Advanced Topics: Work Breakdown Structure (WBS)

Christopher S. Dalton

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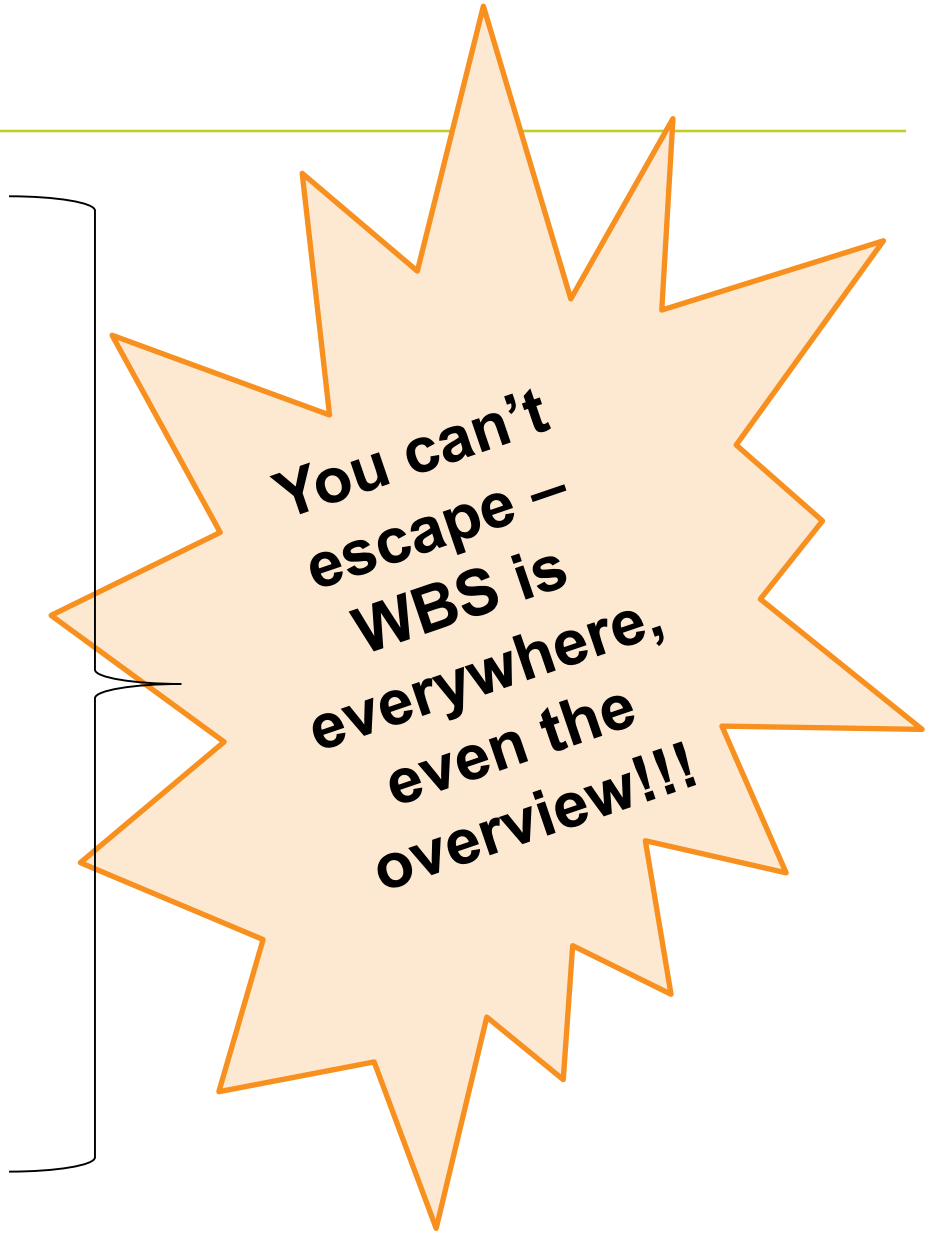
MITRE

Overview

- **Background**
  - History
  - Purpose
- **Development Process**
  - Standards / Guides
  - Challenges
    - Terminology
    - Common Elements
    - Consistency
    - Time
    - WBS Dictionary
- **Wrap Up**



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History

- MIL-STD Established due to need to define the major elements of materiel items (products) acquired by the Department of Defense (DoD) which would standardize the planning, coordination and control of the technical and cost aspects of major defense programs.

- **History:**
  - PERT (late 50s)
  - MIL-STD-881 (1968)
  - MIL-STD-881a (1973)
  - PMI / PMBoK (1987)
  - MIL-STD-881b (1993)
  - MIL-HBK-881 (1998)
  - MIL-HBK-881a (2005)
  - MIL-STD-881c (2011)

- **Drivers…**
  - Established w. C/SCSC (EVMS)
  - Updated WBS requirements
  - Integration w. other products
  - Acquisition Reform
  - New processes / products
  - Updates to 5000.02, Improve & Update Definitions, added multiple new appendices
    - E.g. AIS/ERP, Launch Vehicles, Unmanned Sea, etc.

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Purpose

A more detailed "Purpose" definition is part of CEBOK Module CEB 01

- **The purpose of the WBS is to break a complex, technical program or system into smaller, discreet, manageable pieces that sum to the parent (100% rule)**
  - ***Typically*** the WBS is produced in parallel with CARD / Technical Baseline and they evolve together

  - *The WBS is like Prego® for Engineers: "It's in there!"*
    - Includes all the ingredients for a successful marriage (or at least, a successful cost estimate):
      - Hardware, Software, Services, Data, and Facilities. Usually for the entire lifecycle of the program/system.

"product oriented family tree"

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Primary Standards / Guides

- **All Agency / General**
  - 'The GAO Cost Guide' aka GAO-09-3SP (Mar 2009) [Chp. 8]
  - CAPE Operating and Support Cost Estimating Guide (Mar 2014)
- **DoD Specific**
  - MIL-STD-881c (Oct 2011)
- **NASA Specific**
  - NASA Cost Estimating Handbook v 4.0 (Feb 2015) [Appendix B]

- **Consistent themes:**
  - Product Oriented
  - 100% Rule
  - Mutually Exclusive
  - Standardize Across Program
  - At least to Level 3

- **Rules of thumb for lowest lvl:**
  - "80 hours"
  - "single reporting period"
  - "it makes sense"

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Challenges Overview - Building & Utilizing WBS Effectively

- **Challenges with terminology**
  - Program WBS vs. Contract WBS
  - Product Oriented vs. Functionally Oriented
- **Understanding and applying 'common elements'**
- **Consistency across program documents**
- **Evolution over time**
  - Increasing detail due to improved requirements
  - 881C vs. O&S

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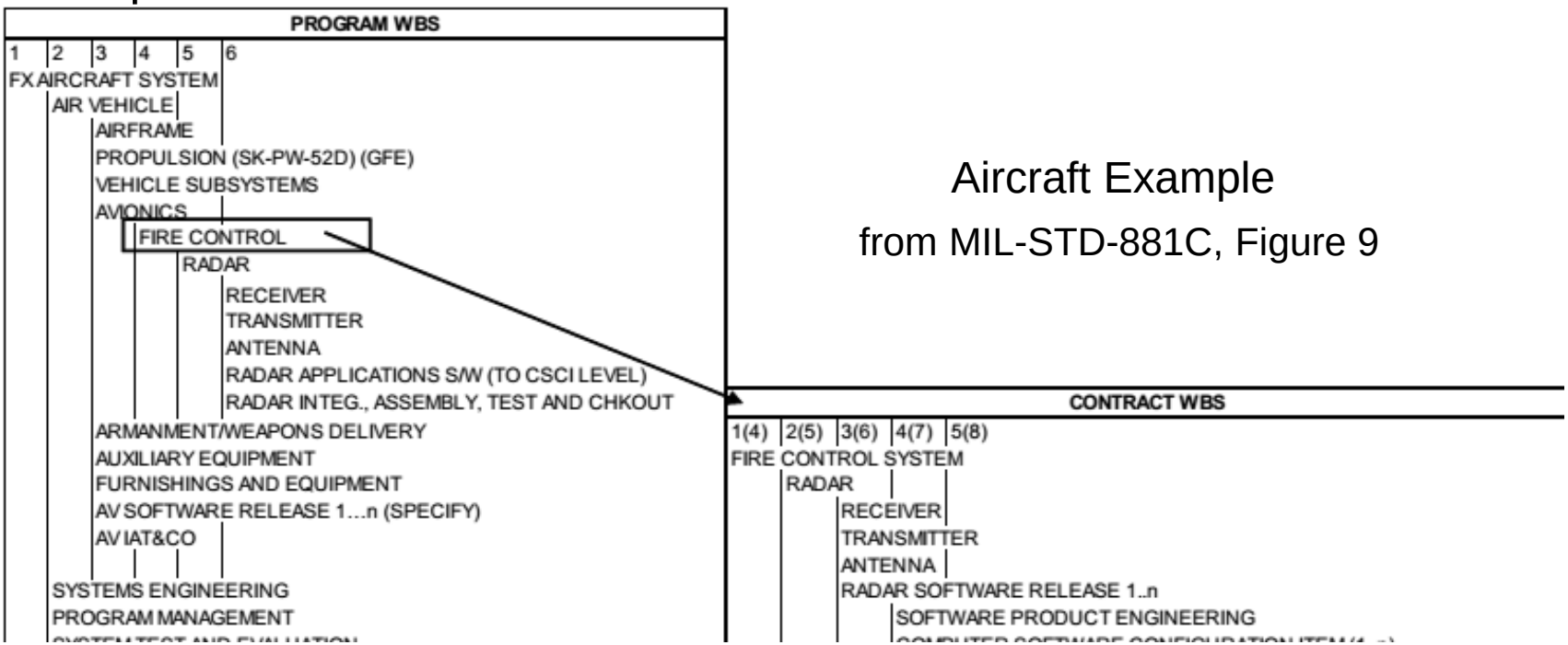
Challenges: Program vs. Contract

- **Program WBS vs. Contract WBS**
  - **Program WBS** encompasses the ***entire*** program
  - **Contract WBS** only includes the elements for which that contractor is responsible. Reporting level will be negotiated and specified in the contract.



Aircraft Example

from MIL-STD-881C, Figure 9

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Challenges (cont): Product Oriented

- **Product Oriented vs. Functionally Oriented**
  - Sometimes tempting to break WBS into **phases**, rather than products (e.g. RDTE, Procurement, O&S) or into **functions** (such as manufacturing, engineering, or quality control)
    - Nearly impossible to identify problems and implement solutions
    - No guarantee 100% of the work is identified
    - No uniformity across government, industry, or academia
  - **Product Oriented** is a best practice
    - Track cost & schedule by defined deliverables
    - Captures 100% of the costs for various deliverables
    - Standardizes and simplifies reporting for cost data collection (e.g. DACIMS) as well as for EVM analysis

Inappropriate Elements:
Functions, such as design engineering, requirements analysis, test engineering, tooling, retest, refurbish, restock, etc // Program acquisition phases and fund types // Recurring & Nonrecurring classifications // Organizational structure

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Challenges (cont): Common Elements

GAO cost guide (March 2009)
881c (Oct 2011)

- **"Common Elements"**
  - Apply to multiple levels of the WBS, not just Level 2
    - Not all common elements will appear at all levels, but some might
    - Need to be clear in the WBS dictionary
    - Strong emphasis on the 'includes' and 'excludes' statements (more on this in later slides)

- **Integration, Assembly, Test, and Checkout**
- **Systems Engineering**
- **Program Management**
- **Training**
- **Data**
- **System Test & Evaluation***

- **Peculiar Support Equipment**
- **Common Support Equipment**
- **Operational/Site Activation**
- **Facilities**
- **Initial Spares & Repair Parts**

Source: GAO Cost Guide, Table 8

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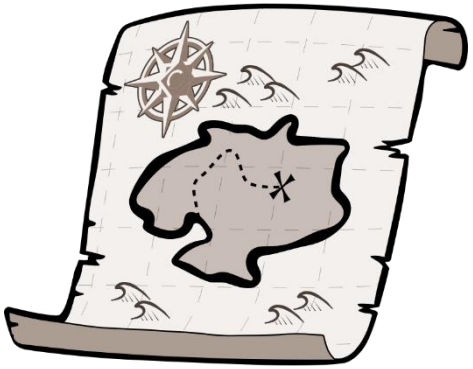
Challenges (cont): Consistency

- **Consistency Across Program Documents**
  - Establish WBS and Dictionary early; makes consistency easier
  - Use same numbering and refer directly to the dictionary
    - Requirements / Specifications
      - e.g. “AIS to process 10M records per day with custom interface to…”)
    - WBS Elements
      - 1.0 AIS
        - 1.1 AIS PMP
          - 1.1.1 Custom Application Software
          - 1.1.2 Enterprise Service Element
        - 1.2 SE
        - 1.3 PM
    - SOW / PWS
      - “Task x.x.x will develop a software module (WBS 1.1.1) to…”
    - IMP, IMS, CLINs, etc



Challenges (cont): Consistency Example Mapping

WBS	WBS Title	PWS Section #	PWS Section Title	Primary CLIN #	CLIN Description
1.10.1	Site Type 1: IT Enterprise				
1.10.1.1	Deployment Hardware and Software				
1.10.1.1.1	Deployment Hardware	5.7.4	Segment 1 Deployment	0010, 1012, 2012	IOC & Site Deployment
1.10.1.1.2	Deployment Software	5.2.2 "a"	SW Requirements, subsection "a"	0005, 0006, 1005, 1006, 1007, 2005, 2006, 2007	Software Licenses
1.10.1.2	User Documentation	CDRL	not separately priced	ODC CLINs only	ODC CLINs only

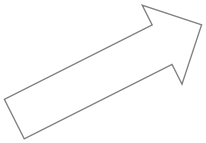
WBS	WBS Title
1.10.1	Site Type 1: IT Enterprise

PWS Section #	PWS Section Title

Primary CLIN #	CLIN Description
0010, 1012, 2012	IOC & Site Deployment
0005, 0006, 1005, 1006, 1007, 2005, 2006, 2007	Software Licenses

Challenges (cont): Time

- **Time**
  - WBS Evolves and becomes more detailed over time (requirements become more detailed)
  - O&S Estimating becomes more important over time
  - WBS consistency challenges transitioning from RDTE/Investment to O&S
    - 881C focus is early acquisition; product oriented
    - CAPE O&S guide focus is post acquisition



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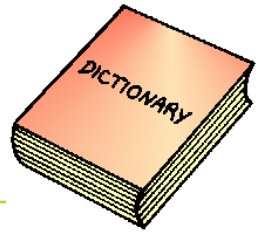
Challenges (cont): WBS Dictionary



- **Perhaps the most important part of WBS development, the dictionary guides everyone**
  - Provides the specific detail of what *is* and *is not* included in every element
    - Best practice: provide pointer to alternative sections. Also, keep date references so the entire team knows which dictionary is current.

WBS	L	Title	Description (updated 6/30/2014)
1.8	2	Peculiar Support Equipment	The design, development, and production of those deliverable items and associated software required to support and maintain the system or portions of the system while the system is not directly engaged in the performance of its mission, and which are not common support equipment. Includes, for example: a. Any production of duplicate or modified factory test or tooling equipment delivered to the Government for use in maintaining the system. (Factory test and tooling equipment initially used by the contractor in the production process but subsequently delivered to the Government will be included as cost of the item produced.) b. Any additional equipment or software required to maintain or modify the software portions of the system Excludes, for example: a. Overall planning, management and task analysis functions inherent in the work breakdown structure element, systems Engineering/Program Management (1.2, 1.3) b. Common support equipment, presently in the DoD inventory or commercially available, bought by the using command, not by the acquiring command

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Challenges (cont): WBS Dictionary

- 1.6 **Training** - Deliverable training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will learn to operate and maintain the system with maximum efficiency.

  Includes, for example:
  a. All effort associated with the design, development, and production of deliverable training equipment and its associated software as well as the execution of training services
  b. Operational trainers, maintenance trainers, training testers, and other items such as cutaways, mock-ups, and models
  c. Training course material development; contractor-conducted training (in-plant and service training); and the materials and curriculum required to design, execute, and produce a contractor developed training program
  d. Materiel, courses, and associated documentation (primarily the computer software, courses and training aids)
  e. Modification or rehabilitation of existing facilities used to accomplish training objectives
  f. Development
  g. Training and professional development
  h. Training software

  Excludes, for example:
  a. User training costs (user training occurs at each individual site deployment under 1.10.x.4)

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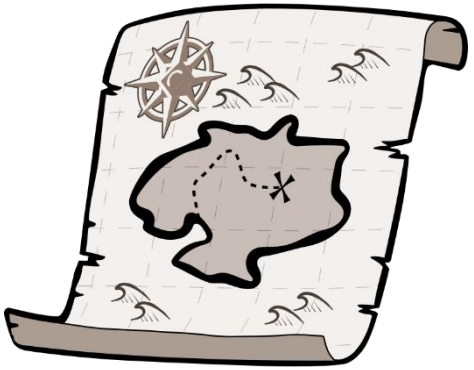

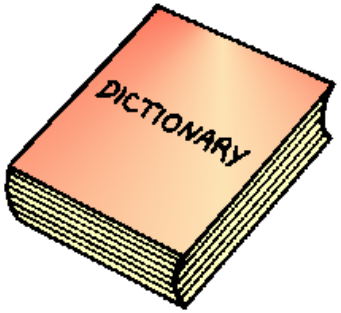

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