Systems Engineering (SE) Analysis & Control: Work Breakdown Structure (WBS)

SEAPOWER THROUGH ENGINEERING

TOPIC LEARNING OBJECTIVES

Upon successful completion of this topic, the student will be able to:

1. Recognize a WBS as a product-oriented hierarchy and an output of the systems engineering process.
2. Identify the role of the WBS in the systems engineering process.
3. Recognize WBS's applicability throughout the acquisition life-cycle and across all acquisition management disciplines (e.g., technical/risk management, contracting, financial and business management, and acquisition planning).
4. Recognize that MIL STD 881 provides guidance for developing a WBS.
5. Recognize the WBS format.
6. Identify the two types of WBS (Program and Contract).
7. Recognize the relationship between the Program and Contract WBS.
8. Identify who is responsible for the development and maintenance of the two types of WBS (Program and Contract).

STUDENT PREPARATION

Student Support Material

1. None

Primary References

1. DoD 5000 Series
2. MIL STD 881 (WBS)
3. MIL HDBK 245 (SOW)

Additional References

1. In Class Video: Project Management: What is a Work Breakdown Structure? https://www.youtube.com/watch?v=wEWhnodF6ig

Overview

- Role of the WBS
- WBS Hierarchy
- WBS Types

Introduction

- Whenever an organization has a large project to manage, breaking down the effort into manageable parts is the first step

- DoD uses a specific format, called a Work Breakdown Structure (WBS), to organize the breakdown of work into small areas and parts

- The WBS is a ***valuable program management tool***
  - Used throughout all life-cycle phases
  - Manages risk by providing insight into technical aspects of program management
  - Benefits all acquisition disciplines (program management, contracting, life-cycle logistics, finance, budgeting)

Basic Role of WBS

- Both DoD and Contractors use WBS to establish a foundation for:
  - Developing program and technical plans through the Systems Engineering process
  - Developing acquisition strategy and contracting documents
  - Establishing schedules
  - Estimating costs and formulating budgets
  - Planning logistics
  - Tracking progress and accomplishments
  - Reporting progress status and analyzing problems
  - Establishing Program Management Baseline (PMB) for Earned Value Management (EVM)

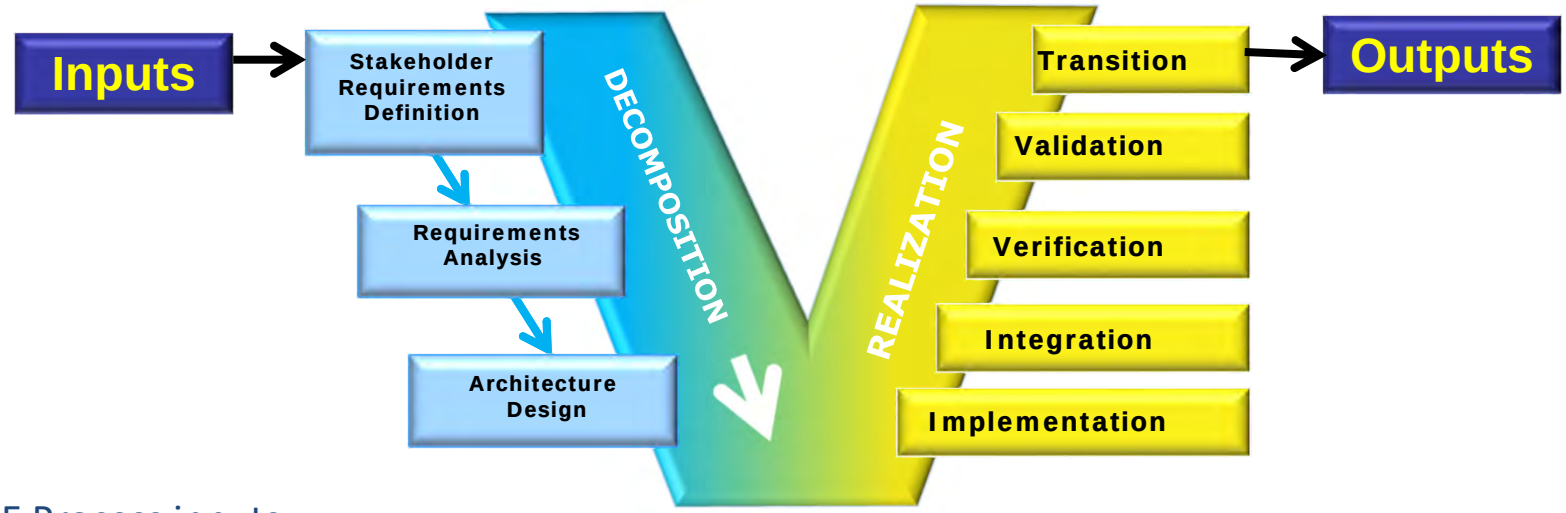
Basic Role of WBS

- Program Managers (PMs) use the WBS as a roadmap for Integrated Product and Process Development of the program
- PMs use the WBS to help stay within budget by identifying and analyzing tradeoffs through monitoring things such as:
  - Cost
  - Schedule
  - Performance
  - Manufacturing
  - Life-cycle Product Support
  - Testing
  - Risk management

WBS is a management tool used throughout the life-cycle and across all management disciplines

WBS and the SE Process

- WBS is an ***output*** of the SE Process



- SE Process inputs
  - Customer needs/objectives/requirements
  - Technology base
  - Output requirements from prior application of SE Process
  - Program decision requirements
  - Commercial standards & performance specs
- SE Process outputs
  - Decision data base
  - ***Work Breakdown Structure (WBS)***
  - System/configuration item architectures
  - Program-unique specifications & configuration baselines

WBS and the SE Process, cont.

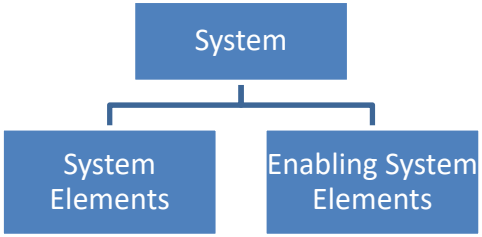
- The WBS supports the SE process in multiple ways to include, but not limited to:
  - Organizing IPT structure
  - Grouping system specifications
  - Structuring technical reviews
  - Understanding the impact of Engineering Change Proposals (ECPs)
  - Managing interface controls throughout the system
  - Conducting risk management, including providing additional attention to candidate risks that occur at relatively high levels, and those that affect integration

Overview

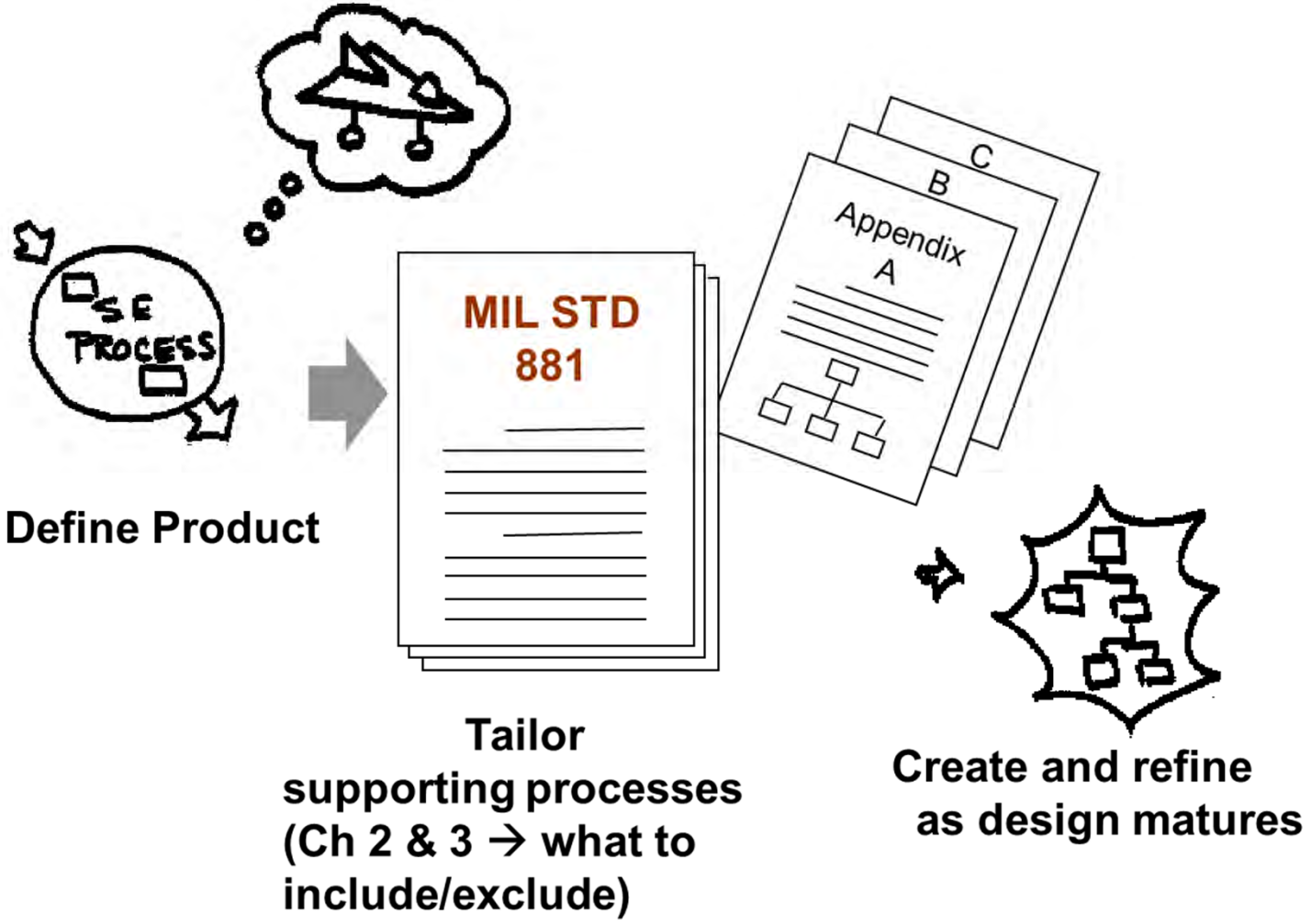
- Role of the WBS
- WBS Hierarchy
- WBS Types

Work Breakdown Structure Hierarchy

- WBS is displayed as ***hierarchically related, product-oriented*** elements and the work processes required for their completion
  - Displays and defines the product or service to be developed, produced or provided
  - Relates the elements of work to be accomplished to each other and to the end product
  - Developed for each program and each individual contract within the program
  - Organizes system development activities based on the system decompositions
- A system is an aggregation of:
  - System elements
  - Enabling system elements
- ***System element*** refers to the ***product parts*** of the WBS
  - Including subsystems, components, assemblies, parts
  - Represents how the system is decomposed into Configuration Items (CIs)
  - Vertical aspect of the WBS
- ***Enabling system elements*** refer to common elements that provide the means for realizing the product:
  - Includes processes, equipment, parts, and facilities
  - Common elements are common to all acquisition programs developed by the DoD
  - Enable realization of the system
  - Horizontal aspect of the WBS



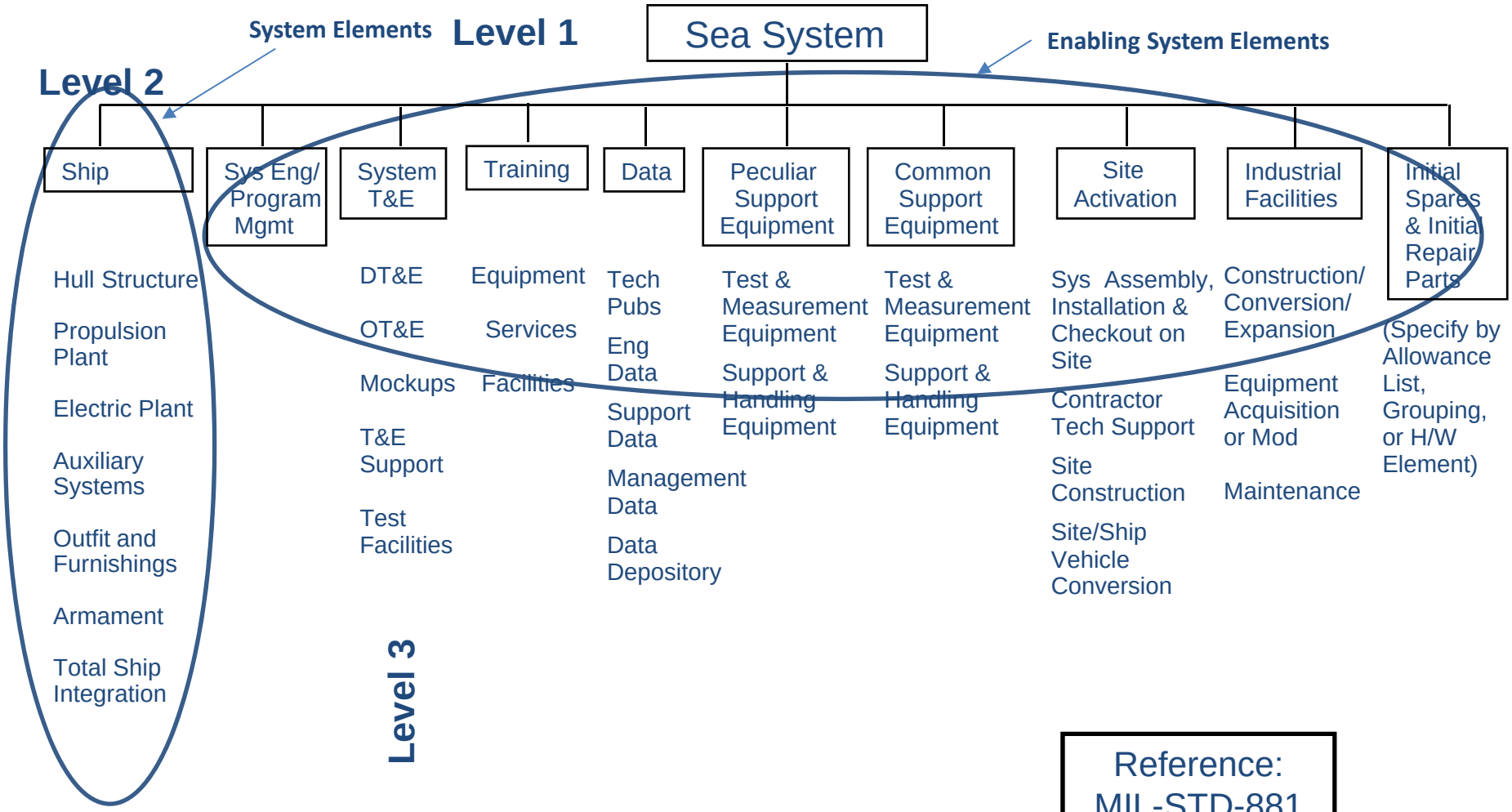
How to Create a WBS



WBS Guidance

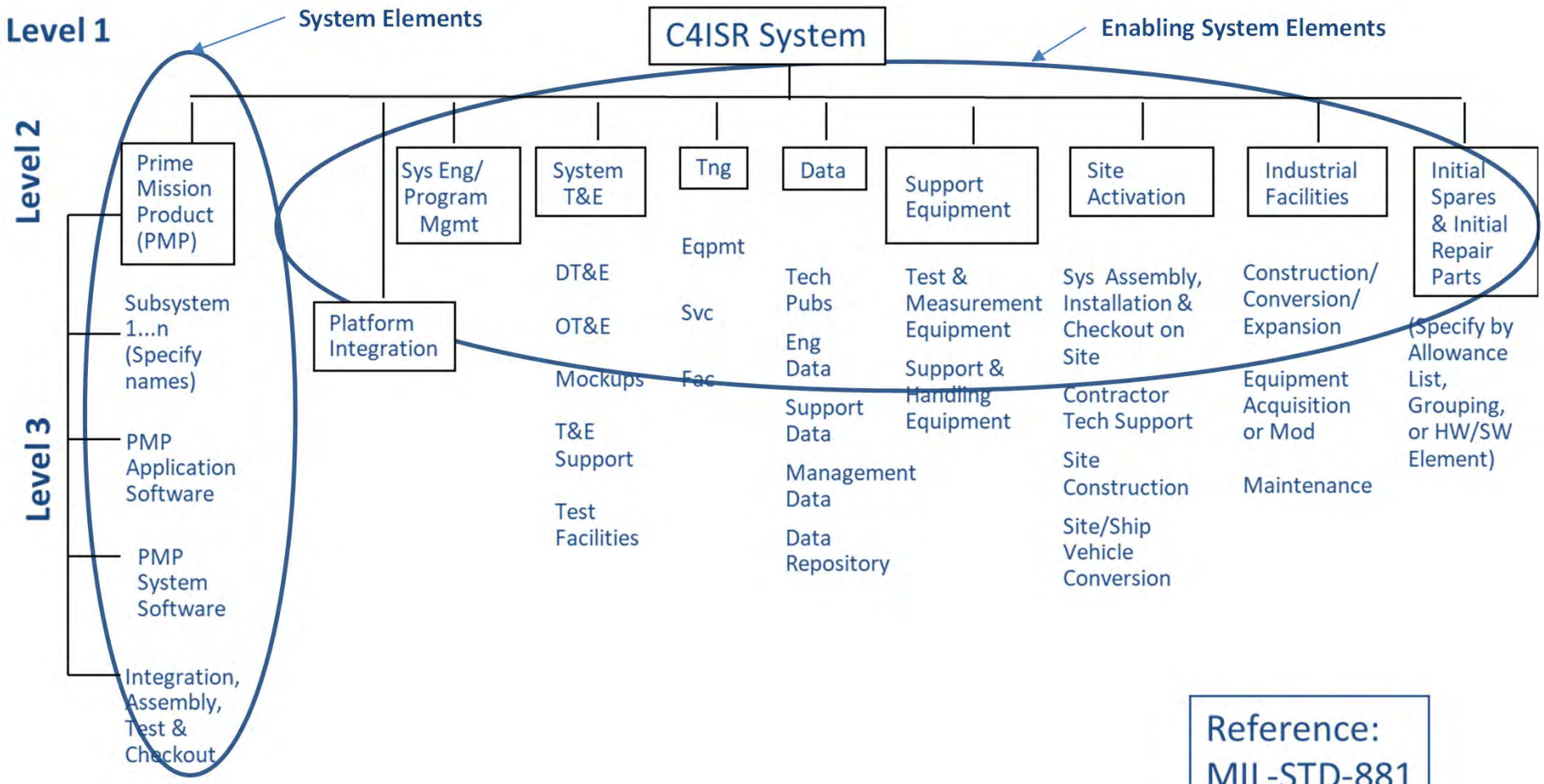
- DoD provides guidance for the development of a ***standardized WBS***
- The principal document is ***MIL-STD-881, DoD Standard Practice Work Breakdown Structures for Defense Materiel Items***
  - Provides uniform and consistent approach to a program's data structure
  - Assists with communication between the Government and the Contractor throughout the life-cycle of the program
- Format provided for 11 types of systems WBS
  - Aircraft Systems
  - Electronic Systems
  - Missile Systems
  - Ordnance Systems
  - Sea Systems
  - Space Systems
  - Surface Vehicle Systems
  - Unmanned Air Vehicle Systems
  - Unmanned Maritime Systems
  - Launch Vehicle Systems
  - Automated Information Systems

Example: Sea System WBS



Reference:
MIL-STD-881

Example: C4ISR System WBS



Reference:
MIL-STD-881

Overview

- Role of the WBS
- WBS Hierarchy
- WBS Types

WBS Types

- Types of WBS are categorized by who controls and maintains the WBS
- Two types:
  - ***Program WBS*** is controlled and maintained by the Program Management Office (PMO)
  - ***Contract WBS*** is controlled and maintained by the Contractor

Program WBS

- Program WBS encompasses the entire program, including Contract WBS and other Government elements (Operations, Manpower, Government Furnished Equipment and Testing)
- Prepared and maintained by the Program Office
  - Derived from MIL-STD-881
  - Tailored to each specific program
  - Provided as a basis for developing the Contract WBS
- Provides a framework for specifying program objectives
  - Defines total program
  - Basis for measuring technical progress, planning technical reviews, and assessing cost and schedule performance
- Consists of levels 1-3

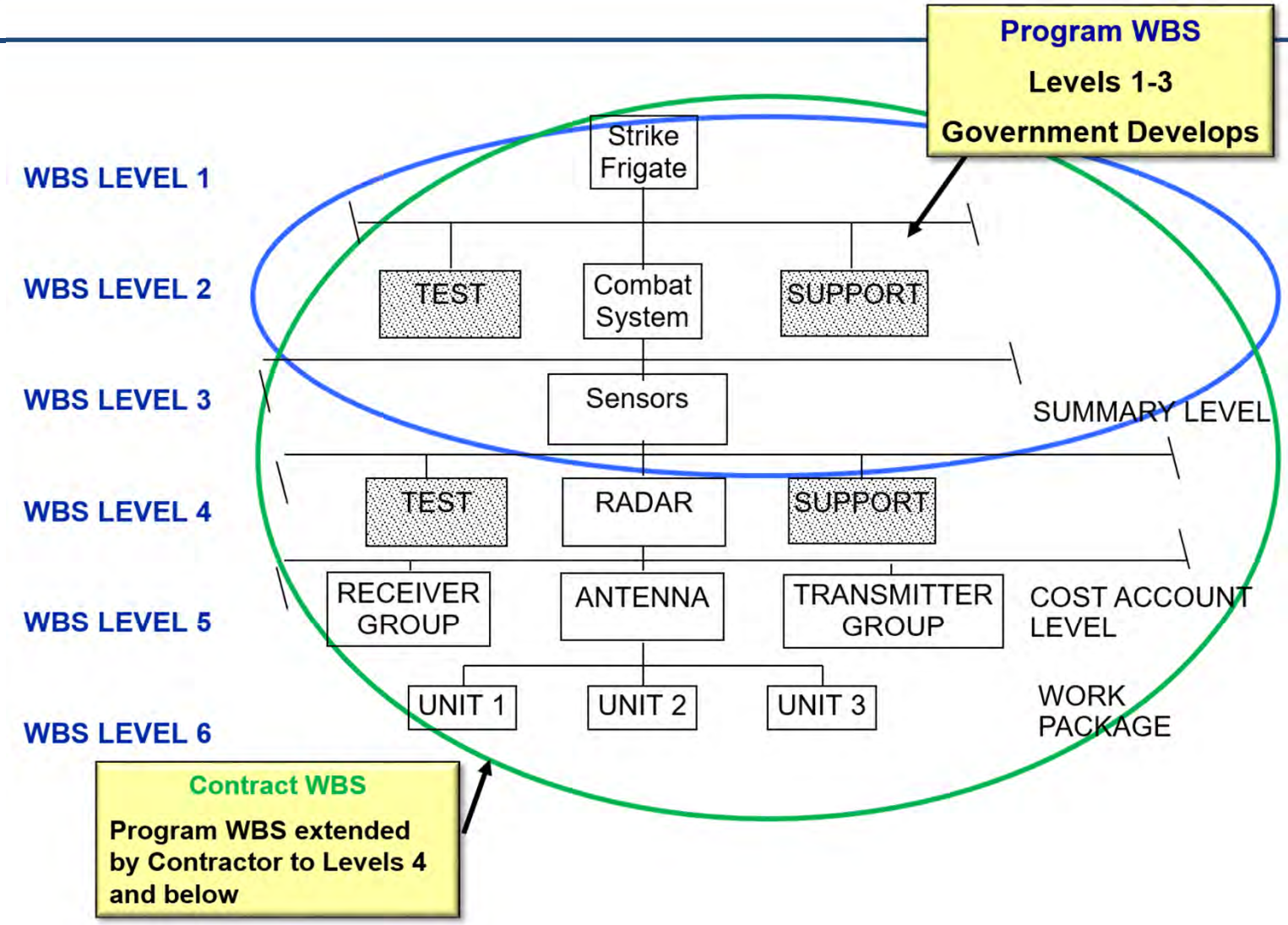
PM is responsible for the Program WBS

Contract WBS

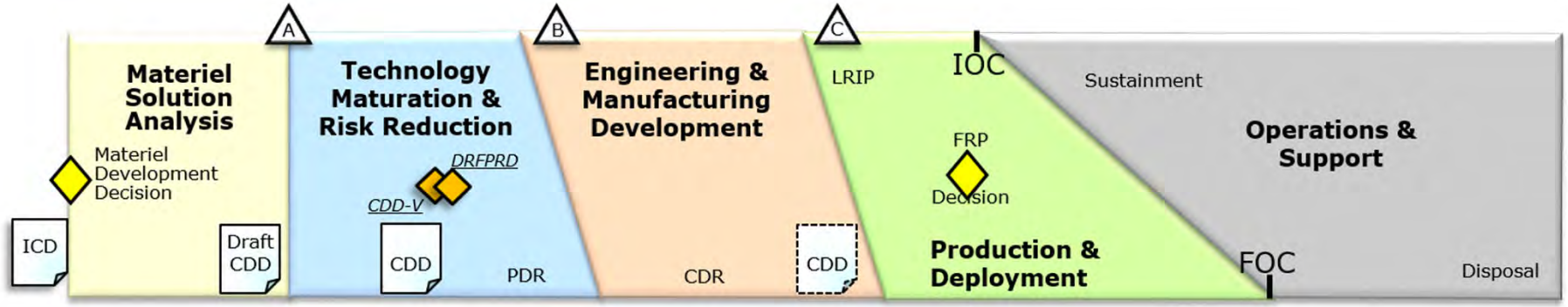
- Contract WBS defines that part of the program that is being produced by a given Contractor and is the basis for collecting cost and schedule data for the contract
  - Contractor extends the Program WBS to a lower level
  - Provides management and cost information to the Government
  - Includes all the elements for products (e.g., hardware, software, data, or services) that are the responsibility of the Contractor
  - Must be consistent with the Program WBS
  - Is prepared by the Prime Contractor and should also include all sub-contractor inputs
- Contractors may extend the work breakdown structure to whatever level is necessary to manage the program

Contract WBS begins with Level 4 and can be broken down to further levels if needed

Two Types of WBS



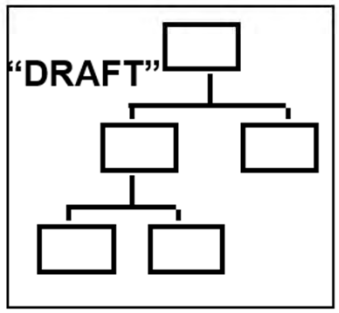
WBS Evolution Across the Life Cycle

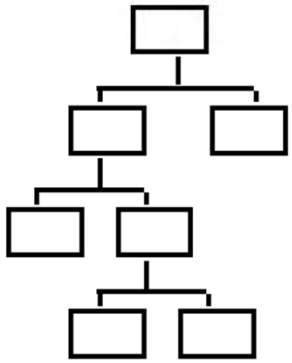


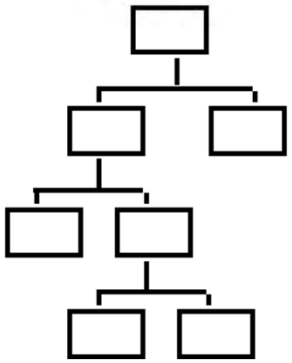
- GOVT proposes WBS
- KTR studies & submits DRAFT WBS

- KTR updates WBS
- GOVT approves updated WBS

- Final design goes into production
- GOVT approves WBS for production







Summary

- WBS is a _____ hierarchy and an _____ of the systems engineering process.
- PMs use the WBS to stay within budget by monitoring:
- Guidance for developing a WBS can be found in
- What are the 2 types of WBS?
- What is the relationship between Program & Contract WBS?
- Who is responsible for the development and maintenance of the two types of WBS?