process for products may also be assessed against this standard to identify its strengths and weaknesses.

Please send any questions to info@icmhq.com and use the form on the last page to request changes.

Definitions

As-Built Records - Completed work authorizations and referenced requirements that define as-built configurations and which include evidence of conforming results.

As-Planned/As-Released Product Baseline - A structured set of information that fully defines the current configuration and also provides visibility of planned changes.

Application Requirements - What a product must do where it is sold and used.

Bill of Material - A document that defines the parent-to-child relationships between physical items. A physical item hierarchy is comprised of indented bills of material.

Business Process Infrastructure - An integrated set of core business processes designed to accommodate change and keep requirements clear, concise and valid.

Corrective Action - The extra effort, or intervention resources, required to compensate for something that should not be necessary.

Deviation - A planned waiver.

Model Number - A unique identifier assigned to a like-family of end-items.

Order Bill - An end-item bill of material that defines what the customer ordered.

Operating Standard - A requirement to be achieved by a core business process.

Primary Documents - The documented requirements for a primary item.

Primary Items - The physical items contained in an end-item product.

Process Plan - A document that provides step-by-step work instructions for how to produce, operate and/or maintain a specific configuration.

Secondary Document - A document that defines a secondary item or a standardized process.

Secondary Item - Equipment or tools used to support a primary item.

Validation - The process of ensuring that the requirements are valid.

Verification - The process of verifying that the results conform to the requirements.

Waiver - A form used to define an item with an unexpected nonconforming condition and signify the customer's acceptance of that condition.

Work Authorization - A form used to authorize and control work performed on physical items and reference the documented requirements to which the results must conform.

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INTRODUCTION

Figure 1 provides insight to the CMII model and how the same CM process can be applied to products and the business enterprise. In both cases, the high-level requirements flow-down through hierarchies and into detailed requirements. Flow-down is an iterative process and changes are continuous. Ability to accommodate change and keep requirements clear, concise and valid is essential.

This standard defines the requirements for a CM process that can:

- (1) accommodate change;
- (2) keep requirements clear, concise and valid;
- (3) keep related data accurate and secure;
- (3) optimize the reuse of standards and best practices; and
- (4) ensure that products conform to their requirements.

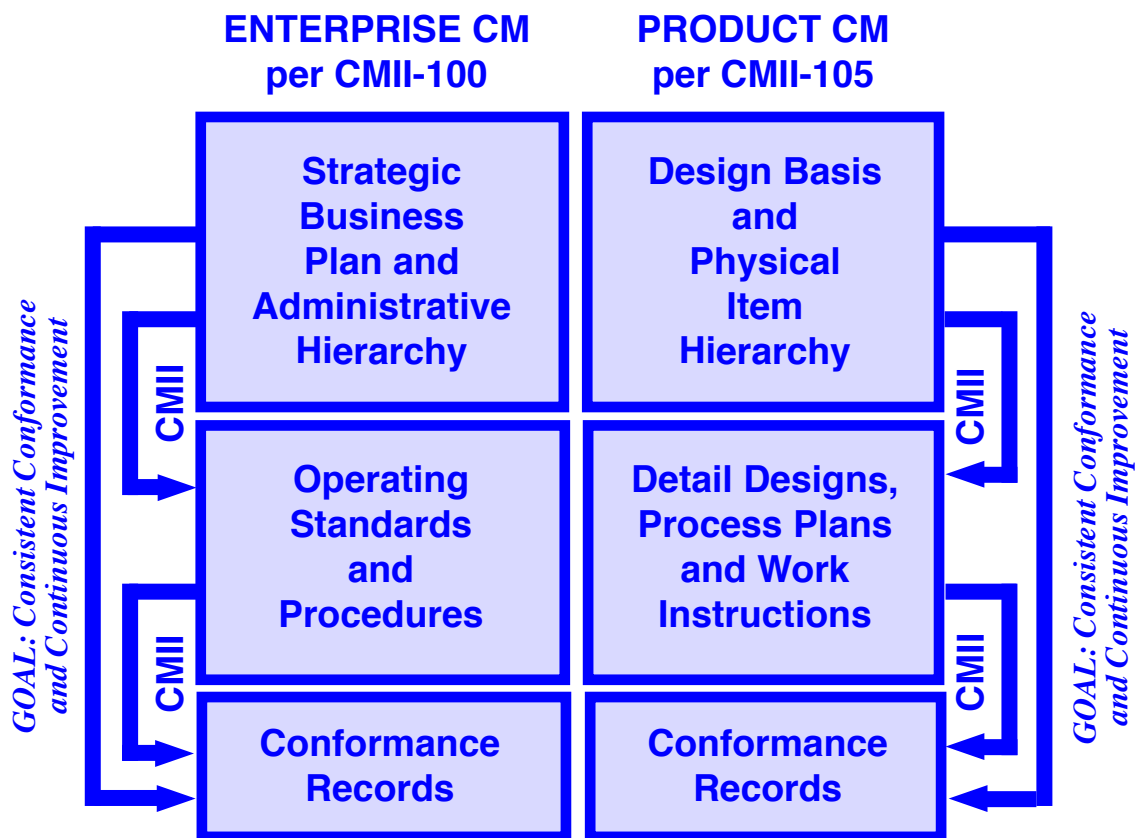


Figure 1 Enterprise CM Relative to Product CM

1. Product Baselines and Work Flows

Product baseline information is created and maintained in accordance with enterprise operating standards and procedures, which are maintained in the enterprise baseline. Product baselines contain the design basis, physical item hierarchy and detailed designs and processes for each item at each level in its hierarchy.

Detailed designs and processes are used to produce and maintain the products. As-built records are retained for each product. As-built records include any modifications made after the product is built.

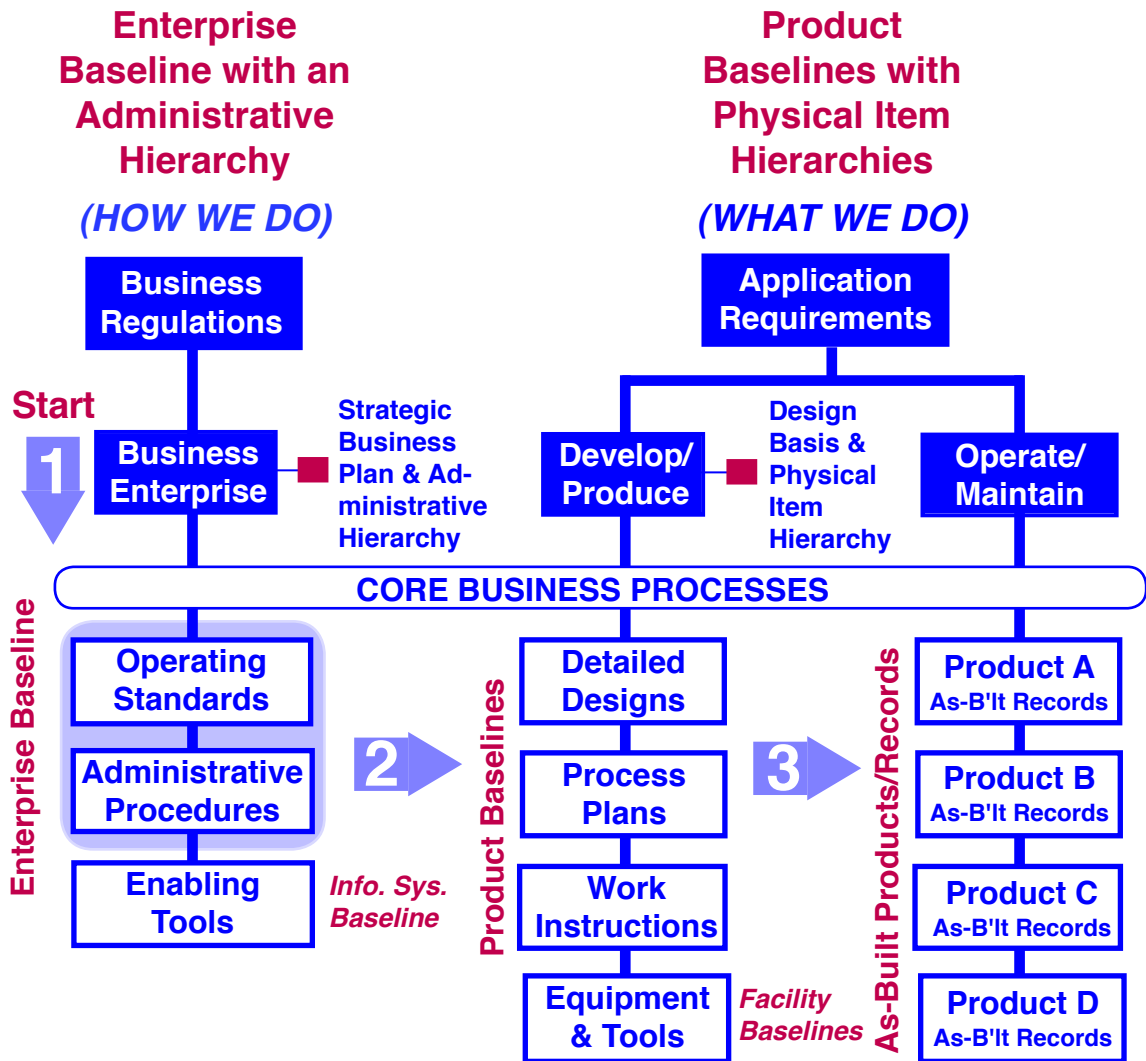


Figure 2 Product Baselines and Work Flows

2. Product Baseline Content and Format

The physical item hierarchy (comprised of indentured bills of material) provides the framework for each product baseline. Product application requirements reside at level 0 atop the hierarchy and the end-item resides at level 1. The actual physical item hierarchy extends downward from level 1.

Each item at each level in the physical item hierarchy is linked to its own set of documented requirements. Physical items are identified by their identification number and name. Documents are identified by type, number and revision level.

Product baselines are always current in that they ratchet forward with each change. Product baselines include visibility of planned changes and display both the superseded and superseding documents. See Figure 7 on page 19 for a detailed example of a product baseline.

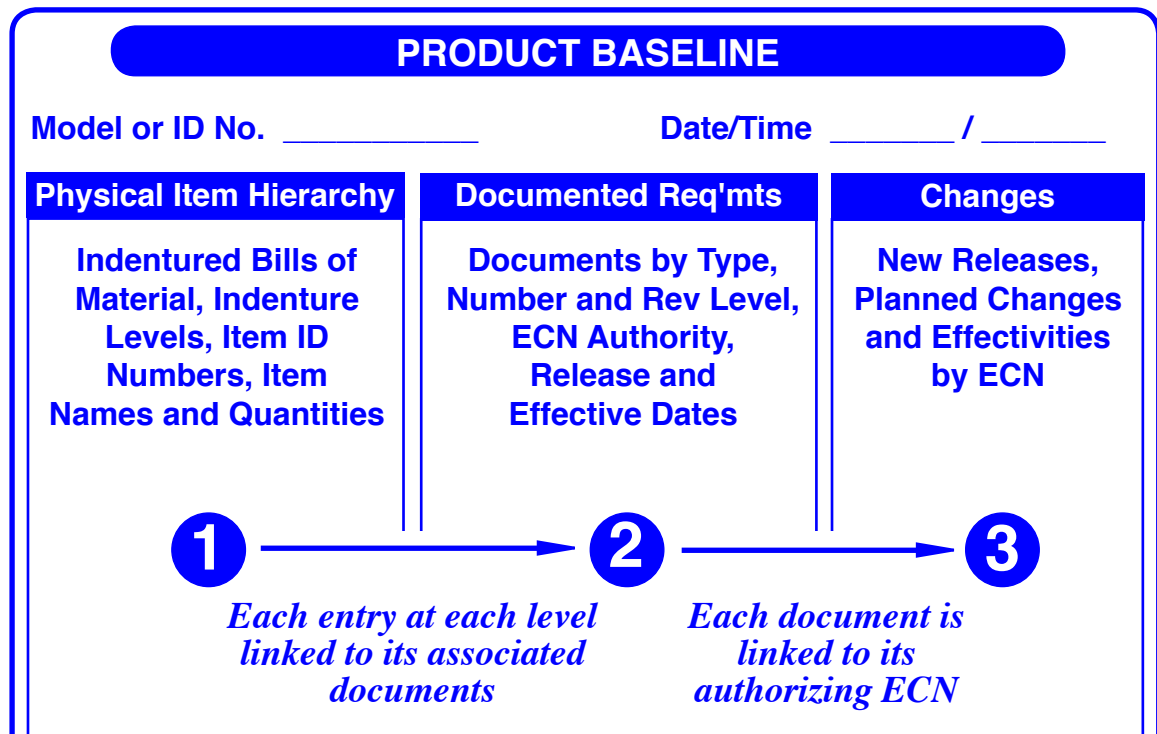


Figure 3 Product Baseline Content and Format

3. Product Configuration Management: Scope and Emphasis

Products go through as many as five major life cycle phases, as shown below. The idea for a product is established in the concept phase. The first stage of development extends the concept into a design basis. The following stages extend the design basis into detailed designs and processes for producing, supporting and decommissioning the product. CM begins with the release of the first conceptual document and continues through the retirement of the last definitive document.

Any information that could impact safety, security, quality, schedule, cost, profit or the environment is included in a baseline or linked to a baselined element. The role of CM, per CMII, is to accommodate change, keep requirements clear, concise and valid and ensure that products conform to their requirements. CM is the process for maintaining both product baselines and as-built records.

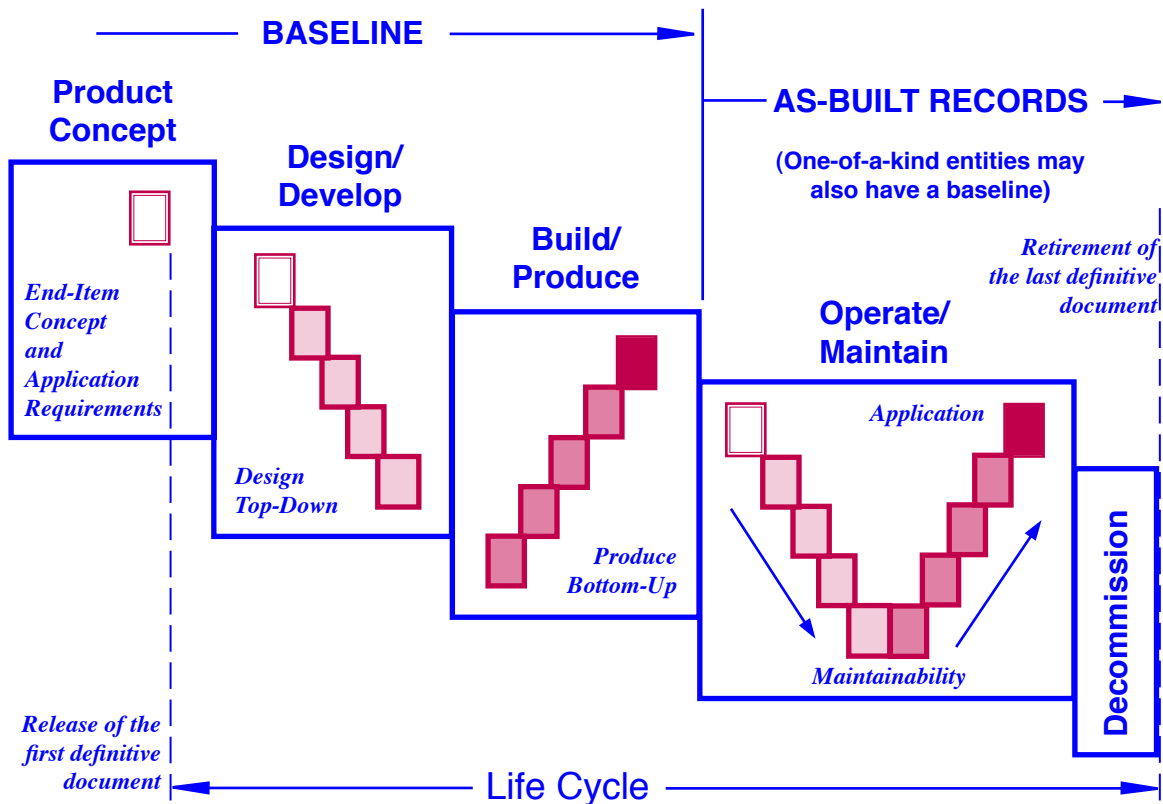


Figure 4 Life Cycle Phases for Products

4. The V-Model for Product Development

Development is accomplished via the V-model utilizing a waterfall approach with minor spiraling at each level, as shown below. Product definition evolves top-down on the left and products are built bottom-up in the right. Each level of the as-built product on the right conforms to its corresponding requirements on the left.

Product baselines are populated during the development phase and updated with changes that occur during the production phase.

Changes initiated on the left side are real improvements. Changes initiated to resolve nonconformances detected on the right represent corrective action. Conforming results are the norm when documented requirements are clear, concise and valid. Results are unpredictable when requirements are not clear, concise and/or valid.

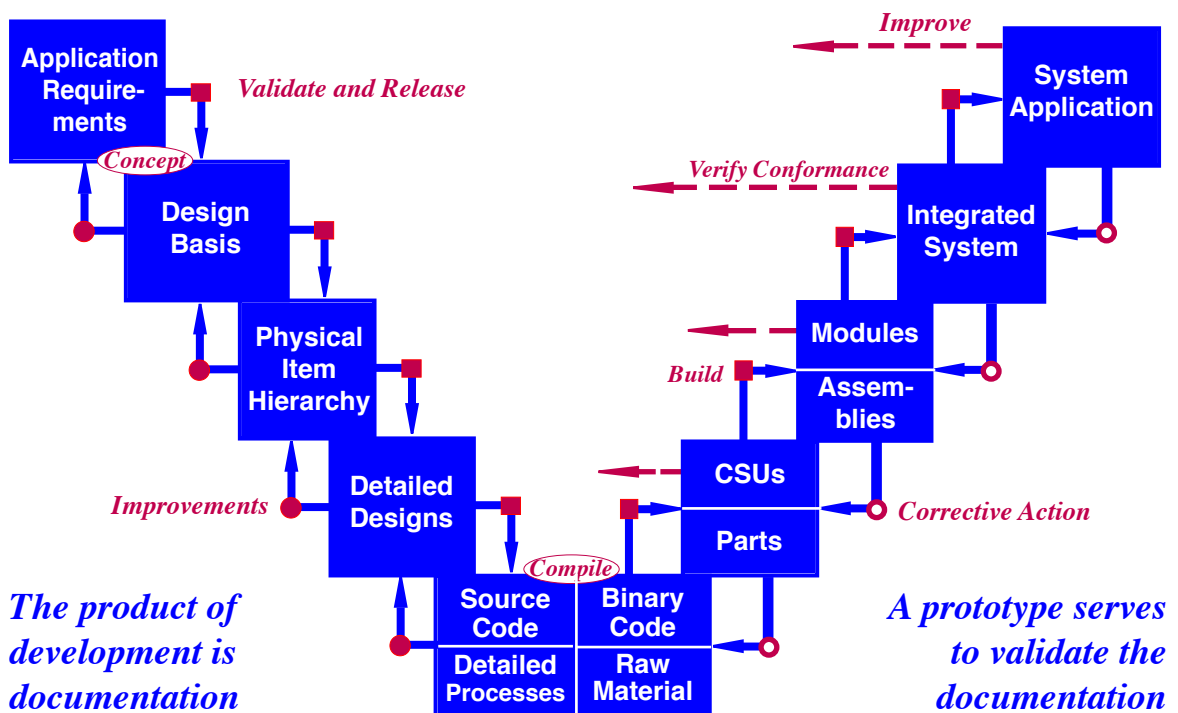


Figure 5 V-Model for Product Development

5. Configuration Management Plan for Products

The configuration management plan for products resides in the hierarchy of administrative requirements maintained in the enterprise baseline. Product configuration management is accomplished with a business process infrastructure comprised of seven sets of operating standards and procedures plus enabling software tools as follow:

- 5.1 As-planned/as-released baselines
- 5.2 Four-tier, nine-step development process
- 5.3 Naming, numbering and reuse
- 5.4 Data and record accuracy (*added*)
- 5.5 Validation and release records
- 5.6 Change and revision records
- 5.7 Verification and as-built records (*added*)
- 5.8 Enabling software tools

5.1 As-Planned/As-Released Baselines

As-planned/as-released baselines are *moving* baselines. They are always current and include visibility of planned changes. Such baselines are utilized in development and production and in operation and maintenance (O&M) for one-of-a-kind entities. As-built records are used to define the configuration of items in their as-delivered state.

5.1.1 Baselines for Development and Production

Each like-family of end-item products has its own as-planned/as-released baseline and the physical item hierarchy is used as its framework. Development and production share the same hierarchy which is structured to support the supply chain. Each physical item at each level is linked to its own set of documented requirements.

5.1.2 As-Built Records for In-Service Products

Individual units of the same model produced over time will differ in accordance with customer-selected options and engineering changes. Except for stand-alone entities, in-service products do not have their own baseline but each has its own as-built/as-maintained record.

5.2 Four-Tier, Nine-Step Development Process

This segment focuses on how products are developed and how as-planned/as-released baselines are populated and maintained. It describes how as-planned/as-released baselines are used to support development and minimize the length of the development cycle.

5.2.1 First Tier, Steps 1 and 2

Product application requirements are defined and entered into the baseline in step 1. The design basis (comprised of functional specifications, system schematics, 3-D layouts and process views) is created and entered into the baseline in step 2.

5.2.2 Second Tier, Steps 3, 4 and 5

The design basis is extended into a complete physical item hierarchy which is added to the baseline in step 3. Detailed designs and processes for each item at each level in the hierarchy are identified and added to the baseline in step 4. Required release dates for each document (new or revised) are identified and added to the baseline in step 5.

5.2.3 Third Tier, Steps 6 and 7

The new detailed designs and processes identified in step 4 are created and released in step 6. Prototypes, as needed to validate the detailed design and process documents, are produced in step 7. Steps 6 and 7 consume the greatest portion of the development resources.

5.2.4 Fourth Tier, Steps 8 and 9

Preproduction end-item products are built and tested in step 8. The development phase is complete once the documentation required to support production, operation, maintenance and decommissioning is confirmed to be clear, concise and valid.

Corrective action costs incurred in development steps 1 through 8 are collected and quantified in step 9.

5.3 Numbering, Naming and Reuse

Standardized numbering and naming conventions are applied to all physical items and documents, both primary and secondary. Each physical item has an ID number, a name and a description. It may also have a lot number and a serial number. Each document is identified by type, number, revision level and includes its source which may be defined with a commercial and government entity (CAGE) code.

5.3.1 Numbering Conventions

Identification (ID) numbers are used to manage interchangeability. Physical items that are not fully interchangeable do not share the same ID number. ID numbers are short as practical and numeric. Significant numbers, if used, are limited to items normally found in standard-part catalogs. Lot-controlled items have a lot number in addition to the ID number. Individual lot controlled items may also have a serial number.

5.3.2 Naming Conventions

Standard conventions are used to name and describe each physical item. A generic noun is used as the name. Each item is described by identifying its attributes in their descending order of significance.

5.3.3 Reuse of Physical Items

The potential for reuse is determined by using the names and descriptions to identify the similarities and differences between items. Interchangeability of similar items is confirmed by comparing their designs.

5.3.4 Primary versus Secondary Items and Documents

A product's physical item hierarchy contains only the primary items contained in the end-item. Each primary item is linked to its own set of primary documents. Tools and equipment used to support primary items are categorized as secondary items and documents and are excluded from the hierarchy. Instead, they are linked to the primary process documents.

5.4 Data and Record Accuracy

The goal for data and record accuracy is 100%.

5.5.1 Data Accuracy and Error Prevention

Product-related data bases are periodically audited to determine their level of accuracy and the effectiveness of error prevention techniques. All data transactions are retained for a predetermined period of time and used to improve error prevention techniques.

5.5.2 Record Accuracy and Traceability

All work is authorized and controlled with forms. The forms remain open until the work is satisfactorily completed. Completed forms are retained as records of work accomplished. Appropriate records provide a complete history of all products, all documents and all changes. Traceability of every product, document or change, from its current state back to its original source, is ensured.

5.5 Validation and Release Records

Documents are validated before they are released, and released before they are used. Only released documents are applied to products. Products conform to the released documents.

5.4.1 Document Ownership and Validation

Each relatively simple document is co-owned and validated by an assigned creator and a designated user who are jointly responsible for ensuring that it is clear, concise and valid for all users. Each complex document is jointly owned by its assigned creator and a cross-functional team of users who are jointly responsible for its integrity.

5.4.2 Document Release Records

A release record is retained for each document that has been validated and released. A document release record includes the document type, number, revision level and its ECN authority.

5.6 Changes and Revision Records

The organization uses one common closed-loop change process which is closely coupled with as-planned/as-released baselines. Standardized forms are used as templates to guide new document releases and changes through the closed-loop process.

5.6.1 Change Analysis and Implementation Phases

Change requests go through an analysis phase and, if approved, an implementation phase. Changes are initiated with a problem report or an enterprise change request (ECR) form. Approved changes are implemented with an enterprise change notice (ECN) form.

5.6.2 Grouping of Approved ECRs as One Change

ECRs which impact one or more of the same documents and may share the same effectivity are grouped and implemented with one ECN.

5.6.3 Change Priorities

Approved changes are assigned one of four priorities. Priority 1 is the highest and is worked full time until completed. A priority 2 is worked ahead of a priority 3 or 4. Standard leadtime is used for a priority 3. A priority 4 is the lowest and is grouped with a priority 3 as possible.

5.6.4 Fast-Track Changes

Relatively simple changes may be processed on a fast-track basis wherein the assigned creator may approve and implement their own technical recommendation. Criteria for using the fast-track process is provided by the Change Review Board.

5.6.5 Baseline Updates and Change Revision Records

Detailed ECN implementation plans are used to update the as-planned/as-released baselines. A document change record (DCR) form is used to capture a was-is record for each document revision. The ECN authority and the from-to revisions are recorded on the DCR.

5.7 Verification and As-Built Records

Each product must conform to its documented requirements, which include criteria for verifying conformance.

5.7.1 Verification

The process of verifying conformance to the requirements.

5.7.2 As-Built Records

Work authorizations for building configurations, once completed, are retained as as-built records and include evidence of conforming results.

5.8 Enabling Software Tools

Overall CM process efficiency can be enhanced with automation to help create and maintain baselines and process changes.

5.8.1 Product Baseline Automation

Automation of a baseline includes putting it on-line and automating its inputs (changes or updates) and its outputs (applications).

5.8.2 Change Analysis

To automate change analysis is to automate the step-by-step work flows for processing problem reports and enterprise change requests.

5.8.3 Change Implementation Planning

To automate change implementation is to automate the step-by-step work flows for creating and implementing enterprise change notices.

5.8.4 Change Task Tracking

To automate change task tracking is to automate the tracking of actual task completions relative to planned completions and adjust the plan as needed to support the dual goals of keeping the plan current and also achieving the initially assigned change effectivity.

Annex A Product Structure or Physical Item Hierarchy

Physical item hierarchies are used as the framework for product baselines. Each item residing at each level within a physical item hierarchy has its own unique set of documented requirements. The end-item application requirements (what the product must do) are segregated from its design basis requirements (what it can do).

The appropriate structure during the development and production phases is comprised of MAKE/BUY units. The appropriate structure during the O&M phase is comprised of REPAIRABLE/REPLACEABLE units.

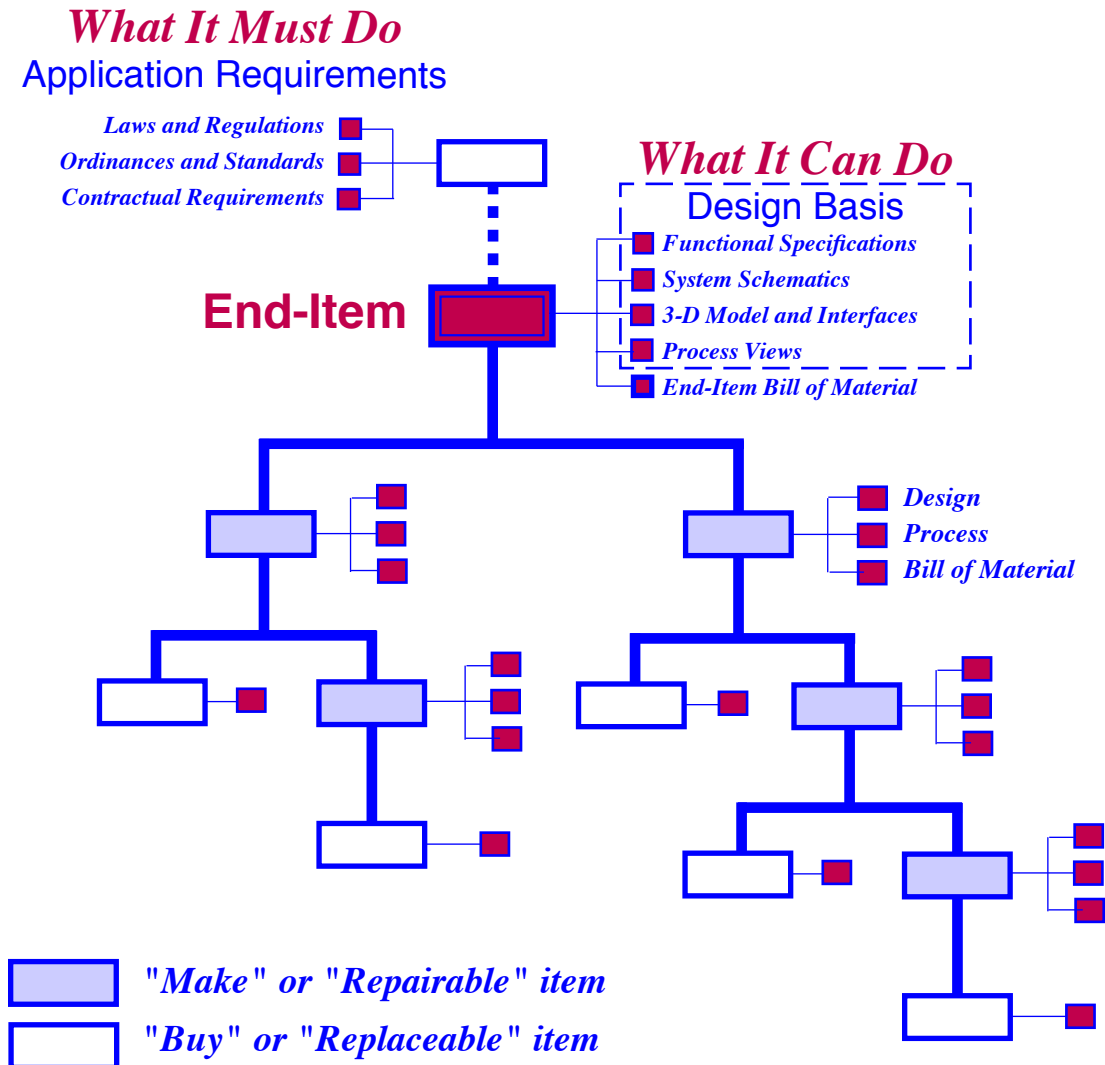


Figure 6 Physical Item Hierarchy

Annex B Detailed Example of a Product Baseline

The baseline example in Figure 7 uses shading to display a change. In this case, the end-item bill of material 9876, revision A is being replaced by revision B of the same bill of material — which serves to replace item 1234 with item 2345. The ECN authority for this change is displayed along with its effectivity. The release date and the effective date for bill of material 9876, revision B, are also shown.

The baseline displays both the superseded and the superseding documents and physical items as long as the effectivity is pending. Once the effectivity is reached, the superseded bill of material and the superseded item are removed from the baseline and moved to a history file. This example also demonstrates why such baselines are called as-planned/as-released baselines and how they can be used to drive the supply chain.

PRODUCT BASELINE											
End-Item ID or Model No. _____						Date/Time ____/____					
Physical Items			Documented Requirements						Planned Ch'gs		
Hierarchy (Qty per)	Item ID Number	Item Name	Type	Number	Rev	Rel. Date	Eff. Date	ECN	A/D	Effec- tivity	ECN
0	NNNN	XXXXXX	TT	NNNN	R	DMY		---			
1	9876	End-Item	TT	NNNN	R	DMY	DMY	NNN			
			TT	NNNN	R	DMY	DMY	NNN			
			TT	NNNN	R	DMY	DMY	NNN			
			BM	9876	A	DMY	DMY	NNN	D	DMY	NNN
			BM	9876	B	DMY	DMY		A	DMY	NNN
1	NNNN	XXXXXX	TT	NNNN	R	DMY	DMY	NNN			
1	1234	XXXXXX	TT	NNNN	R	DMY	DMY	NNN	D		NNN
1	2345	XXXXXX	TT	NNNN	R	DMY	DMY		A		NNN

Figure 7 Detailed Example of a Product Baseline

Form for Requesting Changes to this Standard

Recommendations for changes may be submitted by FAXing this form to CMII Research Institute at (602) 595-8942.

CMII-105 Change Request

CR No. _____

REQUESTOR	PHONE	DATE	Page ____ of ____
MAIL OR E-MAIL ADDRESS			
REQUESTED CHANGE			
BASIS FOR THIS REQUESTED CHANGE			
CONCLUSION AND RECOMMENDATION BY REVIEWER			
			Reviewer _____ Date _____
IMPLEMENTATION PLAN IF APPROVED			