International Aerospace Quality Group

Configuration Management Guidelines

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Foreword

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- The guideline describes Configuration Management functions and principles and defines Configuration Management terminology for use with Aerospace and Defense AS&D product line.
- It is targeted at Small and Medium size companies acting as subcontractors/suppliers either in a Build to Print or a Build to Spec relationship.
- The intention of these guidelines is to assist organizations with understanding the concept and process of Configuration Management and is not intended to be a requirement, nor auditable.

Introduction

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- The Aerospace Standards (e.g. IAQG 9100) call for the implementation of Configuration Management and documents control throughout the entire life cycle of product realization.

- Configuration Management establishes a language of understanding between the customer and the supplier both in predefined relationship (such as Built to Print) and those in which the supplier is given some freedom (such as Built to Spec).

Introduction

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- When Configuration Management principles are applied using effective practices, return on investment is maximized, product life cycle costs are reduced and the small investment in resources necessary for effective Configuration Management is returned many fold in cost avoidance.

- These Guidelines provide the reader with the basic ideas of the industry needs, the benefits to the implementing organization and describes Configuration Management functions and principles.

List of Topics

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1. What is “Configuration”?
2. Why it is important to manage and control configuration in AS&D
3. Applicable Terms and Definitions
4. The objectives of Configuration Management
5. Benefits for an enterprise gained through application of CM
6. CM and Documents control in 9100:2009
7. The Configuration Continuum
8. CM functions
9. CM vs. Engineering Change
10. CM Tools
11. Summary
12. Resources

1. What is “Configuration”?

- Functional and physical characteristics of existing or planned hardware, firmware, software or a combination thereof as set forth in technical documentation and ultimately achieved in a product.

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2. Why is it important to manage and control configuration in Aerospace & Defense?

- Proper CM implementation can positively impact Product Quality, On time Product Delivery, and decrease development and life cycle costs
- Product configuration presents a particularly difficult set of challenges for Aerospace & Defense resulting from:
  - Large products involving a highly complex set of parts and systems
  - Complex set of environmental and safety regulations
  - Ability to respond effectively to customer demands

Aerospace and Defense Functional Needs

- Managing massive bid activities requiring product configuration knowledge
- Managing massive design activities requiring product configuration knowledge for:
  - Program and project management
  - Work Breakdown Structures (WBS)
- Managing manufacturing operations
  - Many, many open work orders
  - Frequent engineering change

Aerospace and Defense Functional Needs (cont')

- Hardware and software CM at all stages of the product life-cycle
- Configuration identification and change control
- Configuration tracking, product traceability and visibility
- Storage, retrieval and transfer of data from a common data base
- The capability to reproduce products/processes
- Manufacture and testing of products only from released documents

Aerospace and Defense Specific Constraints

- Project oriented activities
  - Research & Development
  - Devices Procurement
- Complex & Extensive Bills of Material
- Constant engineering change process
- Long (30+ years) product life cycles
- Legacy mind-sets
  - Both Government/Customers and Contractors
  - Classification & Security aspects

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3. Applicable terms and definitions

Configuration Management (CM)

- CM is a methodology which provides a technical and administrative framework for managing the development, manufacturing and maintenance of Configuration Items.
- CM is an integral part of the product life-cycle management.
- Activity for establishing and maintaining consistent record of the performance parameters of a product and its functional and physical characteristics compared to the product design and operational requirements.

Configuration Management (CM) *(cont'd)*

- This discipline is applicable to hardware, software, processed materials, services, and related technical documentation throughout the entire lifecycle of the product (i.e. development, production, deployment, operation, maintenance and disposal).

- **Configuration Item (CI)**
  - An aggregation of hardware, firmware, software or any of its discrete portions, which satisfies an end use function and is designated by the developer or customer for separate configuration management. Any item required for logistic support and designated for separate procurement is a CI.
- **Configuration Item (CI) selection**
  - CIs should be selected with the object of maximizing control and minimizing the effort required to achieve that control.

Configuration Baseline

- Approved status of requirements and design of a product at key project milestone that serve as reference for activities throughout the life cycle of the product.
- Baselines, plus approved changes, constitute the current approved configuration.
- There are three formal baselines designated configuration baselines in the life cycle of a configuration item:
- Functional Baseline (system specifications)
- Allocated Baseline (subsystem specifications)
- Product Baseline (complete technical data package for the CI)

Configuration Identification

- Coordinated activities to establish rules or configuration item selection, baseline content definition, and product and document identifiers. Identification is provided in the approved baseline technical documentation, as shown in specifications, tests, drawings, associated lists, and reference documents.

Configuration Item Identification Numbers

- For each configuration item you need to know at any time the technical description of the item and the identification should be changed when the technical characteristics are changed and when the two items are not interchangeable. Every item which is defined as a CI must be marked as agreed.

- **Part Number (PN)**
  - All discrete parts, assemblies and units shall be identified by part numbers in accordance with the applicable standards and/or customer definition.
- **Serial and Lot Numbers**
  - A single unit or lot in a family of like-units of a CI shall be permanently and uniquely identified by a serial or lot number.

Configuration Control

- Coordinated activities for controlling change to configuration baseline. Configuration control should be applied to established baselines, configuration identifications and all released engineering data. Configuration control system should screen, classify and process changes in a manner that provides fully coordinated, approved change packages in compliance with the requirements or contract.

- **Configuration Status Accounting (CSA)**
  - A formal process of recording and reporting of product configuration information, the status of proposed changes and the implementation status of approved changes.
- **Configuration Audits (CA)**
  - Performed before the acceptance of a configuration baseline to assure the product complies with its specified requirements and to assure the product is accurately reflected by its configuration documents.

- **Functional Configuration Audit (FCA)**
  - A formal examination of functional characteristics of a configuration item (final product), to verify that the item has achieved the performance specified in its configuration identification.
- **Physical Configuration Audit (PCA)**
  - A formal examination of the "as-built" configuration of a product or a CI against its technical documentation, in order to establish conformance between the product and its current configuration identification.

4. The Objectives of CM

- CM represents a discipline which ensures that all parties to the acquisition of a product:
  - the buyer
  - the developer/designer
  - the manufacturer, and
  - the user (customer)
- Have a common understanding about:
  - how the product looks (physical shape/ software code)
  - what the product is supposed to do (functionality, performance)
  - how the product can be operated (mission profile/capabilities); and
  - how the product is maintained (supportability)

- CM is the process or a set of requirements to be included in every industrial process for establishing and maintaining a consistent record of a product's functional and physical characteristics compared to its design and operational requirements.

- Configuration management is applied through-out the entire life cycle of the product and allows one to:

  - know at any moment the technical description of a system and its components, using approved documentation

  - record and control effectively and continuously evolutions in the technical description and provide traceability of such evolutions throughout the life-cycle of the product

- facilitate the consistency of the system's components (control of external interfaces) and the products that make up these components (control of internal interfaces)
- verify that documentation is and remains the exact image of the products it describes
- identify the current configuration baseline and the as-built configuration of a product, to record discrepancies detected during production, delivery or operation and dispositioned for further use;
- enable any user to know the operational capabilities and limitations of each product item and, in case of variances or non conformances, to know which items are affected

CM accomplishes this through control of the product defining technical data

5. Benefits for an enterprise gained through application of CM

- Conclusive and current information, knowing at any time what the enterprise is;
  - developing
  - building
  - testing
  - delivering
  - maintaining
- Assured product consistency, being enabled to;
  - deliver identical items
  - repeat performance
  - support the delivered product remotely
  - modify the product without the need of reverse engineering

- Control of cost, CM helps a project to stay within the authorized budget frame;
  - Product changes may involve high cost considerations. The right processing of changes and analysis of costs can keep expense per change at its lowest rate.
  - Unauthorized changes will be prevented.
  - Thorough identification of all affected documentation and product elements reduces cost of search and analysis of effects.
  - Approved changes can be immediately incorporated in the technical documentation, but released for implementation into the product in accordance with an authorized budget schedule.
  - Proper identification and change control reduced cost of maintenance and reuse.

- Visibility in planning, CM helps project planning by ensuring that;
  - any schedule effect of a proposed change is reviewed prior to disposition of the change
  - interface requirements are assessed for effect of the change on other design organization's schedules
- Compliance with requirements, CM ensures the intended configuration by;
  - supporting internal and formal design reviews
  - performing the functional and physical configuration verifications (audits)
  - maintaining traceability of software configurations to functional requirements
  - controlling changes to the approved documentation
  - communicating change status to all involved parties

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6. CM and Document Control in IAQG 9100

A documented procedure shall be established to:
a) to approve documents for adequacy prior to issue,
b) to review and update as necessary and re-approve
c) to ensure that changes and the current revision status of documents are identified,
d) to ensure that relevant versions of applicable documents are available at points of use,
e) to ensure that documents remain legible and readily identifiable,
f) to ensure that documents of external origin determined by the organization to be necessary for the planning and operation of the quality management system are identified and their distribution controlled, and
g) to prevent the unintended use of obsolete documents, and to apply suitable identification to them if they are retained for any purpose.

7	**PRODUCT REALIZATION**
7.1	**Planning of Product Realization**
7.1.2	**Risk Management**
7.1.3	***Configuration Management***
7.1.4	***Control of Work Transfers***
7.2	**Customer-related processes**
7.2.1	**Determination of Requirements Related to the Product**
7.2.2	**Review of Requirements Related to the Product**
7.2.3	**Customer Communication**
7.3	**Design and Development**
7.3.1	**Design and Development Planning**
7.3.2	**Design and Development Inputs**
7.3.3	**Design and Development Outputs**

The organization shall plan and develop the processes needed for product realization…
In planning product realization, the organization shall determine the following, as appropriate:
…….
e) configuration management appropriate to the product;
f) resources to support the use and maintenance of the product

The organization shall establish, implement and maintain a configuration management process that includes, as appropriate to the product
a) configuration management planning,
b) configuration identification,
c) change control,
d) configuration status accounting, and
e) configuration audit.
NOTE: See ISO 10007 for guidance.

The organization shall define the data required to allow the product to be identified, manufactured, inspected, used and maintained; including for example
– the drawings, part lists and specifications necessary to define the configuration and the design features of the product, and
– the material, process, manufacturing and assembly data needed to ensure conformity of the product.

7.3.4 Design and Development Review
7.3.5 Design and Development Verification
7.3.6 Design and Development Validation
7.3.6.1 Design and Development Verification and Validation Testing
7.3.6.2 Design and Development Verification and Validation Documentation
7.3.7 Control of Design and Development Changes

Where tests are necessary for verification and validation, these tests shall be planned, controlled, reviewed and documented to ensure and prove the following:
……..
c) the correct configuration of the product is submitted for the test,

Design and development changes shall be identified and records maintained. The changes shall be reviewed, verified and validated, as appropriate, and approved before implementation. The review of design and development changes shall include evaluation of the effect of the changes on constituent parts and product already delivered. Records of the results of the review of changes and any necessary actions shall be maintained (see 4.2.4).

Design and development changes shall be controlled in accordance with the configuration management process (see 7.1.3).

7.4 Purchasing
7.5 Production and Service Provision
7.5.1 Control of Production and Service Provision
7.5.1.1 Production Process Verification
7.5.1.2 Control of Production Process Changes
7.5.1.3 Control of Production Equipment, Tools and Software Programs
7.5.1.4 Post-Delivery Support
7.5.2 Validation of Processes for Production and Service Provision
7.5.3 Identification and Traceability
7.5.4 Customer Property
7.5.5 Preservation of Product

The organization shall plan and carry out production and service provision under controlled conditions. Controlled conditions shall include, as applicable,
a) the availability of information that describes the characteristics of the product,
NOTE: This information can include drawings, parts lists, materials and process specifications.
……

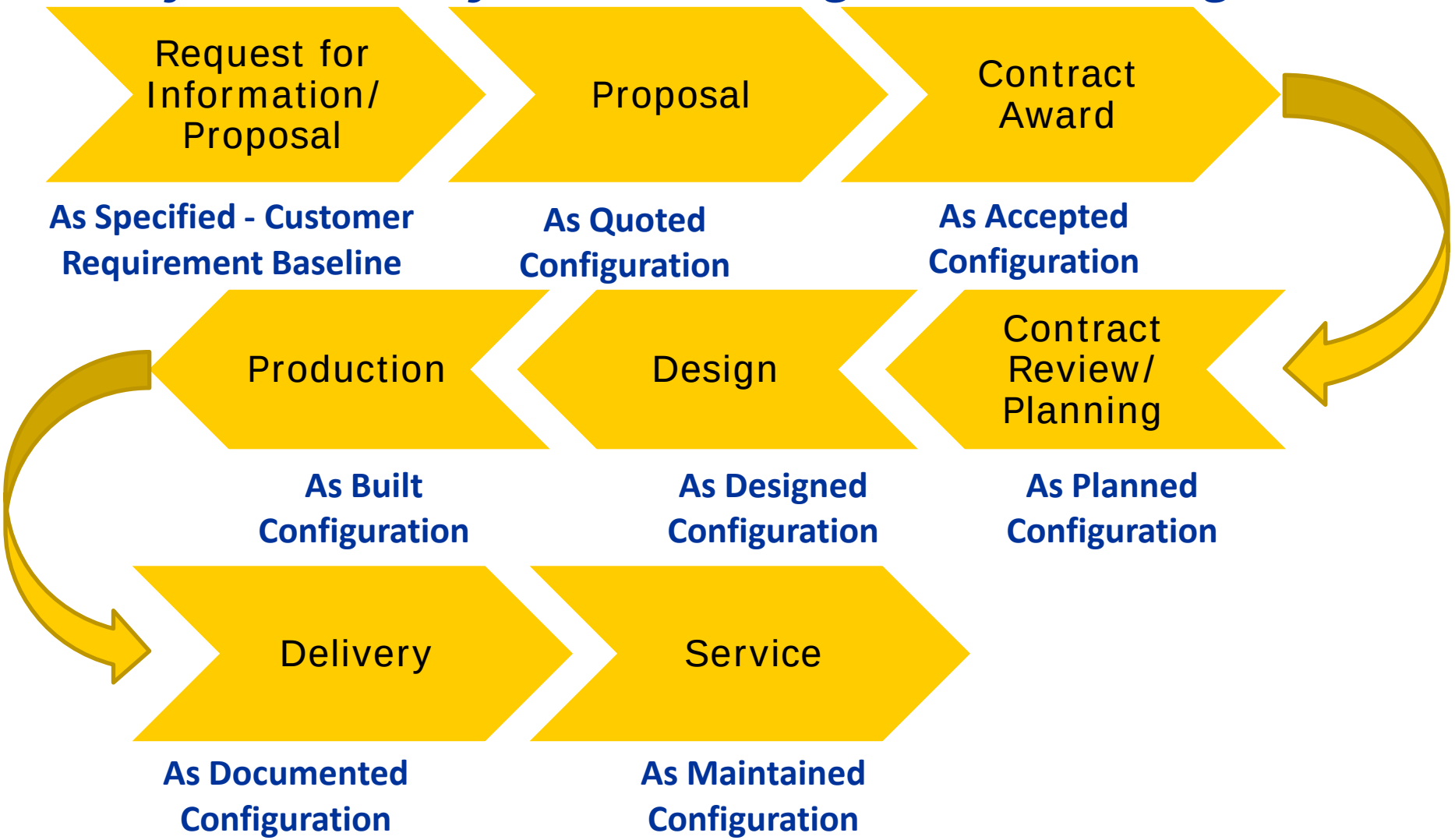
The organization shall control and document changes affecting processes, production equipment, tools or software programs.
The results of changes to production processes shall be assessed to confirm that the desired effect has been achieved without adverse effects to product conformity.

Post-delivery *support shall provide as applicable for the:*
…….
c) control and updating of technical documentation
……..

The organization shall maintain the identification of the configuration of the product in order to identify any differences between the actual configuration and the agreed configuration.
……
Where traceability is a requirement, the organization shall control the unique identification of the product and maintain records (see 4.2.4).
NOTE: Traceability requirements can include:
– identification to be maintained throughout the product life,
……..
– for an assembly, the ability to trace its components to the assembly and then to the next higher assembly, ……
NOTE: In some industry sectors, configuration management is a means by which identification and traceability are maintained (see 7.1.3).

7. The Configuration Continuum

Project Life Cycle – Configuration Progress



As Specified/Requirement Baseline (Request for Information/Proposal – RFI/RFP)

- As Specified/Requirement Baseline is the customer baseline. It is specified in the RFI/RFP and includes any allocated requirements, specifications, structure, configuration management requirements, etc.
- The customer expects to receive information/ proposal from the supplier including supplier attitude to the Requirement Baseline.

As Quoted Configuration (by the supplier)

- Following the RFI/RFP from the customer, the supplier prepares his response.
- In the response the supplier presents his attitude toward the implementation of customer requirements.
- The supplier proposes a configuration management plan in response to the customer's configuration management requirements.
- In some cases the proposed/quoted configuration differs from the As Specified configuration and thus it is the As Quoted baseline.

As Accepted Configuration (Configuration at Contract Award)

- This configuration includes the system requirements specification & the system interface specification as finally agreed by the customer and the supplier.
- The method to manage configuration baselines and changes is established at this stage.
- The As Accepted configuration serves as a basis for the next (planning/review) phase.

- Proper management and control of customer documents is a condition essential to the maintenance of a well regulated production process. The management and control of the customer's documents and drawings should be done as specified by the contract.
- The customer defines the configuration management requirements for the project. These requirements are applicable to all the actors of the project.
- The purpose of the CM plan is to define the process & resources for managing the configuration of the product in a controlled & traceable manner throughout the project life cycle.

As Planned Configuration (Contract/Review Planning)

- The As Accepted configuration is reviewed during initial stages of contract implementation.
- Mutually acceptable revisions to the configuration are included.
- As part of the allocated baseline the sub-systems' requirements & interface specifications are frozen towards the Preliminary Design Review phase (As Planned).

As Designed (By Engineering)

- The As Designed configuration may be accomplished in a few stages (as applicable to the contracted product):
  - System Requirements Review and System Design Review (SRR & SDR)
  - Preliminary Design Review (PDR)
  - Critical Design Review (CDR)
- The configuration at each stage should include block drawings, schematic drawings, design documents, design interfaces documents and Validation & Verification V&V documents. At each stage the configuration should be frozen and change control implemented.
- At As Designed configuration (after CDR) those documents are frozen.

As Built (By Production)

- The manufacturer must enable tracking from the finished product to the components and materials comprising it, in accordance with the type of the product and the contract requirements.
- During procurement, storage, production, assembly, and test, details & identification marking will enable the follow-up of the history of the item in all its stages.
- The level of traceability shall be specified and updated in accordance with contractual requirements.

As Built (By Production)- (cont'd)

- The traceability process shall allow, when required, the identification of all products manufactured from the same batch of raw material or from the same production batch as well as the delivery destination of all products from that batch. In addition, the process shall allow identification of all parts and components of products/assemblies defined as requiring tracking.

As Documented (in Delivery Documentation)

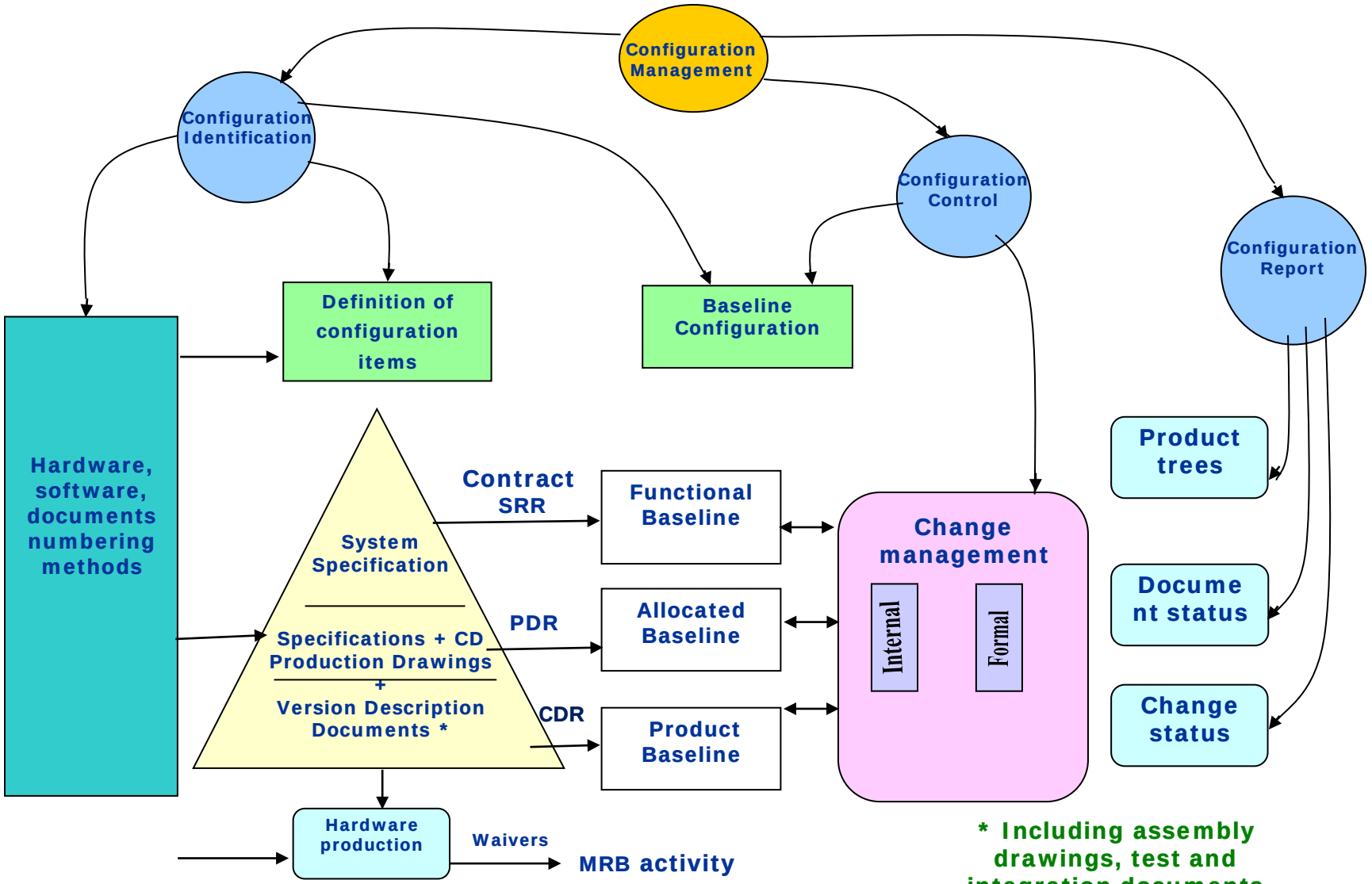
- An individual file will be issued for each item for which all the conditions specified below have been met, unless otherwise specified by contractual requirements:
  - Item have been tested according to their individual test procedures.
  - Item have been identified by individual serial numbers.
  - Item have been awarded a Serviceable tag upon completion of test.

As Maintained (Service Documentation)

- The maintenance contract should define the maintenance levels, and the infrastructure to be prepared.
- Involvement in product maintenance is set according to customer demands, which are decided upon receiving the customer's order.
- In certain cases, the demand will be to apply a specific maintenance policy in manufacturing and the design of the product, including the definition of needs in training, accompanying technical documentation, maintenance contract with the customer and suggestion of spare parts for initial provisioning.

8. Configuration Management Functions

CM Process Flow



Configuration Identification / Configuration Documentation

- **Product File:**

  Provides the engineering documentation needed to build and test the product:

  - Hardware
  - Software
  - Drawings and associated lists
  - Electronic media
  - Diagrams
  - Version Description Document (VDD)
  - Unique processes
  - Printed circuit card design
  - Acceptance test

- **Manufacturing File**

  Consists of the Product File, to which is added manufacturing operation sequences and processes.

- **Data File**

  Contractor Data Requirement List (CDRL) documentation required in addition to the product or manufacturing file – includes specifications, plans, analyses, tests, manuals, etc.

Configuration Manager's Task

- Establishment of Configuration policy.
- Release and submittal of configuration documentation in relation to program events.
- Establishment of internal developmental configuration and contractual baselines.
- Establishment of configuration control boards.
- Implementation of a status accounting information and provision of reports.

Configuration Manager's Task (cont'd)

- Account for and deliver Contractor Data Requirement List (CDRL) items.
- Prevent duplication of data.
- Apply change control.
- Identify and maintain status of data received & submitted.

Configuration Control Board

- Configuration Control Board (CCB) is a group of technical and administrative experts with the assigned authority and responsibility to make decisions on the configuration and its management.
- All proposed changes should be reviewed by the CCB to evaluate the change against the criteria and/or include as an alternate, not making the change.
- In addition, it should evaluate all aspects of the change to include design, performance, cost, schedule, operational effectiveness, and logistics considerations.

Configuration Control

- To maintain product control, no change may be implemented without an approved change order or approved deviation/waiver request.
- The Configuration Manager and the CCB members are responsible for the change control process.
- Configuration control is applied to established baselines, identifications and released engineering data.

Configuration Control (cont'd)

- Configuration control system should be established to provide for screening, classification and processes changes that provide fully coordinated, approved change packages.
- Configuration control should be applied to established baselines, identifications and released engineering data.
- Configuration control should be implemented in stages corresponding to the product life-cycle.
- Before reviews and establishment of baselines, control may be maintained manually by the development engineer or by use of automated tools as they are developed.

Configuration Control (cont'd)

- Upon freezing of the Bill Of Material (BOM) and the order to procure components, changes should be controlled by CCB.
- Manufacturing release should include implementation of all approved internal changes into the drawings.
- Formal change control will commence with successful completion of the production audit or with first delivery.

Configuration Report / Configuration Status Accounting

- Upon initiation of component procurement, changes will be tracked in the database for each document/drawing/list.
- Each hardware delivery will generate an As Planned/As Built Report reflecting the build of each unit.
- Configuration Status Accounting Reports (CSAR):
  - The configuration manager maintains CSAR for the purposes of internal control to assure compatibility of the product and its documentation, and producing the status accounting reports necessary for configuration visibility and traceability.
  - Feed-back from the As Planned/As Built Report provides confirmation of the implementation of changes, deviations, etc.

Configuration Audit

- The purpose of the Configuration audit is to verify that the configuration identification for a configured item is accurate, complete, and will meet specified program needs.
- There are two types of configuration audits:
  - Functional Configuration Audit (FCA) and
  - Physical Configuration Audit (PCA).
- Both audits must be satisfactorily completed by the project team members and the contractor as a prerequisite to establishing the product baseline.

Configuration Audit (cont'd)

- The results of the functional and physical configuration audits should be documented, reviewed and verified.
- Technical documentation and functional deficiencies detected during the audits will be corrected by change order.

9. CM vs. Engineering Change Control

TITLE: CABLE, LONG, ROUND, SLICK — CONTRACT NO. — DWG NO. — NO. 4477

REASON: CHANGE CABLE LENGTH

REMARKS – SUPPLIER INCORP ON UNIT

PURCHASING | LOGISTICS SUPPORT | DEPTS. AFFECT | CHG COORD. | FIRM PLANNING INCORP. | DATE | NCI | B/P DIST. | MFG ACTION

OUTSTANDING EO'S | EO'S INCORPORATED

EO | DD | DCN | EJS | CHANGE PROPOSAL DOCUMENT

WRITER | APPD | CHK | APPD | STR | APPD | GP ENG | CUST | LIA ENG | DATE ISSUED

DRAWING CONFORMS ☐ YES ☒ NO. CODE IDENT. 76301

REQUEST FOR ENGINEERING CHANGE

PRIORITY & CAT. | SUPP. SEQ. | DATE TO ENG

MDC DEPT/SUPPLIER | DISPOSITION

WRITER — RAW STOCK

APPD — ROUGH PARTS

APPD — FINISHED PARTS

APPD — TOOLS

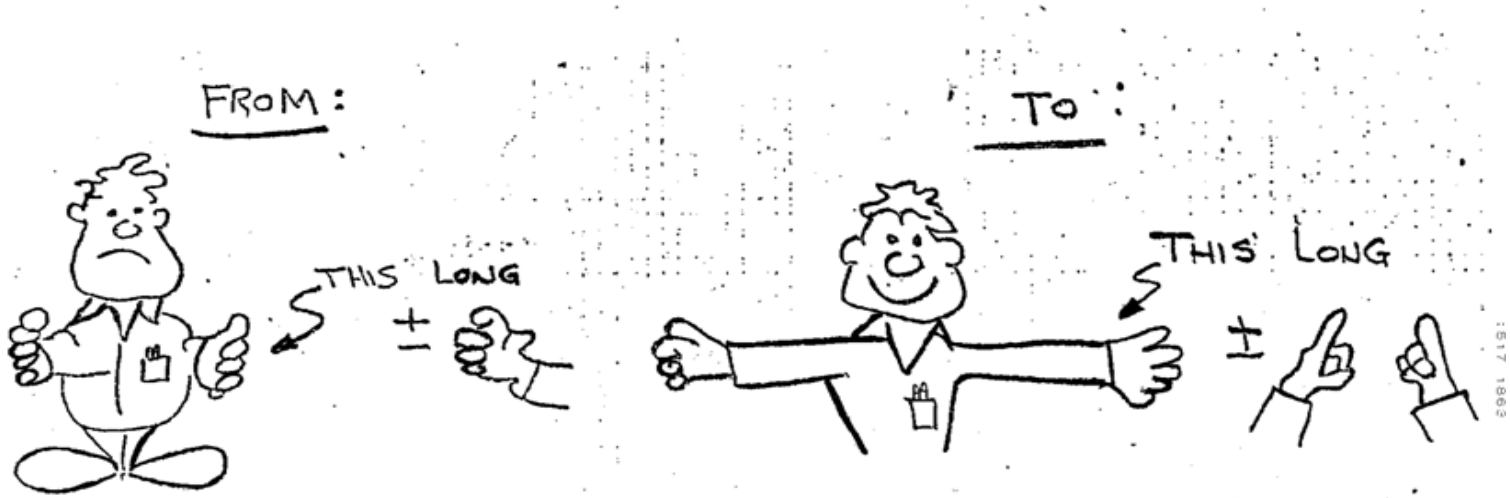
MODEL SERIES	EFFECTIVITY	NEXT ASSEMBLY	ASSY DASH NO.	QTY PER ART	CREATE SAME AS NO.	SUPERSEDES -EO-ING	MATERIAL CODE

#REISSUE

LTR	APPROVAL	DATE	LTR	APPROVAL

B/P DIST. CODE | DRAWING NUMBER

CHANGE CABLE LENGTH AS FOLLOWS:



CODE IDENT.	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	STOCK OR MAKE FROM PART NUMBER	FIND NO.	NOTE	-ED SUPERSED	-ING	MATERIAL
			MATERIAL			MATER		
			SUPPLIER NAME AND ADDRESS					

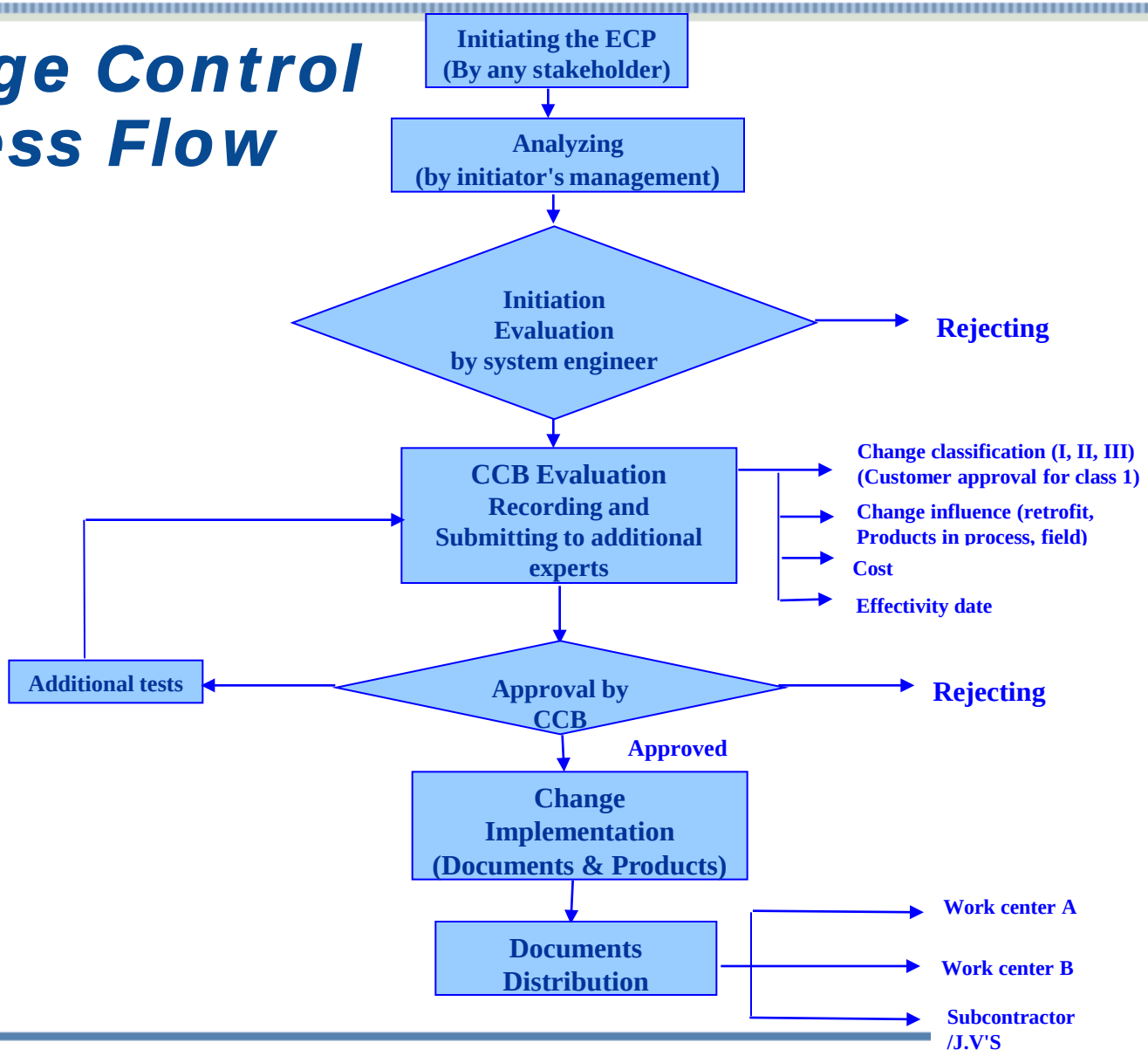
Introduction

- The aerospace and defense industries rely on the development and manufacture of complex products comprised of multiple systems, subsystems, and components each designed by individual designers (design activities) at various levels within the supply chain (by the customer or by any of the suppliers)
- Each design activity controls various aspects of the configuration and specifications related to the product

Introduction (cont'd)

- When a change to design information is requested or required, the change has to be evaluated against the impacts to the higher level system, as detailed in "Notice of Change Requirements" (AS9016).
- A change request can be initiated by any of the stakeholders: customer, prime contractor, supplier, etc.

Change Control Process Flow



- Design activities must meet the Quality System Requirements and Customer Agreements before implementation of changes as follows:
  - Changes that Require Customer Acceptance Prior to Implementation
  - Changes that May Require Acceptance Prior to Implementation
  - Changes Implemented Concurrent with Notification for Customer Acceptance
  - Non-Configuration changes

- Design activities shall create a Notice of Change (NoC) or Engineering Change Notice (ECN) and implement the change. The design activity shall either submit the NoC to the customer or make all NoC records available for review, depending on customer requirements.
- The activities required are:
  - Approval of Design Activity to Perform Change Impact Assessments
  - Requirements for Data Submission of NoC
  - Record Retention

What is an Engineering Change?

- Changing the Product Structure (Bill Of Materials)
  - Adding a part
  - Deleting a part
  - Changing the quantity per assembly
- Changing the Part Itself
  - Changing specifications
  - New Part Number
  - Changing approved sources?
- Changing the Routing
- Changing the Process
- Changing the process sequence

- The Engineering process have three main milestones to start an engineering change control process:
  - Functional Baseline (FBL)
    - As part of the FBL, the following engineering documents are released;
      - System Specification
      - System Requirements
      - System Interface Definition/Specification
    - Following the SDR & SRR, these documents are frozen.

- Allocated Baseline (ABL)
  - As part of the ABL, the following engineering documents are released;
    - Sub-Systems Specifications
    - Sub-Systems Interface Specifications
  - Following the PDR, these documents are frozen
- Product Baseline (PBL)
  - As part of the PBL, all engineering documents are released;
  - Following the CDR, these documents are frozen

- After all engineering documents are released & frozen (per the Baselines), changes need to be done due to the following items:
  - Design
  - Performance
  - Reliability
  - Safety
  - Production
  - Drawings errors
  - As results of operation, maintenance
  - Change or new configurations (marketing)
  - As a result of a failure requiring Engineering Change

- The Change Control Process is performed by a Change Control Board (CCB).
- Engineering, Production, Purchasing, Customer, Subcontractors are permitted to ask CCB to handle any change request
- The Change Control Process includes two types of changes:
  - Major Change (Class 1 change)
  - Minor Change (Class 2 change)

- Major Change is defined as a change in at least one of the following parameters (FFFFLS):
  - F- Form (What does it look like)
  - F- Fit (How does it interface)
  - F- Function (What does it do)
  - F- Fee/Cost (What should we charge for it)
  - L- Logistics
  - S- Safety
- Major change requires new part number
- Major change needs customer's approval
- Any other change is a Minor Change with no necessity to change the part number

What must an Engineering Change Proposal do?

- Tell us WHAT to change
- Show us HOW to make the change
- Tell us WHEN
  - Applicability (implementation)
- Tell us WHO
  - Define tasks and assign responsibilities
- Show us WHERE
  - What documents, parts, purchasing
- Tell us WHY
  - Really explain the reasons

- The Engineering Change Proposal (ECP) should present to the stake-holders all the data needed to approve or disapprove an Engineering Change
- The approval procedure needs to refer to the following:
  - Is the change justified?
  - Is the change a must ?
  - Can it be implemented ?
  - What could be the results if the ECP is not approved?

- The Engineering Change Proposal (ECP) should present the following data:
  - General Data
    - ECP Number, Title, Major/Minor change, reason of change
  - Argument for change
    - Source of problem, description and justification of change, solution description of change
  - Impact of change
    - Number of items and drawings effected, dealing with produced items
    - Effect on reliability, safety, changeability, interface, software, spare parts
    - Change initiating project/product
    - Additional affected projects/products
    - Instructions for inventory

- Change Cost
  - Cost in engineering departments (design and drawing revision)
  - Cost in production engineering (Route Cards, tools)
  - Purchasing & Manufacturing Cost
  - Cost of change implementing at the customer
  - Cost includes working hours and materials
- Change Validity
  - From which point in time a S/N change is implemented, and where (production line, storage, maintenance, ILS)
- Change Priority
  - Change Priority is determined by Project Manager or Customer

- Consolidating Change Order (Consolidating ECO)
  - It is possible to consolidate several change orders in order to reduce the effort related to CCB activities.
  - A combined change order combines a number of change orders which refer to the same CI for simultaneous implementation.

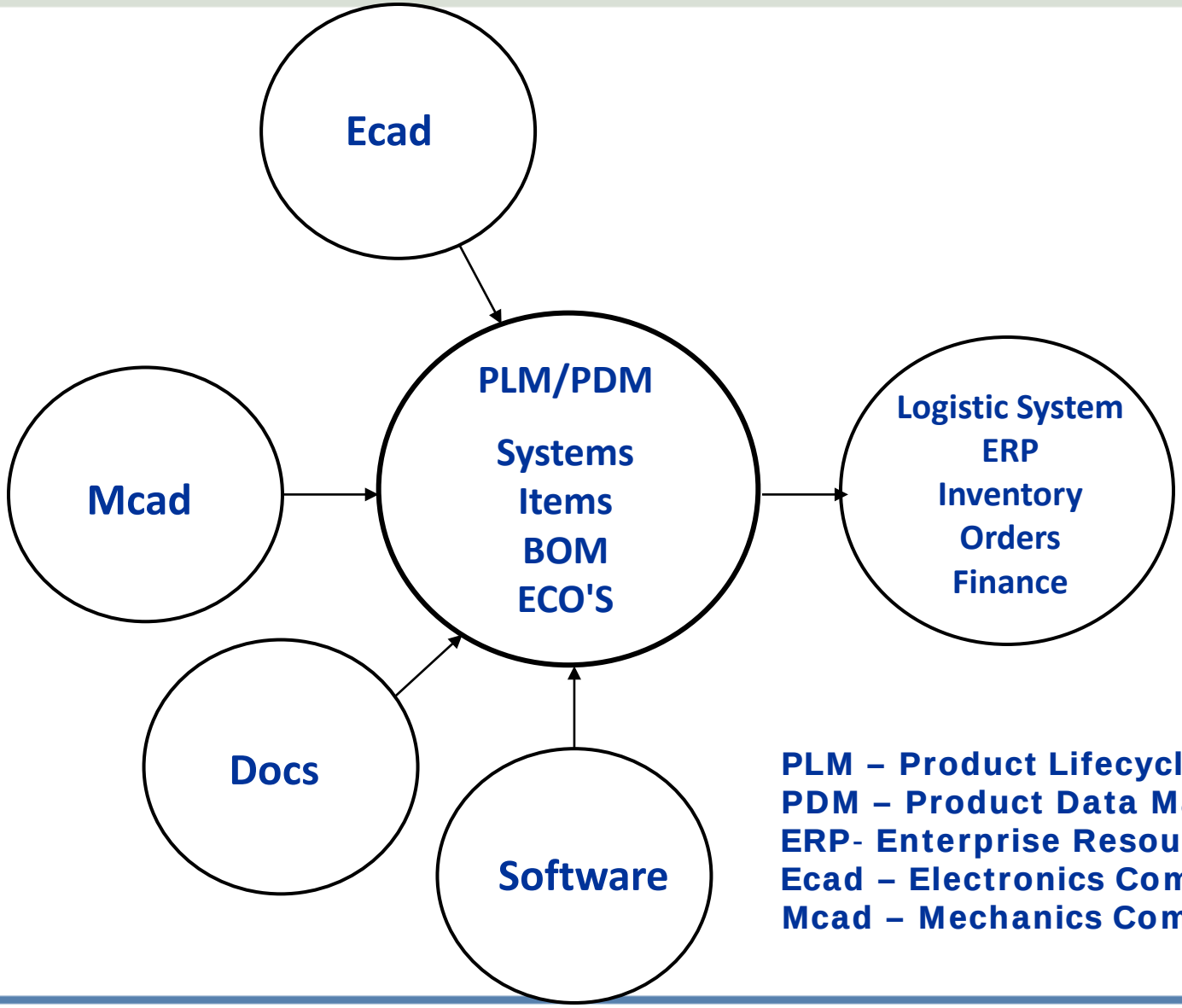
Effectivity of Change

- By Revision Letter
  - Engineering's preference
- By Dates
  - Do not use before, do not use after
- Other methods (needs)
  - Use to depletion of old part
  - Lot (batch) Number
  - Project (contract) Number
  - Customer Number
  - Purchase Order Number
  - Serial Number

- How should the ECN timing be dealt with?
  - If high priority: Stop work and fix
    - The sun will not set before preliminary action is taken
  - Otherwise:
    - Define Effectivity and schedule into the manufacturing, planning and execution process:
      - Plan for least disruption and part obsolescence
      - No more than 2-3 working days until preliminary release
    - Aggregate and hold for product upgrade
      - Batch release no less often than quarterly

10. Configuration Management Tools

CM Systems Relationship



PLM – Product Lifecycle Management
PDM – Product Data Management
ERP- Enterprise Resources Planning
Ecad – Electronics Computer Aided Design
Mcad – Mechanics Computer Aided Design

- Implementation of Configuration Management requires use of a computerized system which can be simple or comprehensive depending on the type and size of organization.
- Usually the CM should be accomplished using information management systems.
- Many organizations use ERP & PDM systems:
  - The ERP system manages logistic objects: stock, orders, human resources, finance… (examples: Oracle Applications, SAP, Priority…)
  - The PDM system manages engineering objects: Items, BOM, ECO‘s… (examples: Teamcenter, Agile, Enovia…)

- Ecad & Mcad systems usually have some configuration tools but in most of the organizations the configuration management is managed in the PDM.
- Usually there are interfaces between the systems. The ERP system has interfaces with the PDM in order to transfer items & BOM.
- Ecad & Mcad systems have interfaces with the PDM in order to transfer the documentation files.
- Software configuration systems usually don't have interfaces with other systems. Software configuration is managed using tools like Clearcase & Clearquest. The software files which are needed for production are transferred to the PDM system.

11. Summary

- Configuration Management, is a discipline widely used in the acquisition of defense systems as well as for commercial products and services.
- When Configuration Management principles are applied using effective practices, return on investment is maximized and product life cycle costs are reduced. The small investment in resources necessary for effective Configuration Management is returned many fold in cost avoidance.
- Configuration Management (CM) applies appropriate processes and tools to establish and maintain consistency between the product and the product requirements and attributes defined in product configuration information.

- A disciplined CM process ensures that products conform to their requirements and are identified and documented in sufficient detail to support the product life cycle.
- CM assures accurate product configuration information and enables product interchangeability and safe product operation and maintenance to be achieved.
- CM implementation requires a balanced and consistent implementation of CM functions, principles, and practices throughout the product life cycle. CM facilitates orderly identification of product attributes and provides control of product information and product changes used to improve capabilities; correct deficiencies; improve performance, reliability, or maintainability; extend product life; or reduce cost, risk or liability.

- Although product configuration information does not include project or administrative types of information (e.g., schedules, plans, and cost information), these types of information may also be placed under Configuration Control.

12. Resources

- AAQG AS9016
  - "Notice of Change (NOC) Requirements"
- ANSI/EAI – 649
  - "National Consensus Standard for Configuration Management"
- ECSS-M-ST-40
  - "Space Project Management – Configuration Management"
- IAQG 9100
  - "Quality Management System"
- ISO 10007
  - "Quality Management Guidelines for Configuration Management"
- MIL – HDBK-61A
  - "Configuration Management Guidance"
- MIL-STD-973 (obsolete/but available)
  - "Configuration Management"