



Configuration Management

**2010 NDIA SEI CMMI Conference
Denver, Colorado**

*To
Al Florence*

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Presentation Contents

- ➔ ■ Introduction
 - Reasons for Configuration Management (CM)
 - CM Concepts
- Formal CM
 - Formal Baselines and Configuration Items (CIs)
 - Configuration Control Boards (CCBs)
 - Supported with Technical Review Boards (TRBs)
 - Change Control
 - CM Audits and Status Accounting
- Internal CM
 - Internal Baselines
 - CM of Design, Code, Hardware Items, Test Articles
- Operation CM
 - During Operation / Maintenance
- References

Why CM?

- **CM ensures that the current configuration of items are known throughout their lifecycle**
- **CM ensures that changes to the configuration of evolving items are correct, controlled, managed, and documented**
- **CM helps manage complexity, interface dependencies, increases security, and recovery from errors**

What is CM?

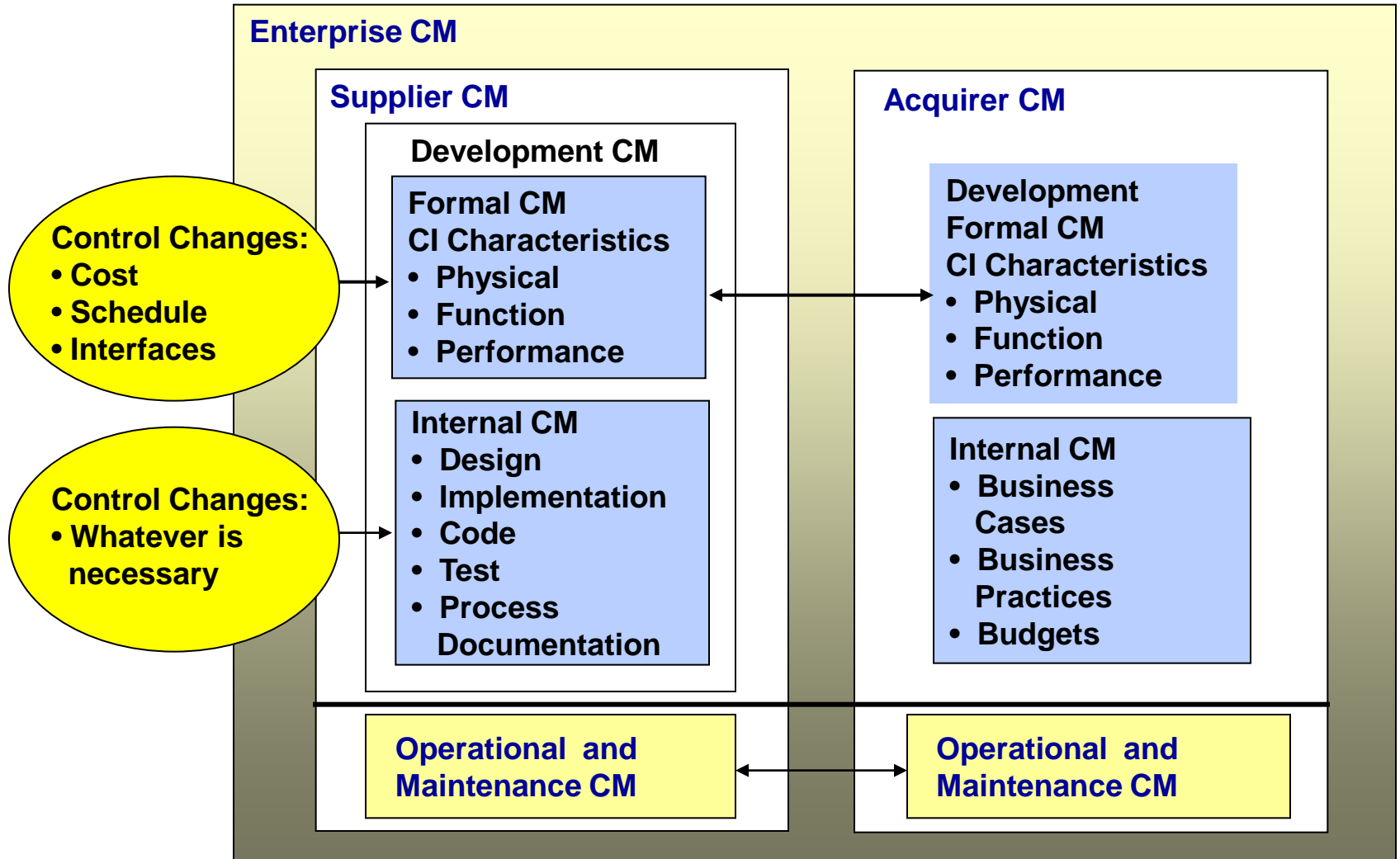
- **CM is a discipline applying technical and administrative direction and surveillance to:**
 - **Identifying and documenting the physical, functional, and performance characteristics of items**
 - **Baselining those characteristics**
 - **Controlling changes to those characteristic**
 - **Providing status on those characteristics**
 - **Conducting audits on those characteristics**
- **The CM tasks that produce these results are:**
 - **Configuration Planning**
 - **Configuration Identification**
 - **Configuration Control**
 - **Configuration Status Accounting**
 - **Configuration Management Audits**

Application of CM

- **The CM concepts presented in this course can be applied to:**
 - **Hardware (H/W)**
 - **Software (S/W)**
 - **Facilities**
- And their appropriate documentation**

**During Development and Operation by the
Acquirer and Supplier**

Some Levels of CM



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- ➔ ■ Formal CM

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- Configuration Control Boards (CCBs)
 - Supported with Technical Review Boards (TRBs)
- Change Control
- CM Audits and Status Accounting

- Internal CM

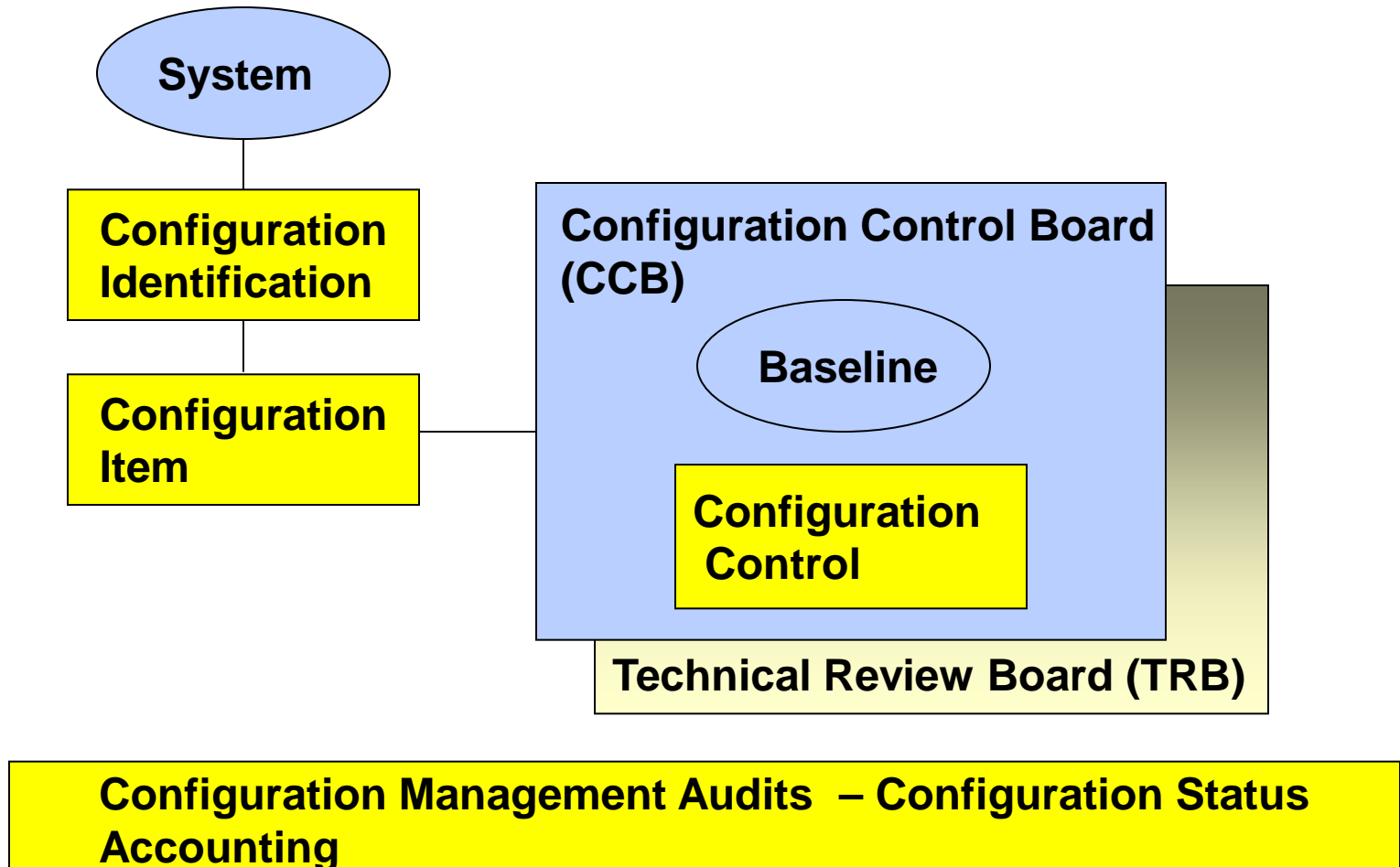
- Internal Baselines
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Configuration Management Overview



Configuration Identification continued

- Three level of Configuration Identification are established

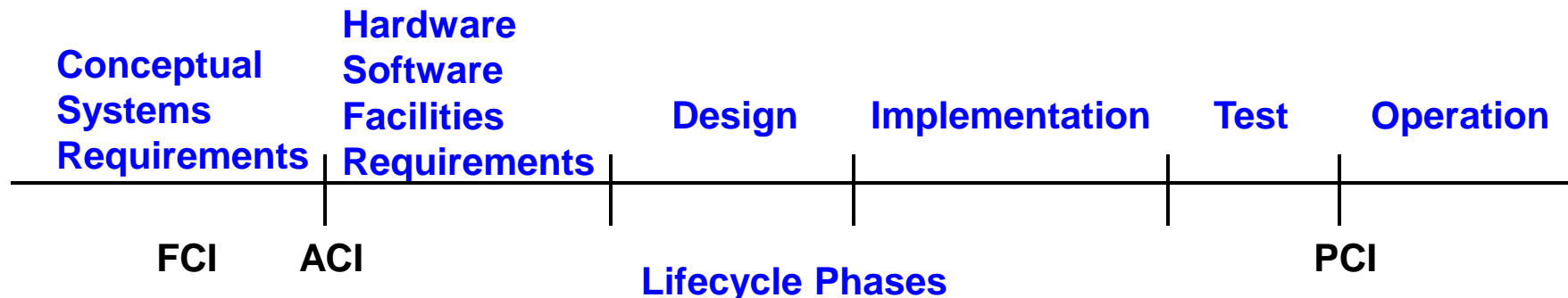
- Functional Configuration Identification (FCI)



- Allocated Configuration Identification (ACI)



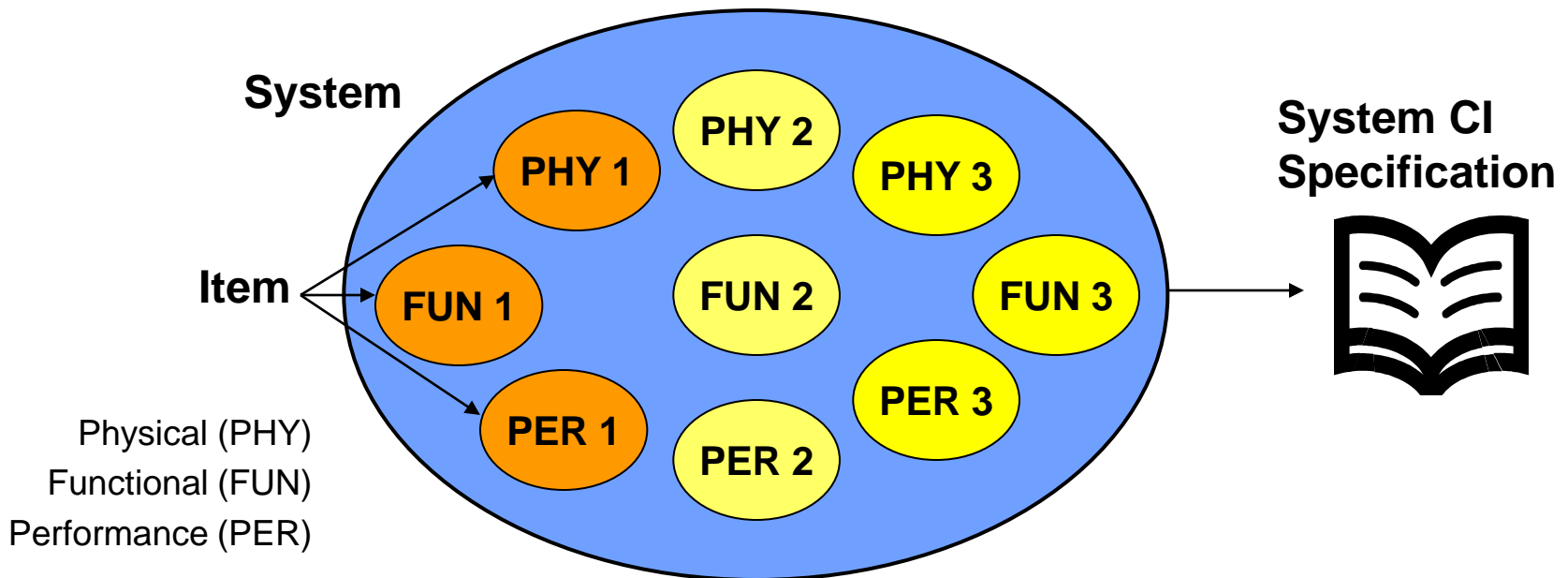
- Physical Configuration Identification (PCI)



Functional Configuration Identification

Functional Configuration Identification (FCI)

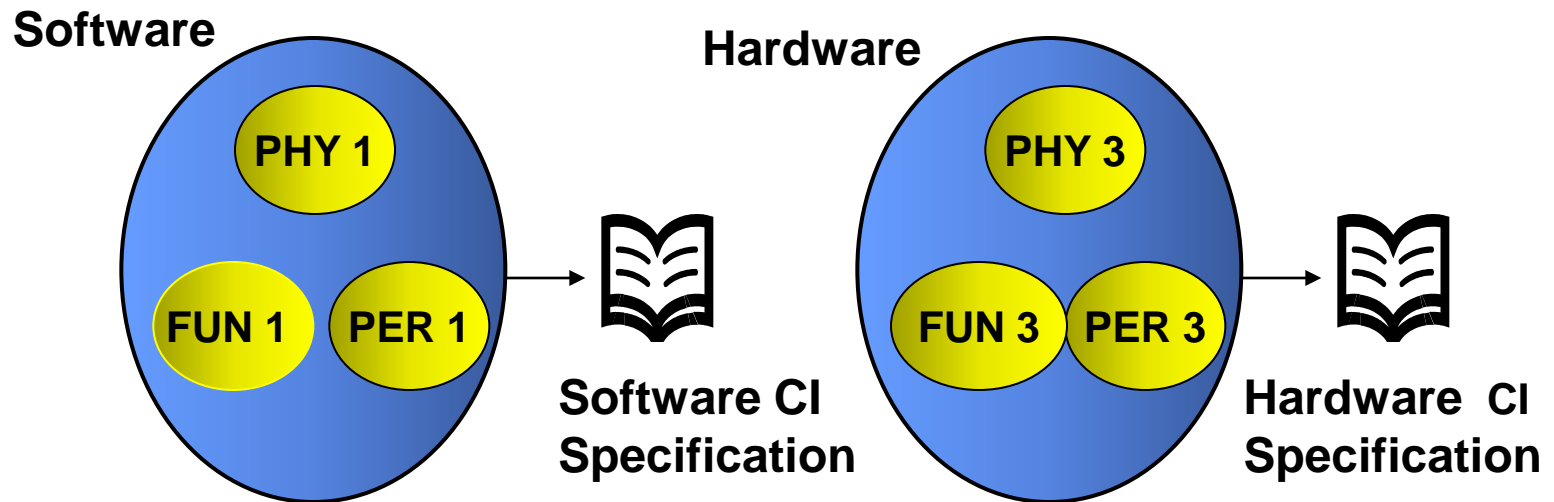
The identified system and system items and their physical, functional, and performance characteristics which are documented in a System Specification



Allocated Configuration Identification

Allocated Configuration Identification (ACI)

Later in development the physical, functional, and performance characteristics of the system are allocated to lower level entities: software, hardware, facilities, and are documented as Allocated Specifications for requirements

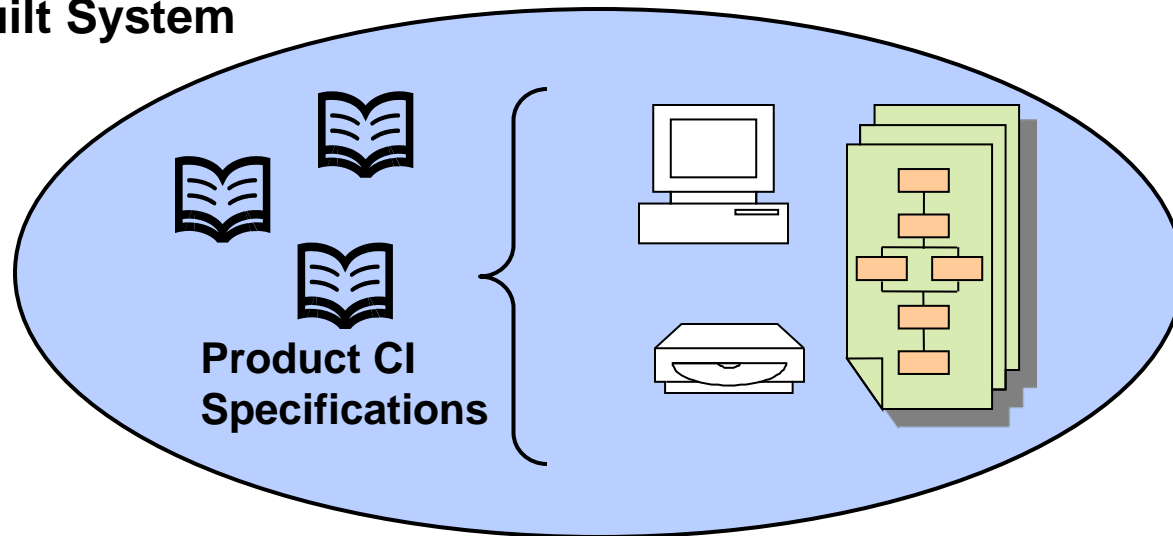


Physical Configuration Identification

Physical Configuration Identification (PCI)

Finally, the products of the developed system: software, hardware, facilities are defined in a series of Product Specifications that describe the as-built system

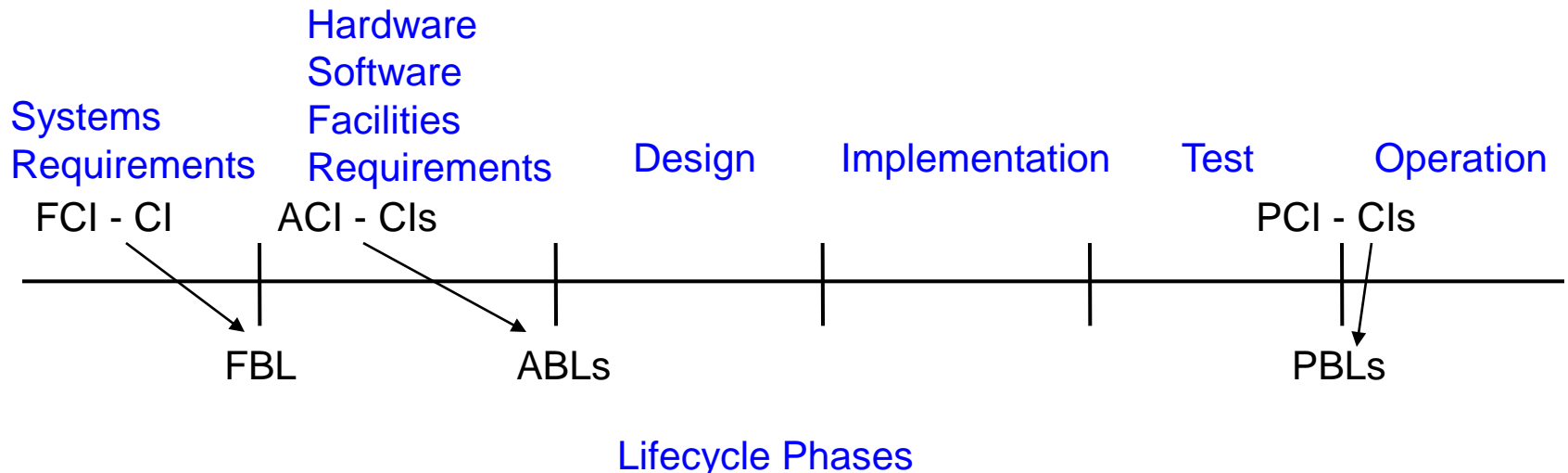
As-built System



Formal Baselines

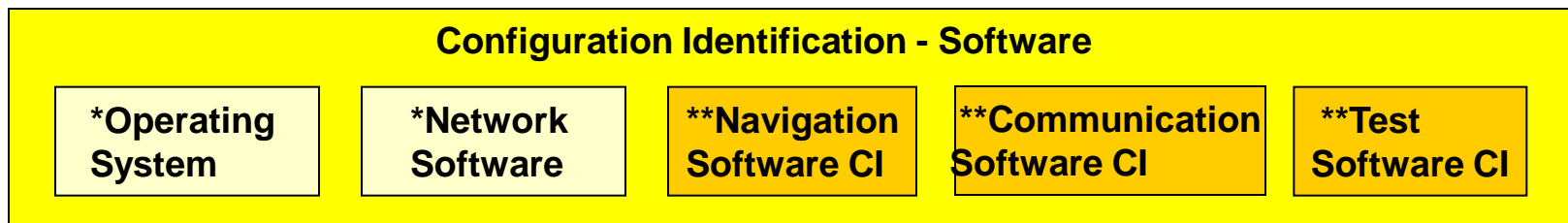
Baselines are established at strategic points in a system lifecycle. Three baselines may be defined

- Functional Baseline (FBL)
- Allocated Baseline (ABL)
- Product Baseline (PBL)



Configuration Identification and Configuration Items

- Configuration Identification is an activity that identifies items and their characteristics: physical, functional, and performance
- Not all items that are identified need be controlled at the same level of rigor
- Configuration Items are selected for **formal change control** from items identified

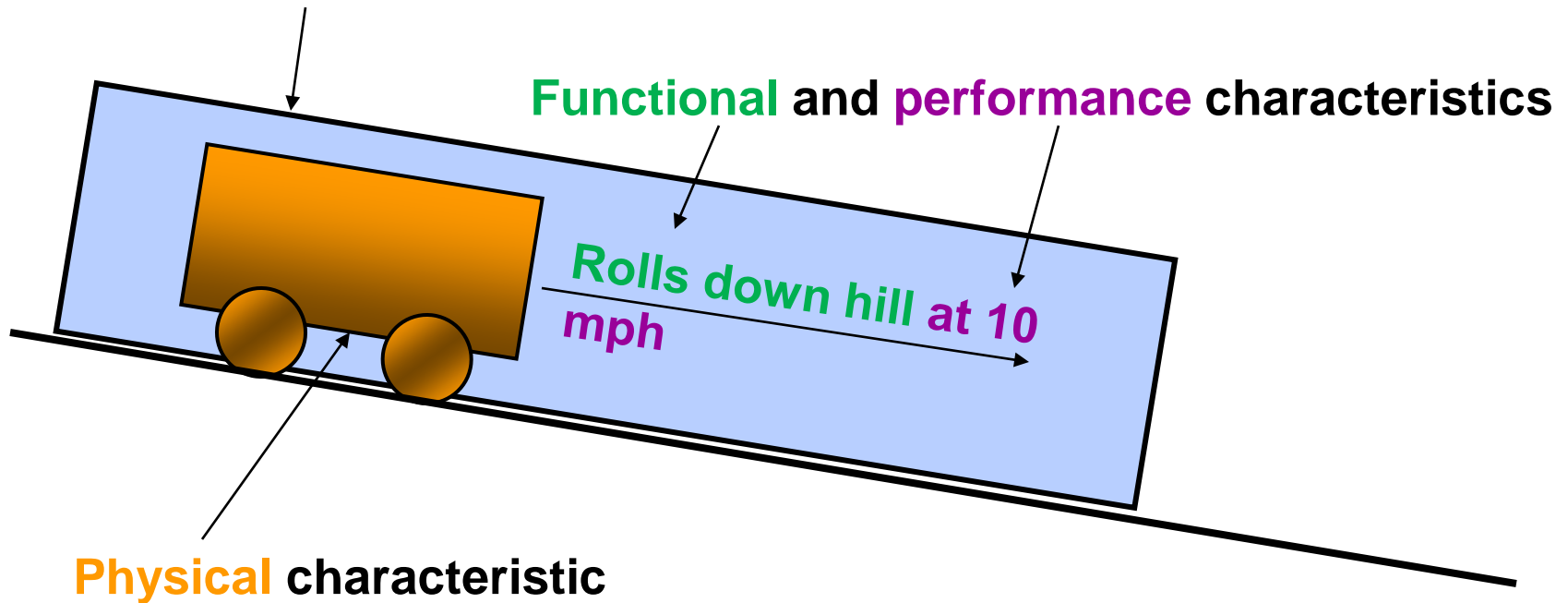


*Commercial products **MAY** not be subject to change – In operation everything is under CM control

**Applications software in development that is subject to change

Configuration Item

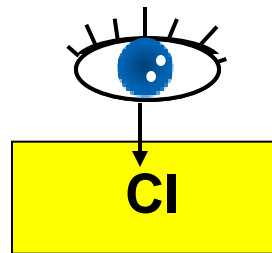
Represents the characteristics of a Configuration Item



Baseline vs. Configuration Items

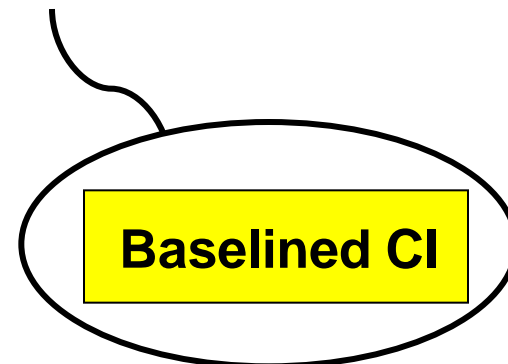
- The approved and fixed (baselined) configuration of a CI at a specific time in its lifecycle that serves as a reference point for change control

CI's are used for visibility



Visibility

Baselines are used for control



Control

Configuration Control

- **The systematic**

- evaluation
- coordination
- approval or disapproval, and
- implementation

of changes to the physical, functional, and performance characteristics of a baselined CI

- **Changes are requested with a Change Request (CR) form**

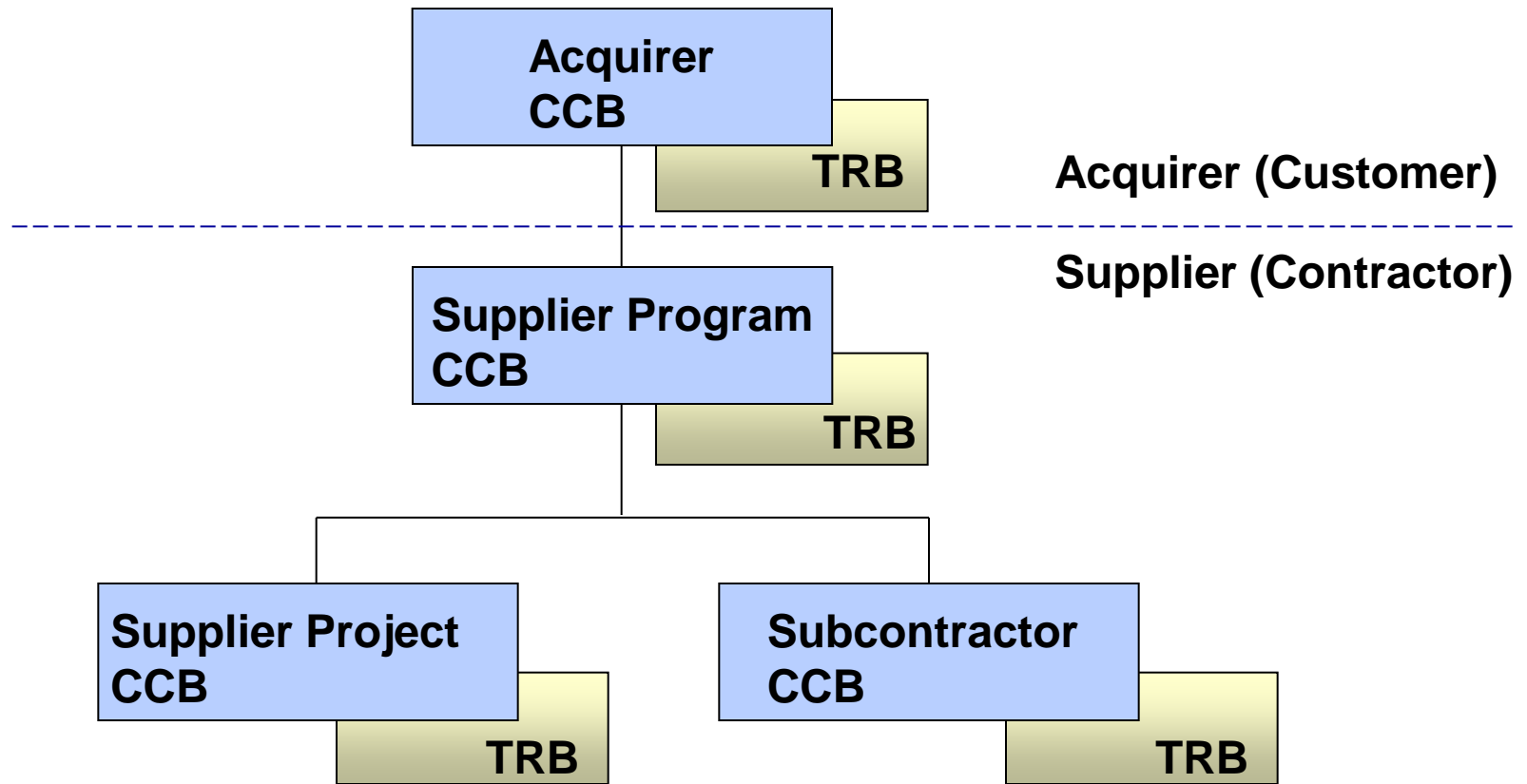
Configuration Control Board (CCB)

- Establishes baselines for CIs
- Reviews and approves / disapproves / defers Change Requests to CIs
- Membership comprised of management, and other stakeholders and supported by the subject matter experts
 - Project Management
 - Systems Engineering
 - Software/Hardware Engineering
 - Test Engineering
 - Quality Assurance
 - Configuration Management
- Chaired by the program / project manager or designee

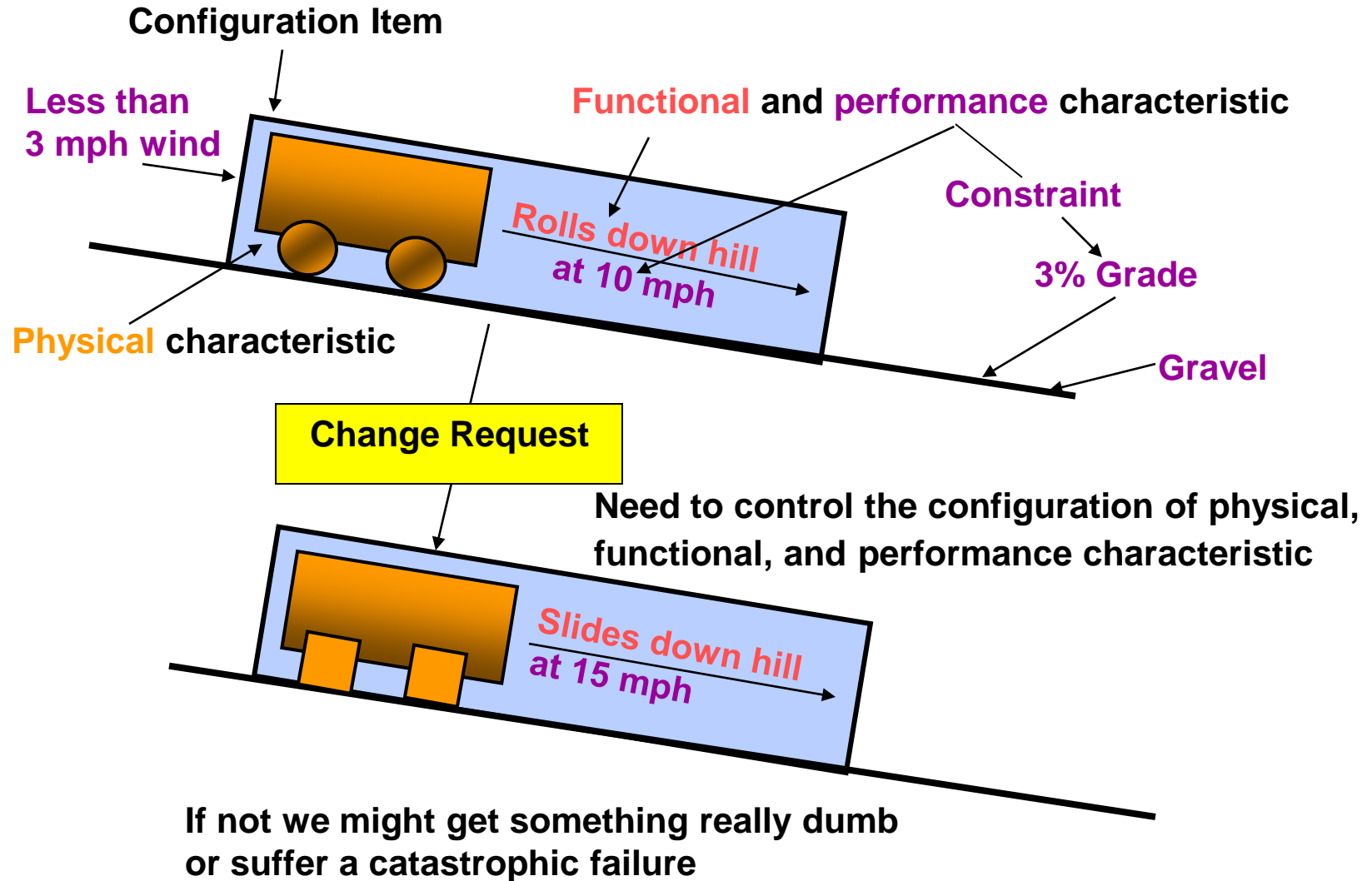
Technical Review Board (TRB)

- **Provides technical and programmatic support to the CCB**
 - **Conducts impact assessment on CRs to baselined CIs**
 - **Makes approval / disapproval recommendations to the CCB**
- **Membership comprised of program / project personnel and subject matter experts**
- **Chaired by a technical manager**

CCB and TRB Hierarchy



Configuration Control

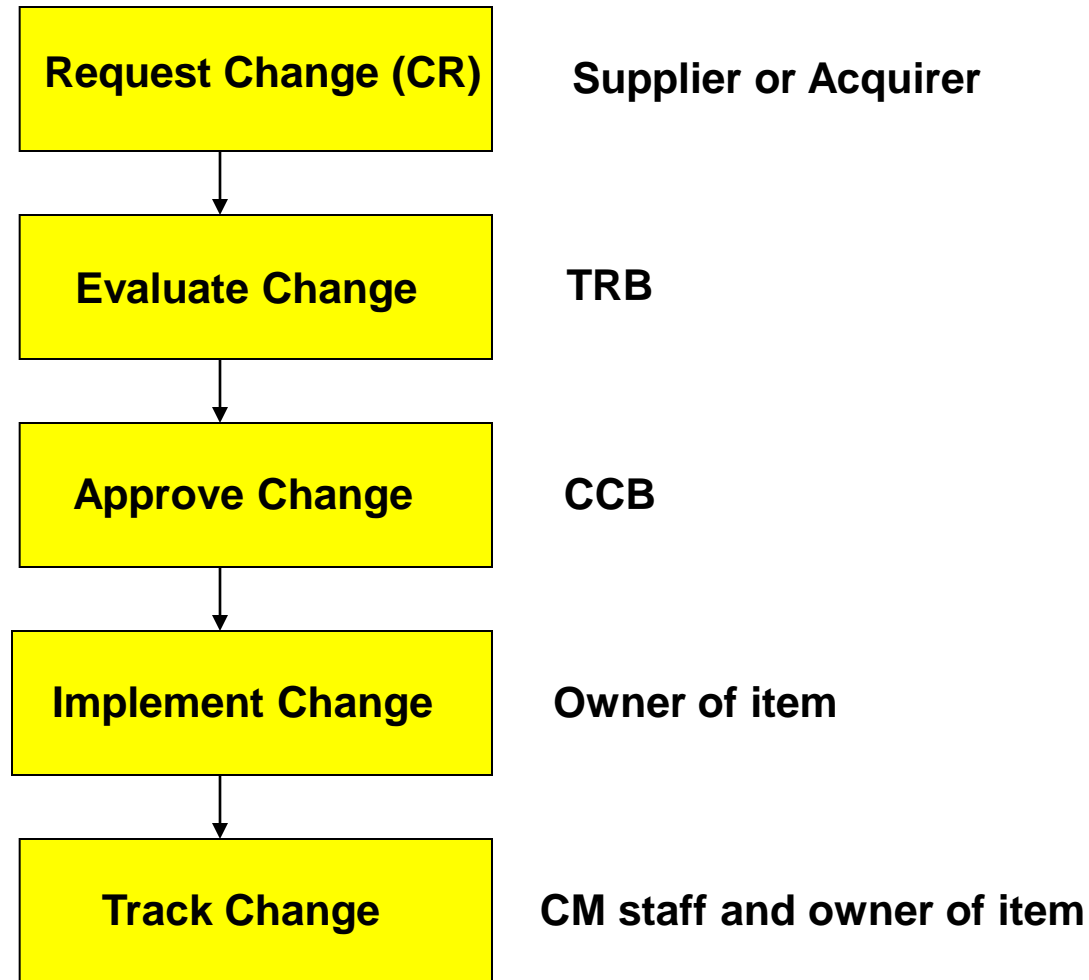


CR Example

Change Request

CR #	Date: 12/4/2003	Requestor: ET	Class: I <input type="checkbox"/> II <input type="checkbox"/>
Problem: A requirement to deploy the probe's parachute does not exist			
Change: Add the following requirement: The probe's parachute shall be deployed .01 second after the heat shield has been jettisoned			
Impacts: Enter figures for cost and schedule and list affected interfaces or "None" and attach impact assessments			
Systems: Hardware: Software: Test: Configuration Management: Quality Assurance: Contracts: Other [Specify]:			
Approve:	TRB Date:	Chair:	
	CCB Date:	Chair:	
Disapprove:	TRB Date:	Chair:	
	CCB Date:	Chair:	
Assignee:	Due Date:		

Change Flow



Impact Assessments

- **Impact assessments need to be conducted by all stakeholders:**
 - **Systems**
 - **Hardware**
 - **Software**
 - **Test**
 - **Configuration Management**
 - **Quality Assurance**
 - **Contracts**
 - **Others**

- **On CI characteristics:**
 - **Physical**
 - **Functional**
 - **Performance**

- **Against their interests:**
 - **Cost**
 - **Schedule**
 - **Interface**

Classification of Changes

At least two types of changes can be defined:

- **Class I**—affects the Acquirer’s interest in one or more of these factors:
 - Physical characteristics
 - Functional capability
 - Performance
 - External interfaces
 - Cost
 - Schedule

Supplier must submit change to the Acquirer for approval before implementation

Classification of Changes concluded

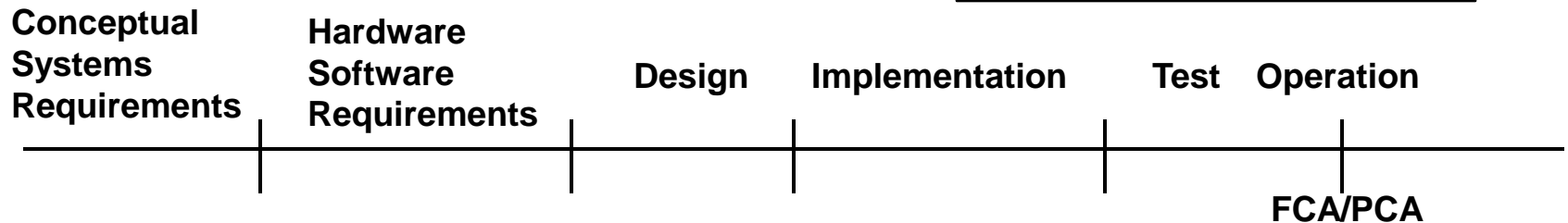
- **Class II** - Does not affect any of the Class I factors, affects changes such as:
 - Spelling or typographical errors
 - Addition of clarifying comments
 - Changes that do not affect external interfaces, change functionality or degrade performance

**Supplier may implement it without Acquirer's approval
but must inform Acquirer of change**

CM Audits

- Functional Configuration Audits (FCA) and Physical Configuration Audits (PCA) are conducted by Engineering and facilitated by CM and/or Quality Assurance (QA)
- Other audits conducted by QA and CM may include:
 - Audits of CM Repository that contains CM records, documentation, processes, procedures, artifacts, etc.
 - Audits of Program/Project organizations to ensure CM process is being followed
 - Audits of status of approved CRs
 - Audits to ensure that CIs are consistent with CM records

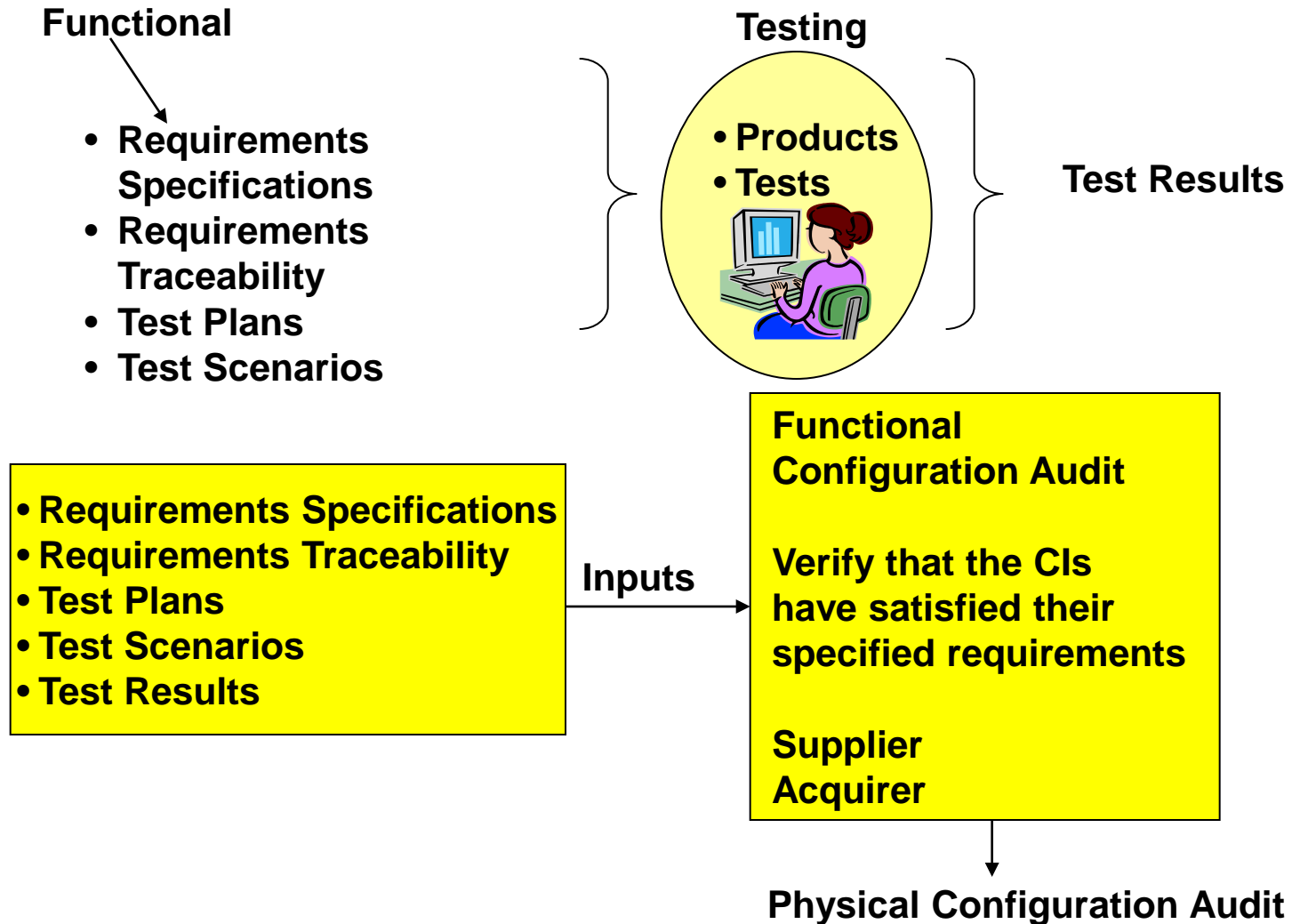
PCA can be prolonged
until after Operational Tests
If necessary



Functional Configuration Audit (FCA)

- A formal examination of test results of the as-built functional configuration of CIs, prior to acceptance, to verify that the CIs have satisfied their specified requirements
- This audit is conducted by the Supplier for the Acquirer and attended by
 - Management
 - System Engineering
 - Hardware / Software Engineering
 - Test Engineering
 - QA and CM
 - Contractsof both the Acquirer and Supplier

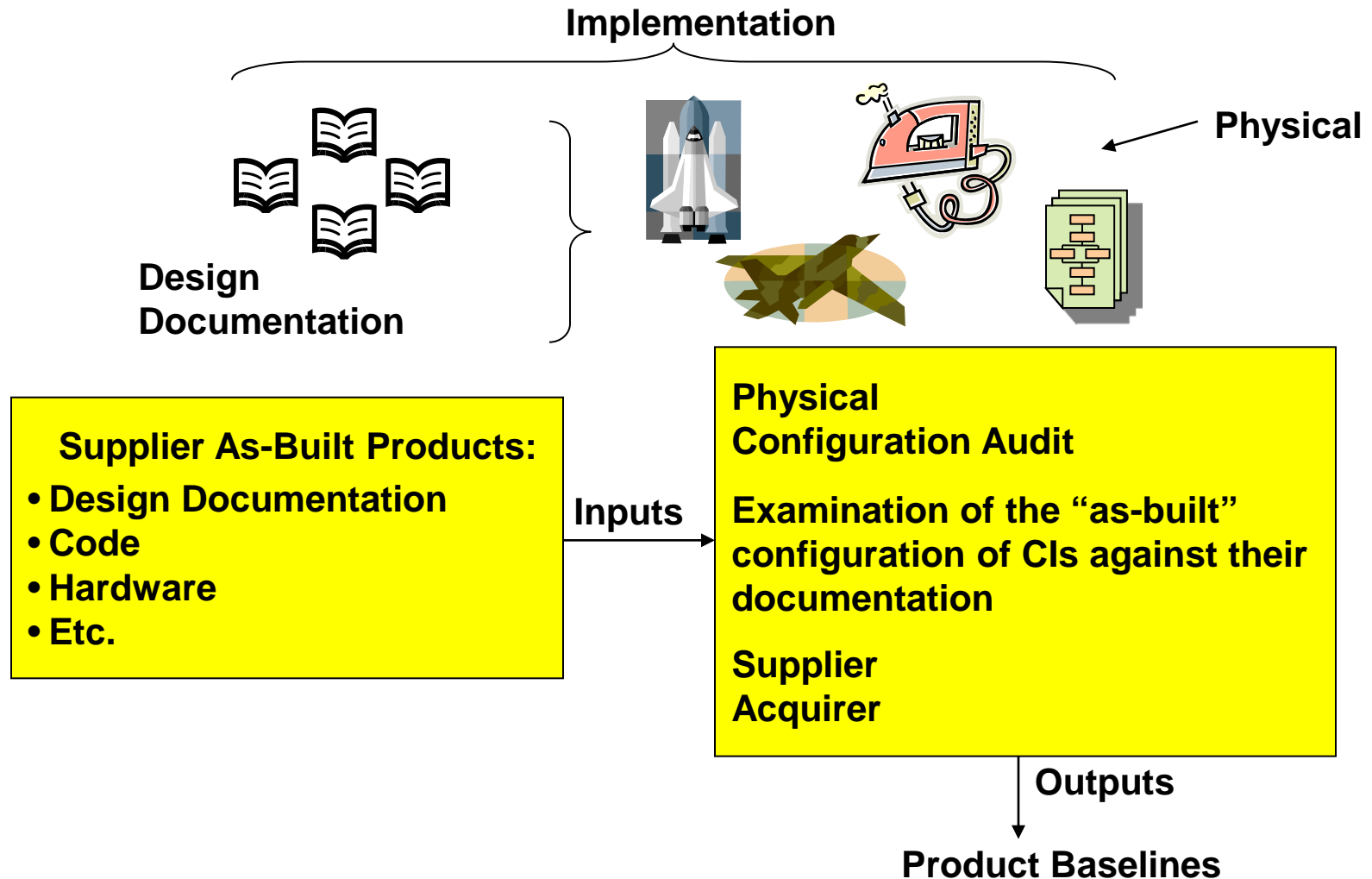
Functional Configuration Audit continued



Physical Configuration Audit (PCA)

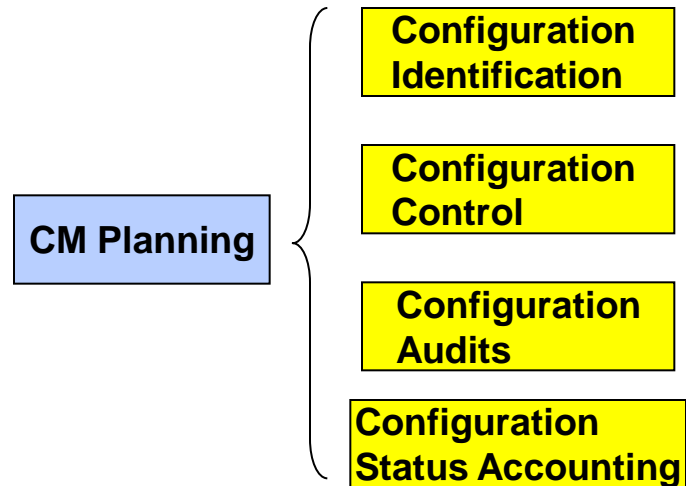
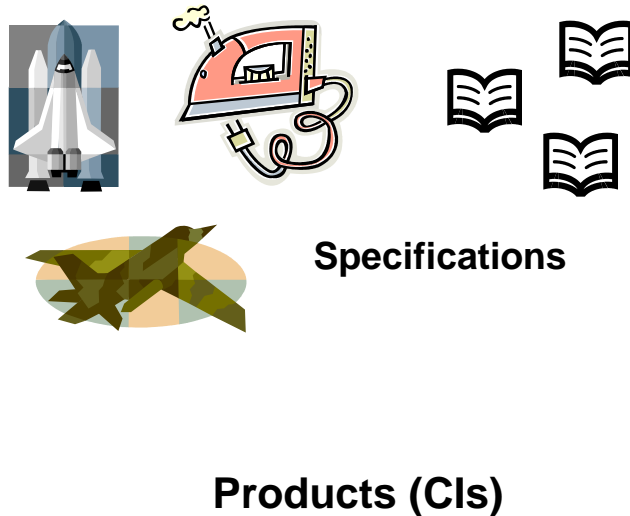
- A formal examination of the as-built physical configuration of CI products against their design documentation
- This establishes the Product Baseline
- This audit is conducted by the Supplier for the Acquirer and attended by
 - Management
 - System Engineering
 - Hardware / Software Engineering
 - Test Engineering
 - QA and CM
 - Contractsof both the Acquirer and Supplier

Physical Configuration Audit continued



Configuration Status Accounting (CSA)

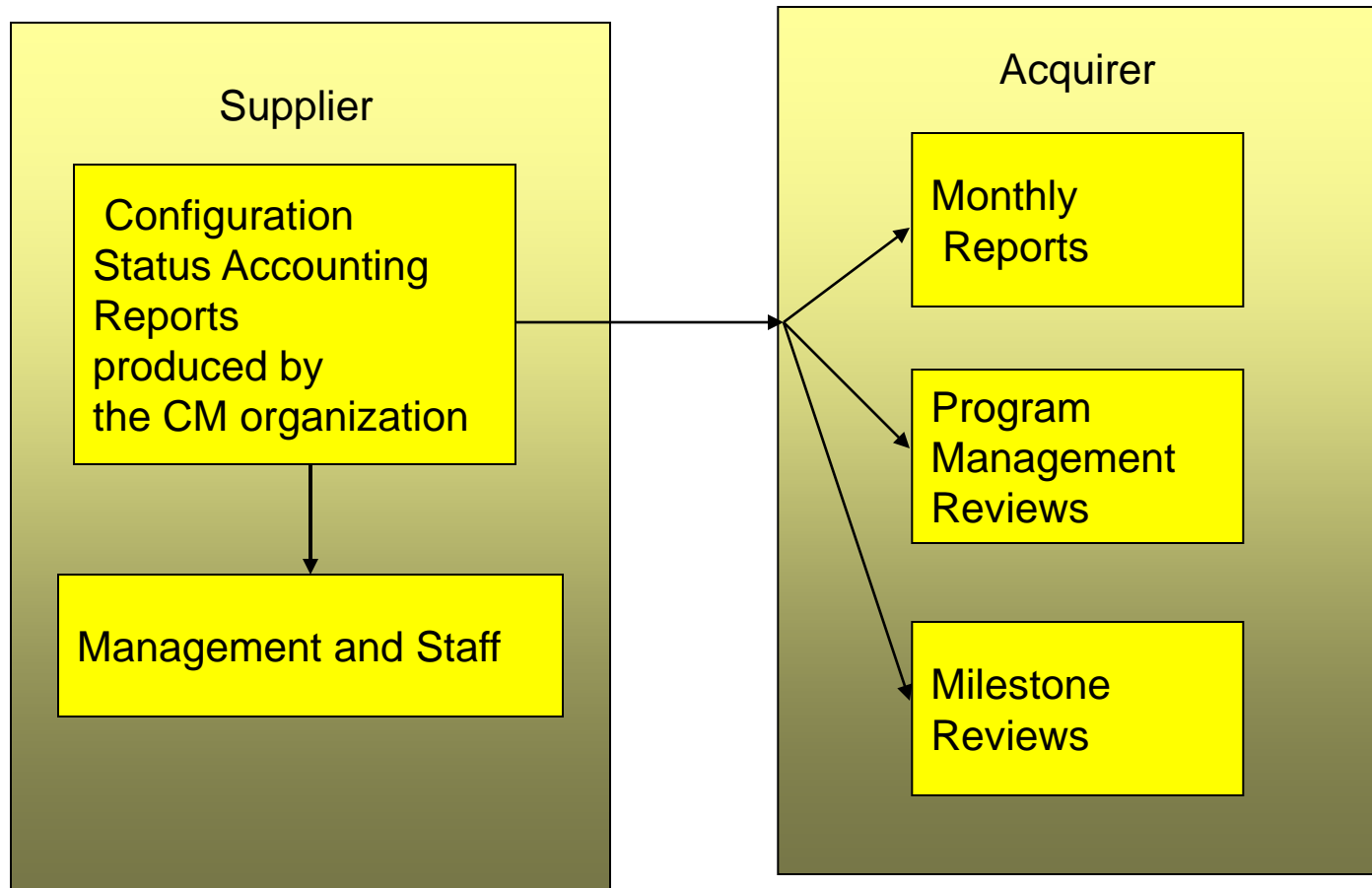
- CSA is performed to gather, correlate, maintain and provide status on controlled products (CIs), and on CM tasks



Configuration Status Accounting continued

- The Configuration Status Accounting (CSA) task gathers, correlates, maintains, and provides status on CM controlled products and CM tasks
- Provides the means for reporting status on:
 - Configurations
 - FCI
 - ACI
 - PCI
 - Baselines
 - FBL
 - ABL
 - PBL
 - Other
 - CM metrics
 - CM activities
 - CM Audits

Configuration Status Accounting concluded



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Internal CM versus Formal CM

- **Formal CM is concerned with**

- High Level baselines
 - FBL
 - ABL
 - PBL

- Master Schedules
- Contractual Items

- **Internal CM is concerned with**

- Design BL
- Code BL
- Hardware component BL
- Test BL
- COTS BL
- Etc.

Internal CM Concerns

■ Documents

- Database
- Test procedures
- Analysis that drive requirements and design
- Etc.

■ Plans

- Project plans
- CM plans
- QA plans
- Risk Management plans
- Test plans
- Etc.

Formal CM Under Configuration Control Board (CCB)

- Configuration Control Board is Chaired by PM
- Membership composed of management
 - Systems
 - Software
 - Hardware
 - Test
 - CM
 - QA
 - Etc.

Internal CM Under Technical Review Board (TRB)

- **Chaired by Deputy PM or Lead Systems Engineer**
 - **Systems**
 - **Software**
 - **Hardware**
 - **Test**
 - **CM**
 - **QA**
 - **Etc.**

Internal CM Concerns continued

- **Internal CM is concerned with**
 - **Version Control**
 - Documents
 - Code
 - Hardware items
 - COTS
 - **Data Management**
 - Documents
 - Plans
 - Process Documentation
 - Procedures
 - Metrics
 - Action Items
 - Etc.

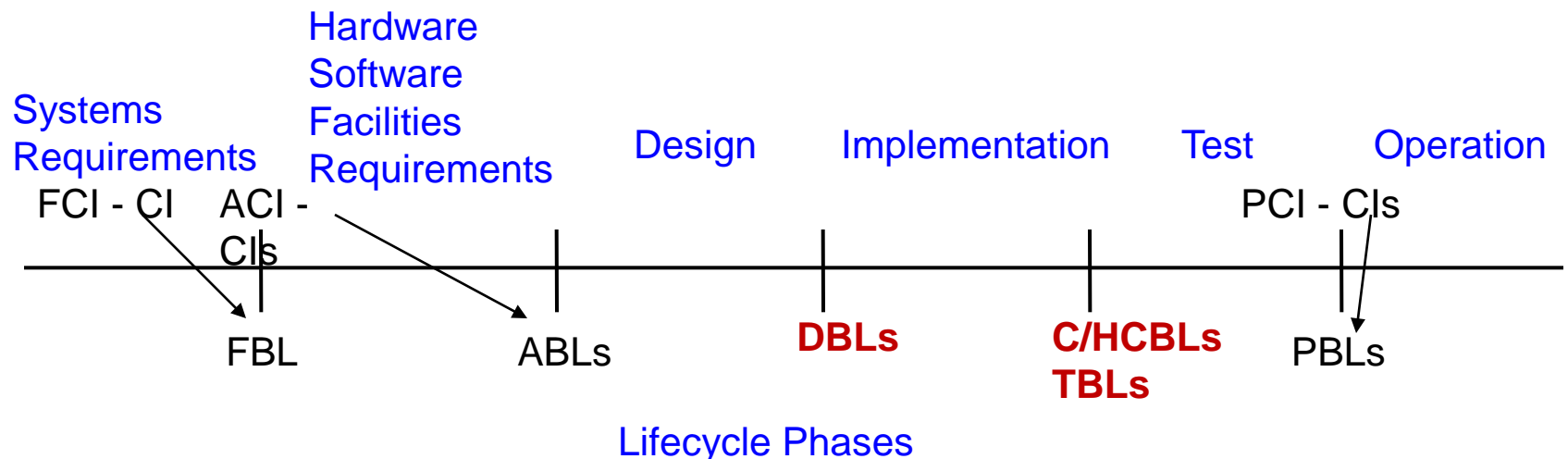
Internal CM & Testing

- **Internal CM during testing is concerned with**
 - **Code changes (TRB)**
 - **Design changes (TRB)**
 - **Test case changes (TRB)**
 - **Requirements changes (Require escalation to CCB)**

Internal Baselines

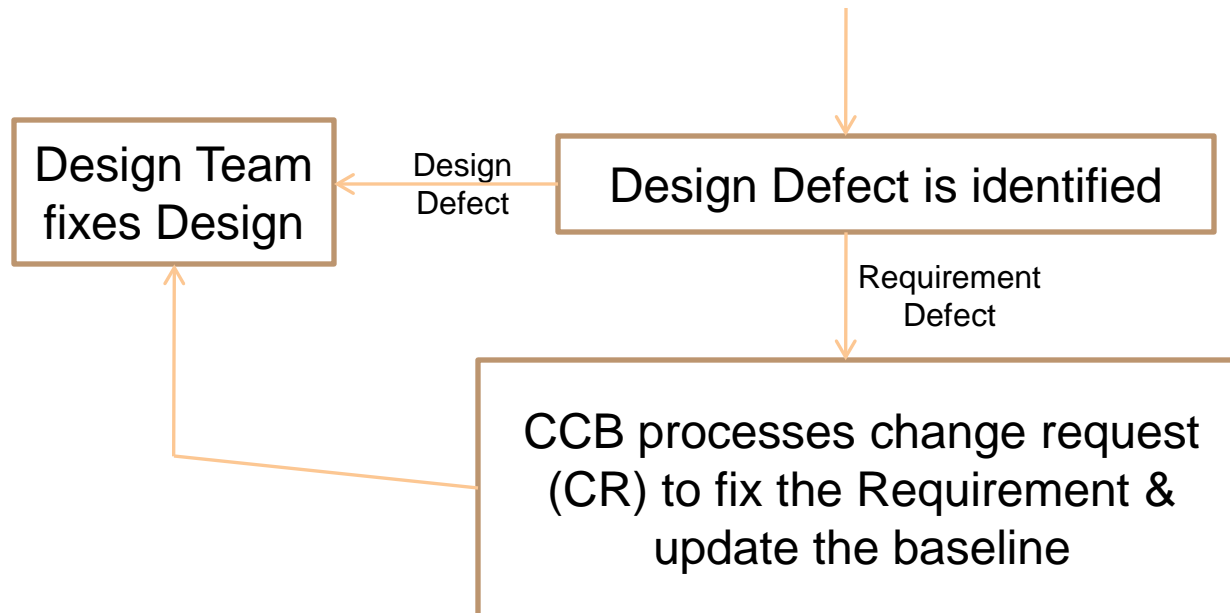
Internal baselines are established at strategic points in a system lifecycle. Three internal baselines may be defined

- Design Baseline (DBLs)
- Code/Hardware Components Baseline (C/HCBLs)
- Test Baseline (TBLs)



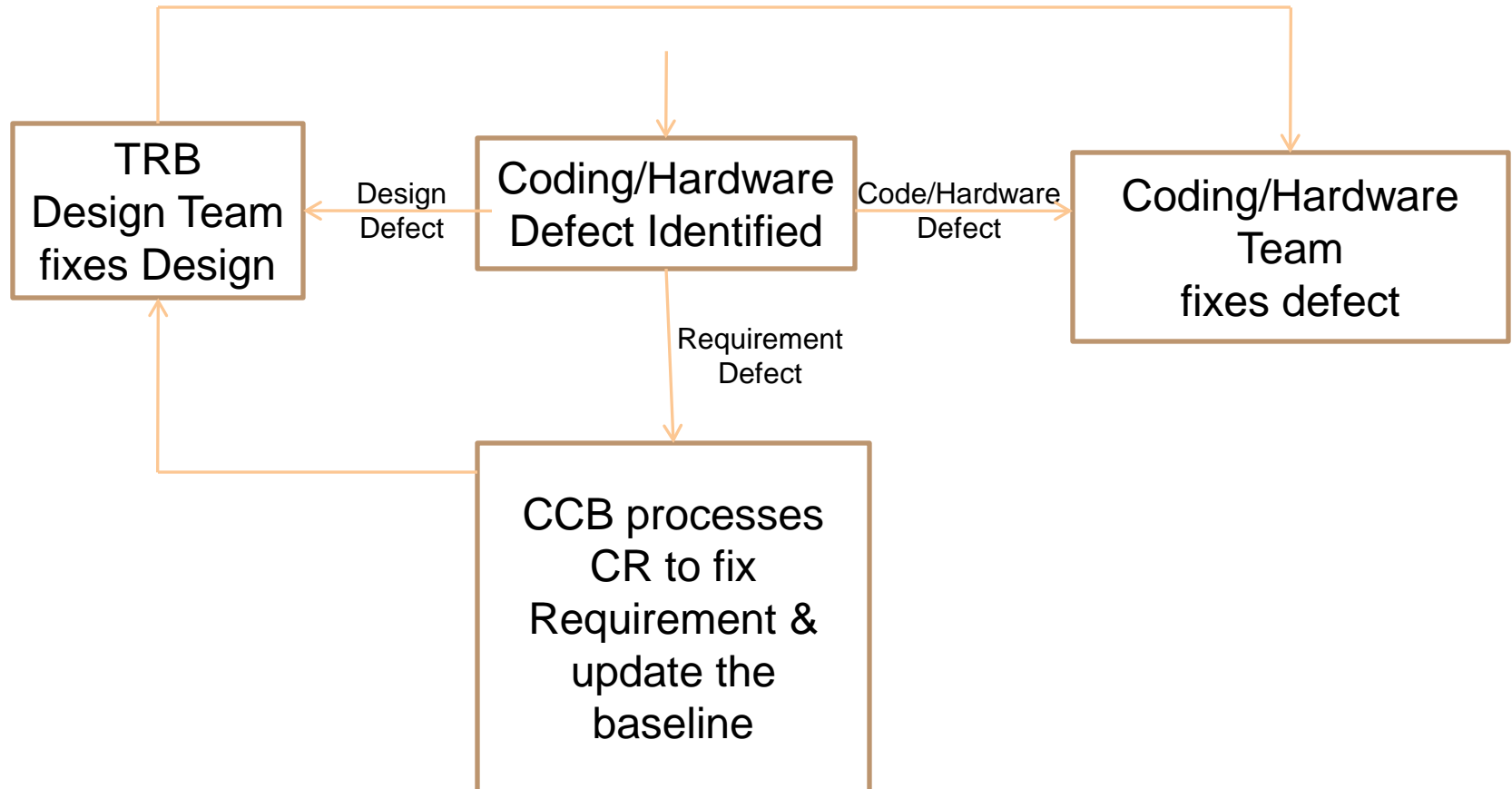
Internal CM During Design

Design not yet Baselined



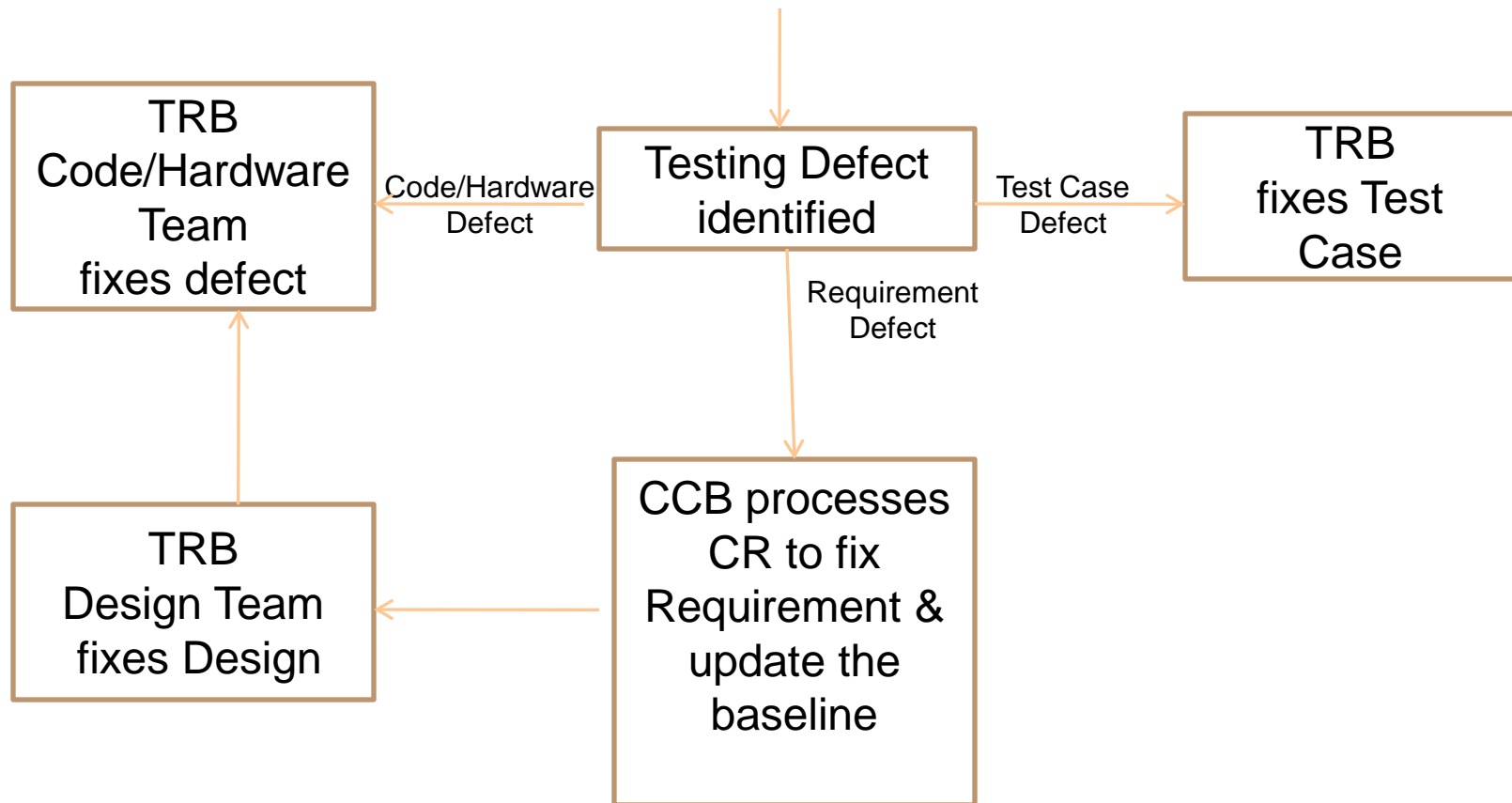
Internal CM During Coding

Design Baselined, Code not Baselined



Internal CM During Testing

Design, Code & Test Cases Baselined



CM During Operation

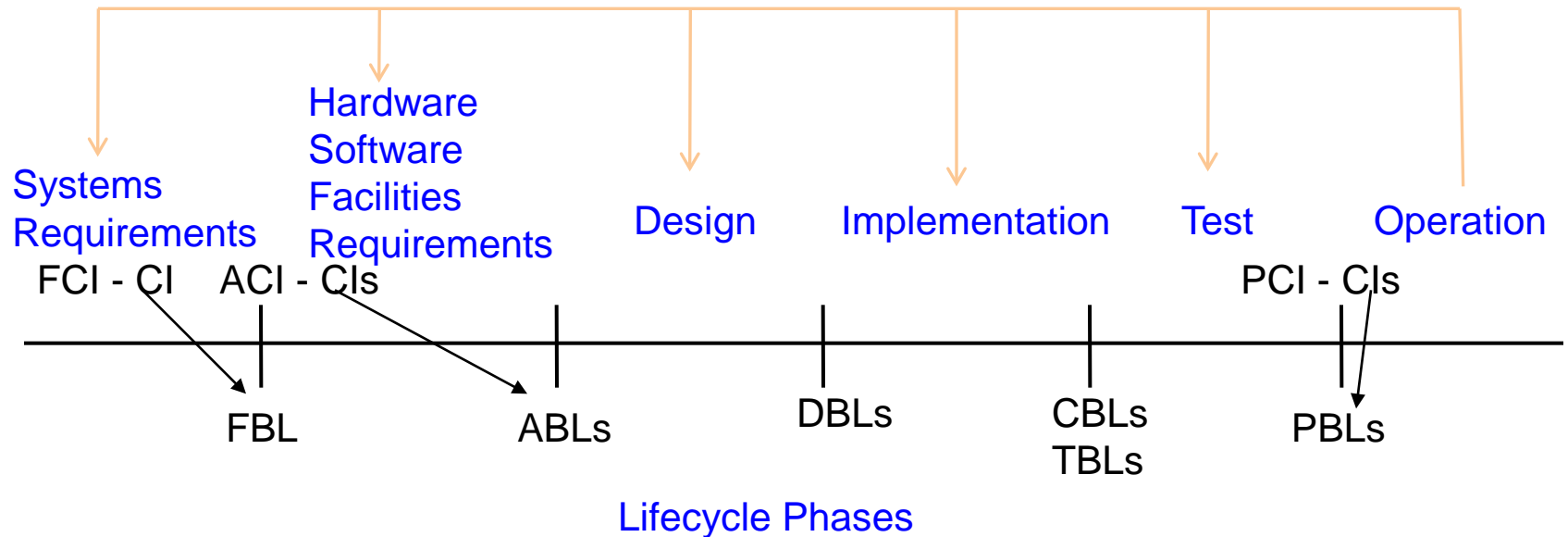
- Operation CM does not differ from CM conducted during development
 - Formal CM
 - Internal CM
- The players may change
 - A different Operation contractor
 - A different Operation agency
 - Acquisition Agency vs. Operation Agency
- The Operation Baseline has been established

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CM During Operation continued

Defects and changes during Operation may require repeat of activities that were conducted during development and reestablishment of baselines as appropriate.



References/Suggested Reading

- *IEEE Std. 828-1998 IEEE Standard for Software Configuration Management Plans*
- *IEEE 1042, Guide to Software Configuration Management*
- *ANSI/EIA-649-1998 National Consensus Standard for Configuration Management*
- *IEEE 828-2005 – Standard for Software CM plans*
- *MIL-STD-973 Military Standard for Configuration Management (cancelled, but still good reference)*
- *CM Today Yellow Pages, Your Source for Daily CM News, www.cmtoday.com/yp/configuration_management.html*
- *CM BoK – Configuration Management Body of Knowledge. www.cmcrossroads.com/cgi-bin/cmwiki/bin/view.cgi/CM/CMBoK, CM Crossroads, CM Community Forums*
- *Capability Maturity Model Integration (CMMI®), Version 1.3 Software Engineering Institute*

Contact Information

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