Applying Systems Engineering to Fielded Weapon Systems and End-Items

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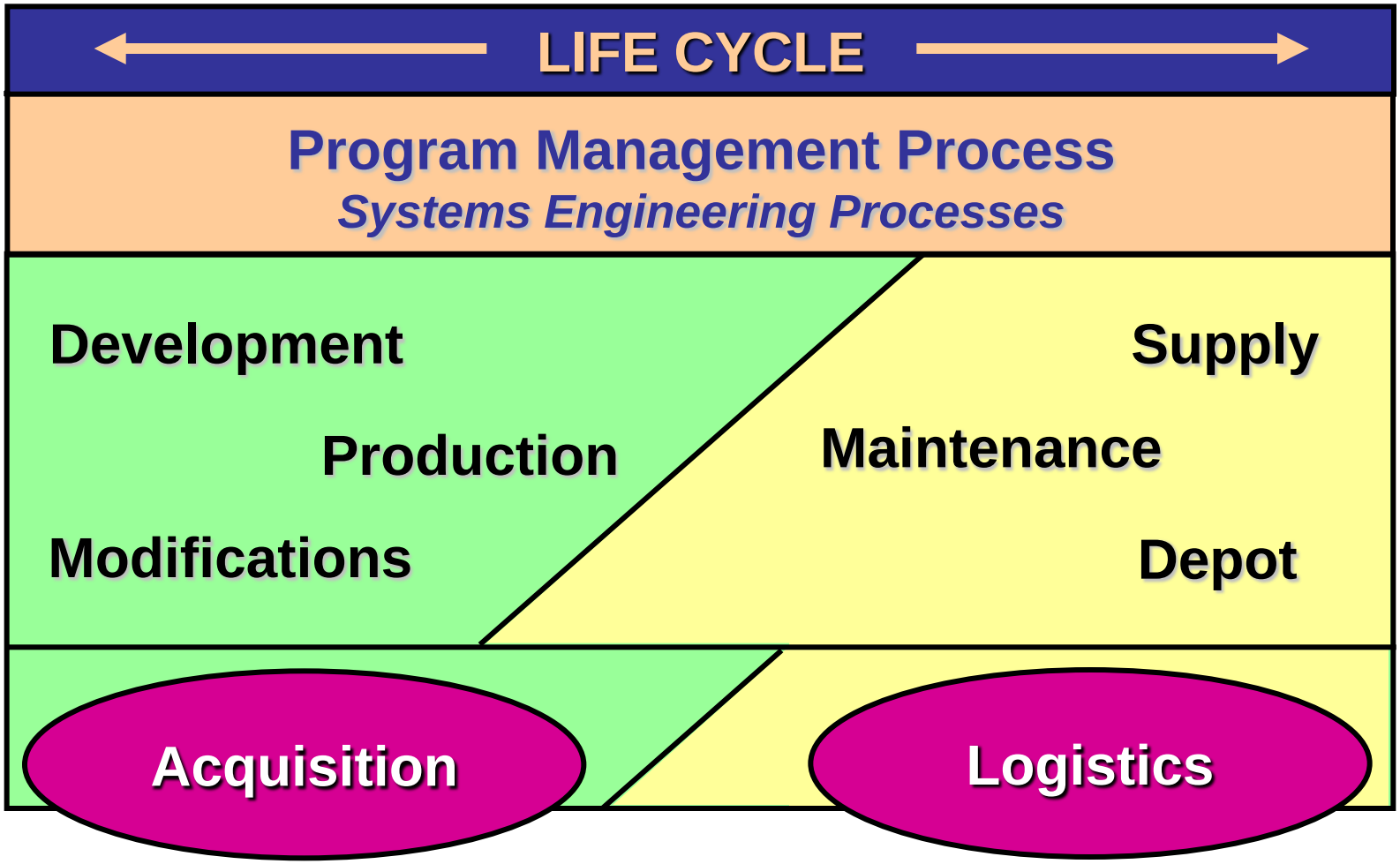
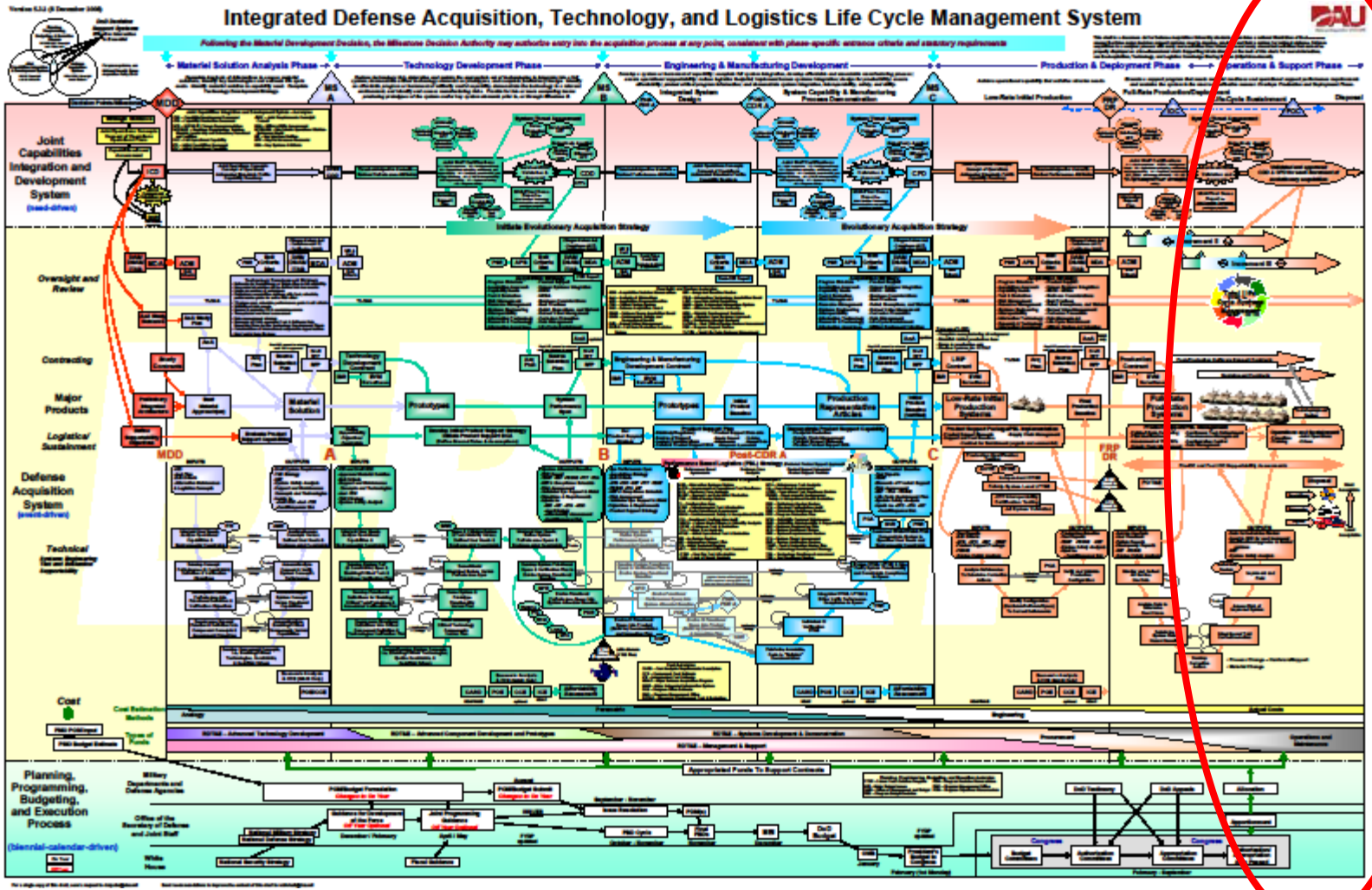
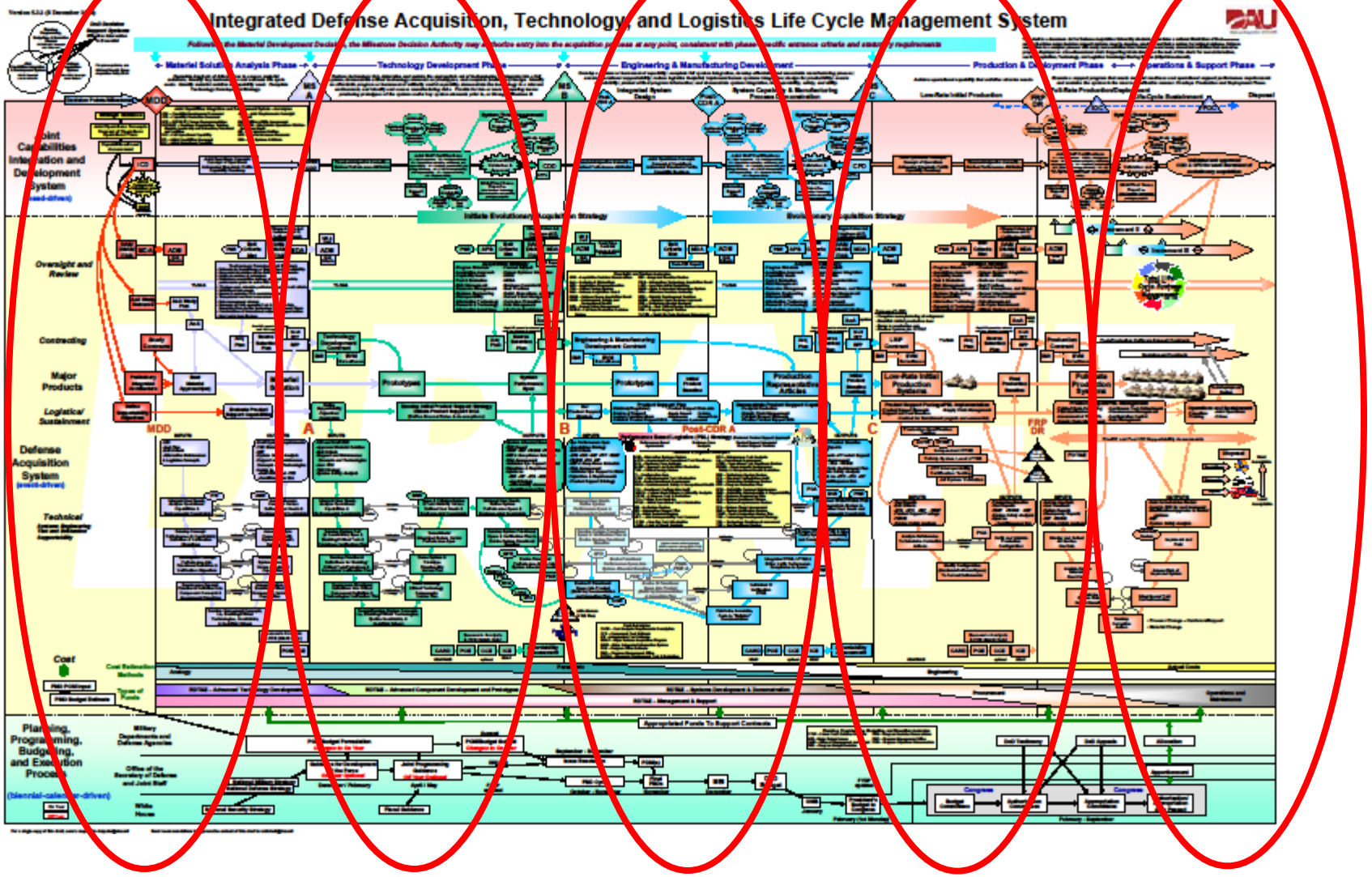
Product Life Cycle



Sustainment View of DoD 5000.02



Real View of SE Process



Incorrect Assumptions

- **Developers work with a blank canvas – sustainers are given a painted picture**
  - Once a concept is created, the canvas is no longer blank for anyone
  - It becomes a continuous improvement/refinement process from that point on
- **Sustainment SE processes are different than acquisition SE processes**
  - Processes and process objectives are the same
    - Process implementation can vary
    - Organizational responsibility can vary
    - Domain knowledge required can vary
  - Every cycle through the SE process reassesses prior decisions for cost, schedule, and performance soundness

SE Processes per DAG Chapter 4

Technical Management Processes

- Decision Analysis
- Technical Planning
- Technical Assessment
- Requirements Management
- Risk Management
- Configuration Management
- Technical Data Management
- Interface Management

Technical Processes

- Stakeholders Requirements Definition
- Requirements Analysis
- Architectural Design
- Implementation
- Integration
- Verification
- Validation
- Transition

Some SE Process Examples

- **Technical Planning (e.g. SEP)**
  - Modifications
  - Engineering authority / MRBs
  - CCB procedures / membership
  - OSS&E characteristics
  - Data repository
  - Master documentation updates
  - Maintenance data systems
  - etc

SE Processes independent of color of money!!

- **Risk (Opportunity) Management**
  - New technology considerations
  - Disposition of DMS issues
  - Resolution of aging issues
  - TOC reductions
  - etc

SE Processes – Plain English

Technical Processes

- Analyze customer needs
- Convert customer needs into system level performance requirements
- Allocate and derive system level performance requirements into performance requirements for system pieces
- Develop design solutions for performance requirements of system pieces
- Verify design solution meets performance requirements
- Validate design solution satisfies customer needs

Can't Buy Parts – Now What?

- **Buy enough spares to last through the product's remaining life**
- **Cannibalize parts from other systems and end-items in the inventory**
- **Acquire technical data/rights and qualify (1) a new supplier or (2) in-house production**
- **Qualify a new design to an existing performance specification**
  - One for one
  - Many for one (e.g. replace 3 existing boxes with 1 new box)
- **No data available case**
  - Identify/measure operational environment
  - Define requirements and conduct tests to compare existing part with new part
  - Use new part if as good or better than existing one

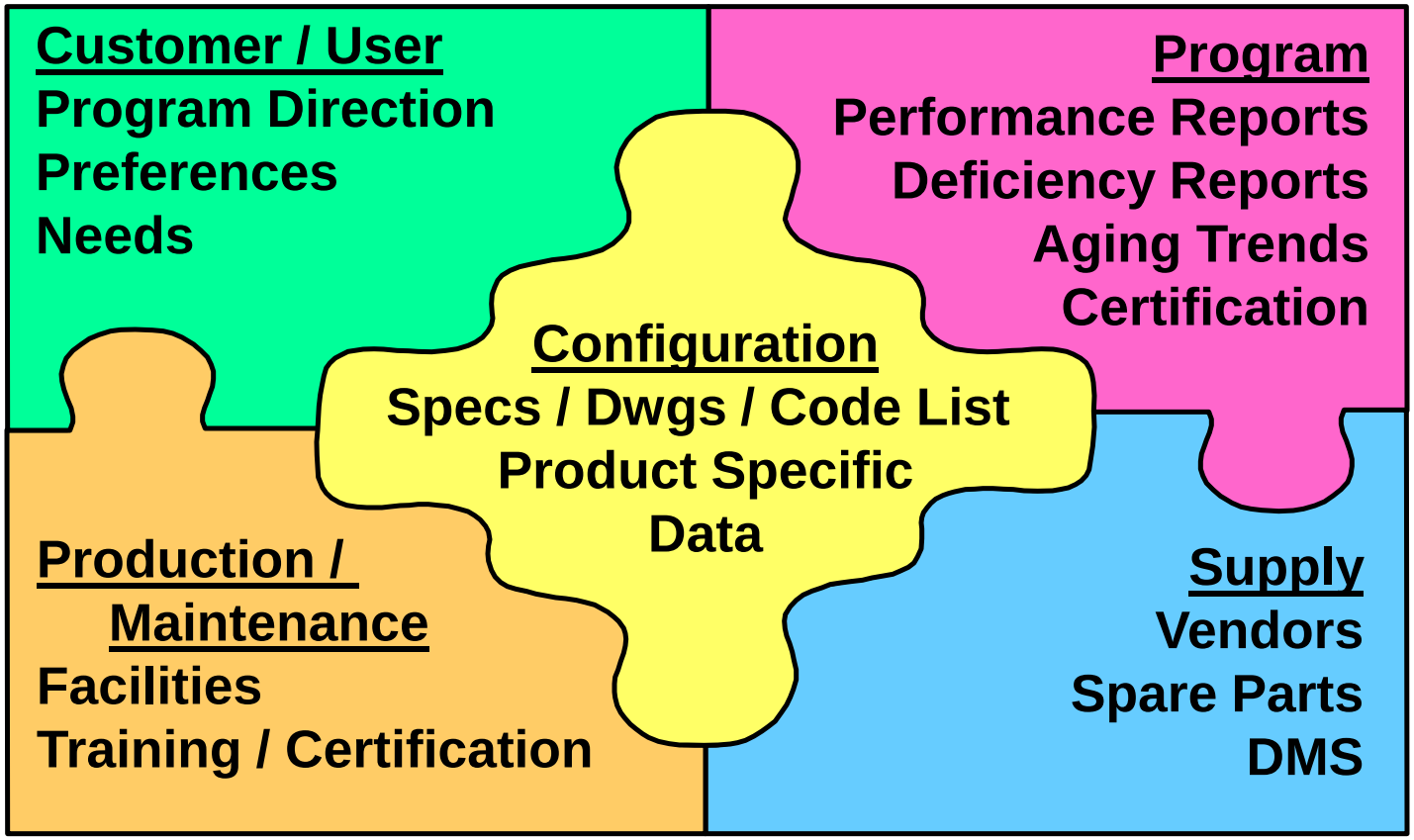
SE Sustainment Tasks

SE Processes – Plain English

Technical Management Processes

- Make technical decisions
- Plan the technical management of the program
- Conduct technical studies
- Analyze technical information
- Document decisions
- Develop backup approaches for risky areas
- Manage technical changes
- Develop and **maintain** technical information

Technical Baseline



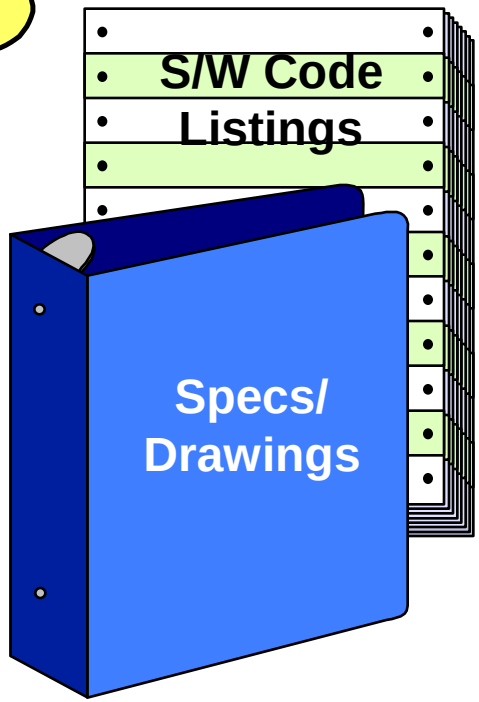
Technical Baseline

- ***Definition*** **–** all of the technical information needed to support a product throughout its life cycle
- **Many different approval processes involved**
  - Configuration change control
  - Maintenance procedures
  - Verification
  - Validation
  - Certification
  - etc
- **All of the information needs to be archived and maintained throughout a product's life cycle**

Configuration Information

Configuration Baselines

Config Baselines



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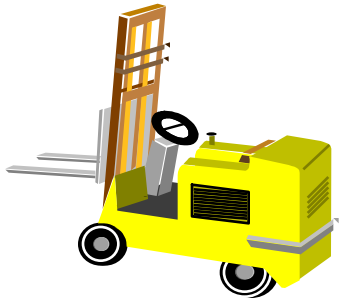
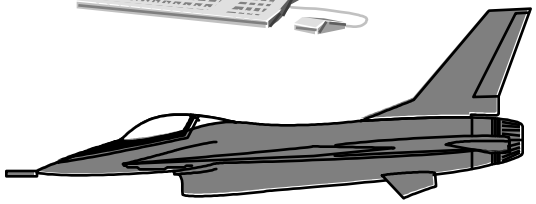
Products / Processes





Configuration Baselines

Performance Based

FUNCTIONAL (CONCEPT) BASELINE

1. Performance Requirements – System
2. Verification Methods (Qualification) – System

ALLOCATED (DEFINITION) BASELINE

1. Performance Requirements – System Pieces
2. Verification Methods (Qualification) – System Pieces

Design Based

PRODUCT (BUILD) BASELINE

1. Design solutions (dwgs, code listings) – System Pieces
2. 1st Article Reqts – System Pieces
3. Lot / Acceptance & Inspection Reqts – System Pieces
4. Verification Methods (1st Article, Lot / Acceptance) – System Pieces

Specifications

- ***Definition*** **–** contains both requirements and verification methods in one “document”
  - Requirement documents (SRDs/TRDs) missing verification methods
- **Product types**
  - System
  - Item
  - Software
  - Process
  - Material
- Other types include – Interface
  - Don’t buy interfaces -- buy to an interface

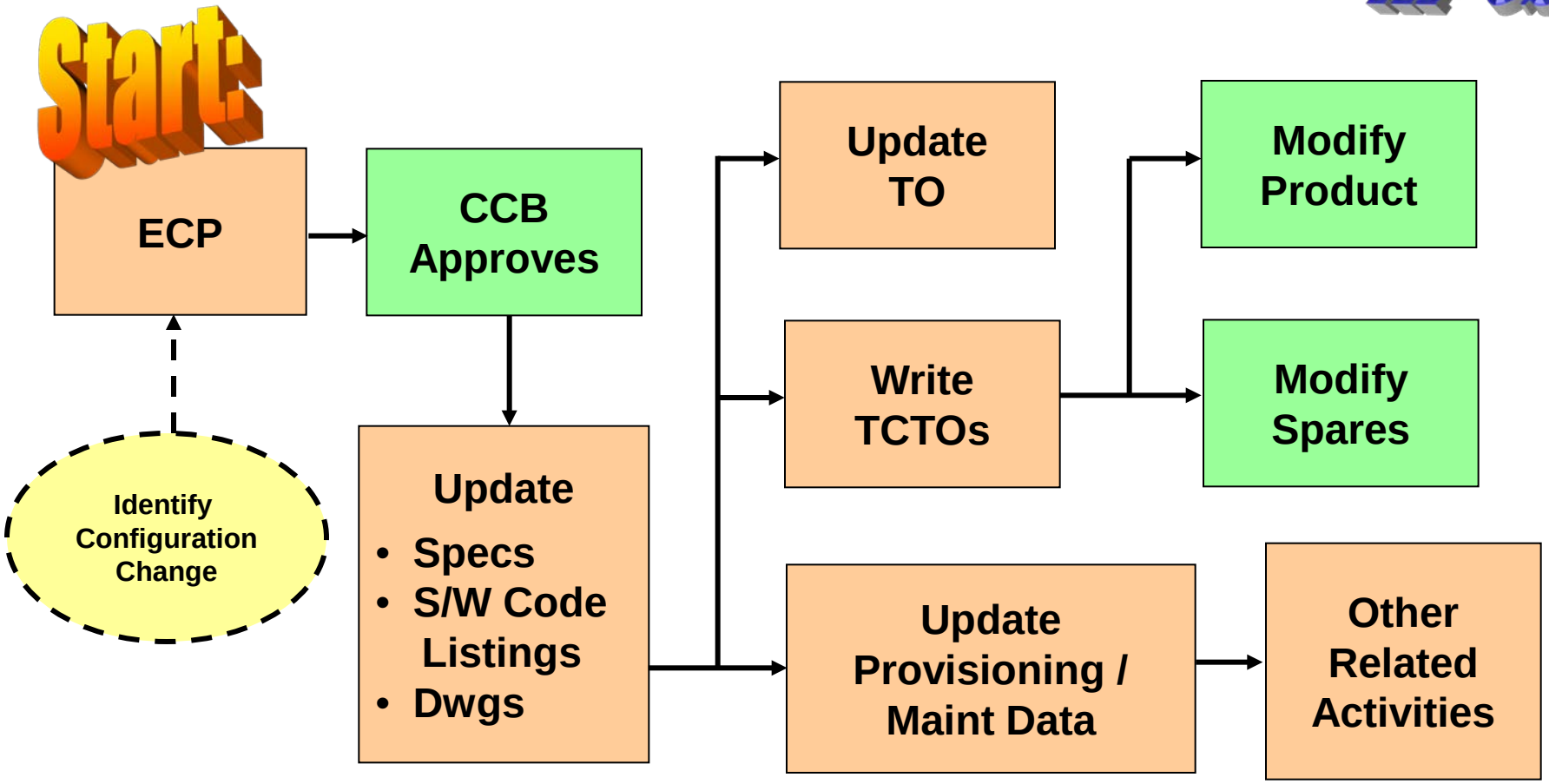
Configuration Baseline Control

- **Configuration Control Boards (CCBs)**
  - Focus on configuration baseline documentation
  - Engineering change proposals (ECPs)
  - Non conformance (waivers, deviations, variances, etc)
  - Can be used to establish baselines

- **ECP Classification**
  - Class I
    - Change form, fit, or function
    - Note: Changing the length of a decal is a Class I change
  - Class II
    - Everything else (minor corrections)

Defining Class I as gov't control and Class II as contractor control is incorrect

Configuration Changes



The PM Is Responsible For The Data

Configuration Baseline Control

- **Material Review Boards (MRBs)**
  - Used to disposition minor non conformances
  - Mirrors Class II ECP approval / delegation
- **Critical / Major Non Conformances**
  - Requires CCB approval
- **Supply Prime Vendor Contracts**
  - May allow parts substitution
  - Changes the configuration when it happens

Product Specific Data

- **Requirements and interface management information not incorporated into configuration baseline documentation**
- **Actual product configuration**
  - Product built against a specific configuration
    - Part numbers / serial numbers / lot numbers / stock numbers / etc
    - Maintenance procedures and data
    - Verification / validation reports
    - Etc
- **Verification information / tools**
  - Test plans / procedures
    - Demonstrated performance / market standards
  - Number of test articles / test sequence
  - Modeling and simulation tools
  - Analytical tools

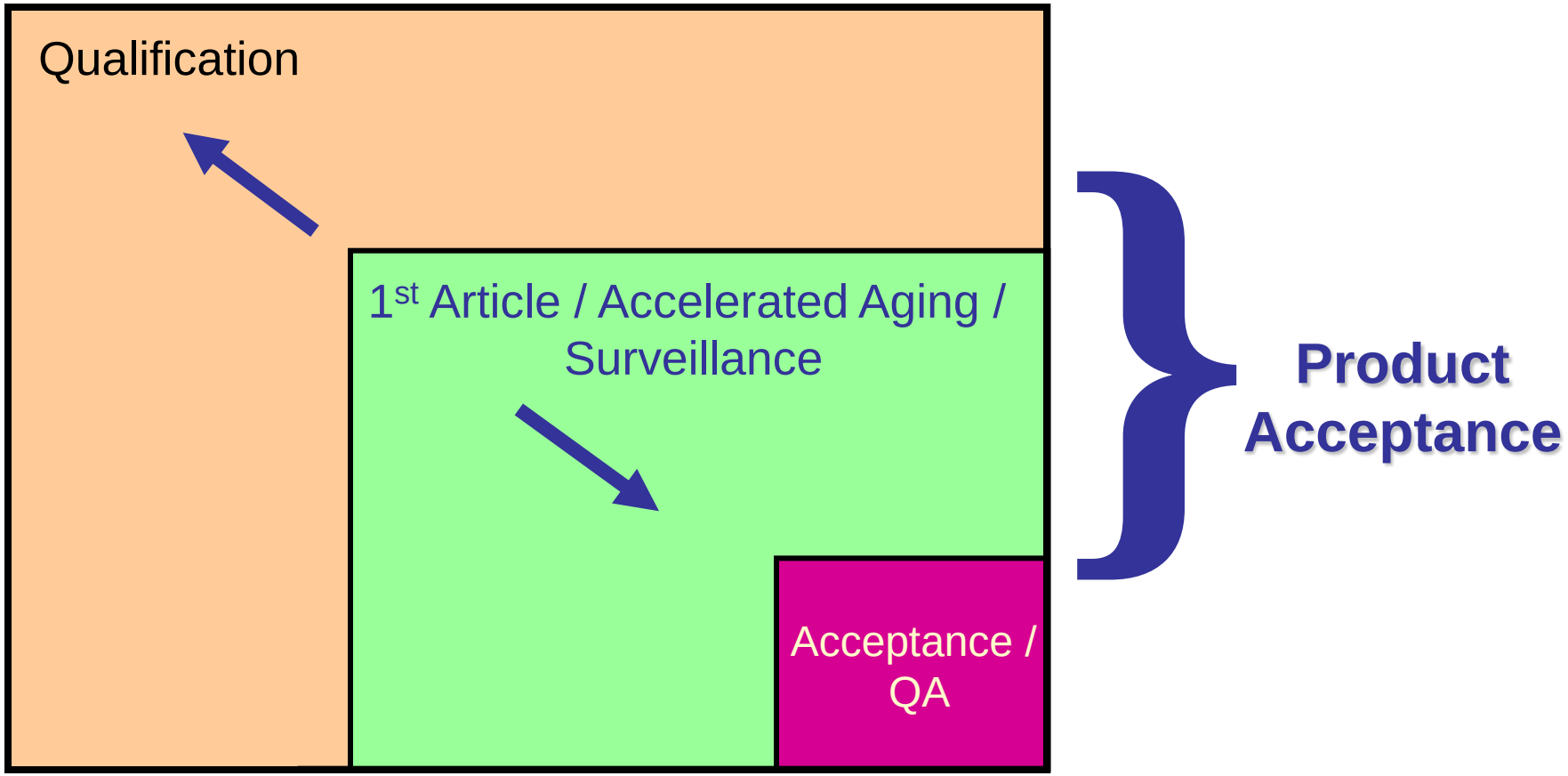
Verification / Validation

Verification / Validation

- ***Verification:*** Satisfies configuration baselines
  - Developmental test and evaluation
  - Usually performed by contractor with government observation

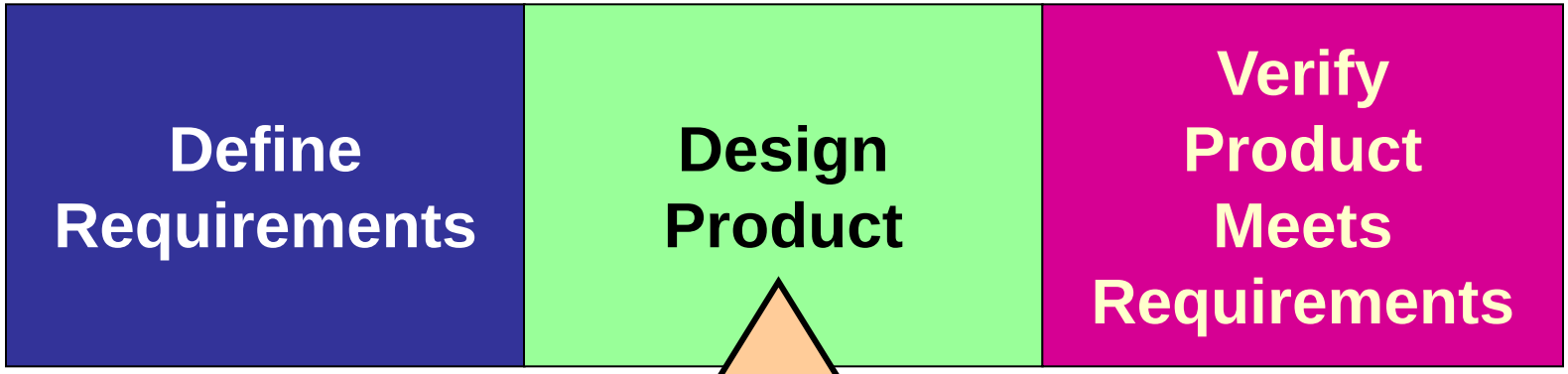
- ***Validation:*** Satisfies customer / operational user needs (i.e. capabilities)
  - Operational test and evaluation
  - Performed by customer or operational user

Verification



Verification

Gov't Development:



Commercial Buy:

Final Thoughts

- **F^3I (Form, Fit, Function, & Interface) Replacement**
  - New component **must** be verified
  - Really **F^2I:** form changes
- **Depot**
  - The **only** engineering authority the depot has is what it's given in the Work Specification
  - Work Specification mandates maintenance procedures depot is to use to make repairs
    - Phrase – Make "X" repair using best commercial practice – gives depot authorization to use their own repair procedures
  - Same Work Specification used for both in-house and contracted depot work

Final Thoughts

- **Government Supply Chain Managers**
  - **Not** program managers
  - Responsible for stock, store, and issue tasks only
  - DLA Directive 3200.1 states services **retain** engineering and configuration management responsibility for the parts DLA buys
    - Applies even if not classified as a critical safety item

- **Can't find old performance specifications – check out bidder packages / CDs**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Questions ?