<u>WBS Development:</u> Rules, Aberrations, and MIL-STD-881C Implementation Challenges

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Some material was taken from DCARC training materials also developed by:
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Work Breakdown Structures

- Defines the work necessary to complete a project
- Provides a consistent framework for project management
- Can be used to track cost, schedule, and technical data
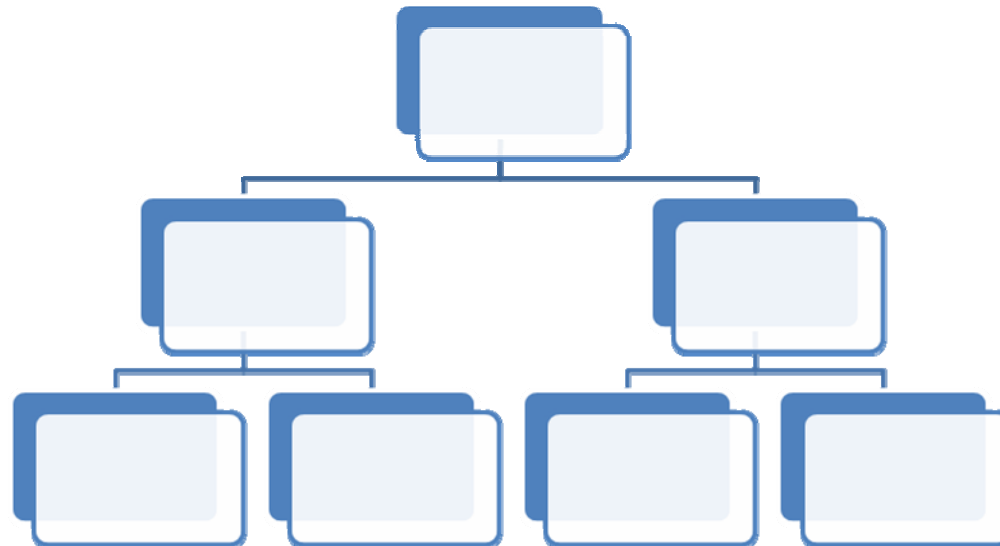
WBS Application in DoD

- Product-oriented
  - Composed of hardware, software, services, data, and facilities elements that make up end item

- Derived from MIL-STD-881C appendix
  - Prime Mission Product (PMP) required to Level 3, Common Elements to Level 2
  - Lower level elements must come from MIL-STD-881C where available

- Created by CWIPT prior to RFP
  - Data quality increases when WBS defined up front

Goal: Achieve a consistent application of the WBS for <u>all programmatic needs</u>

Product-Oriented WBS

GAO Best Practices:

Prime Mission WBS elements are defined deliverables (products)

Hierarchical structure

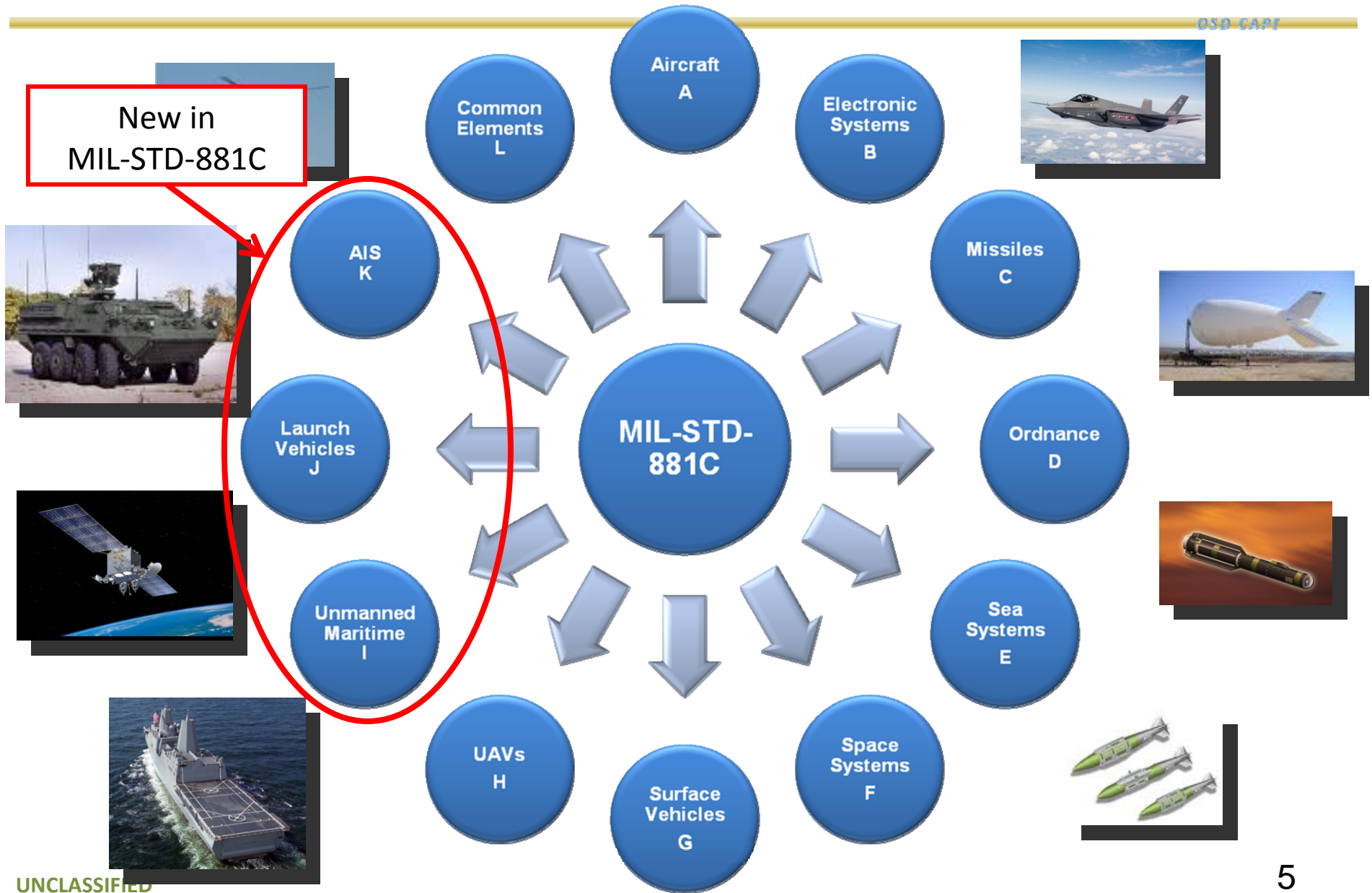100% Rule: Lower-level elements sum to equal the parent element

Standardized at higher levels, program specific at lower levels (Level 4+)

From MIL-STD-881C Appendix A for Aircraft	
WBS Element Code	WBS Element Name
1.0	F-51 Fighter
1.1	Air Vehicle
1.1.1	Airframe
1.1.2	Propulsion
1.1.3	Vehicle Subsystems
1.1.4	Avionics
1.1.4.1	Avionics IAT&C
1.1.4.2	Communication/Identification
1.1.4.3	Navigation/Guidance
1.1.4.3.1	Navigation
1.1.4.3.2	Guidance
1.1.4.4	Mission Computer/Processing
…	…
1.1.4.12	Avionics Software Releases
1.1.5	Armament/Weapons Delivery
…	…
1.1.9	Air Vehicle IAT&C
1.2+	[Common Elements, such as SE/PM, Data, Training, etc.]

MIL-STD-881C Appendices

New in MIL-STD-881C

- Common Elements L
- Aircraft A
- Electronic Systems B
- AIS K
- Missiles C
- Launch Vehicles J
- MIL-STD-881C
- Ordnance D
- Unmanned Maritime I
- Sea Systems E
- UAVs H
- Surface Vehicles G
- Space Systems F

Other WBS Rules

- ## WBS Level:
  - Only high-value, high-risk, or high-interest elements should be defined below Level 3 or 4
  - No "Single Child" elements

- ## If it doesn't fit, use Appendix B
  - Electronic Systems WBS is framework for any PMP
    - Allows system to be broken into subsystems and provides distinction for hardware and software
  - Often used for Subcontract WBS

- ## Robust WBS Dictionary is required
  - Context is needed to make data useful

WBS Drivers and Influences
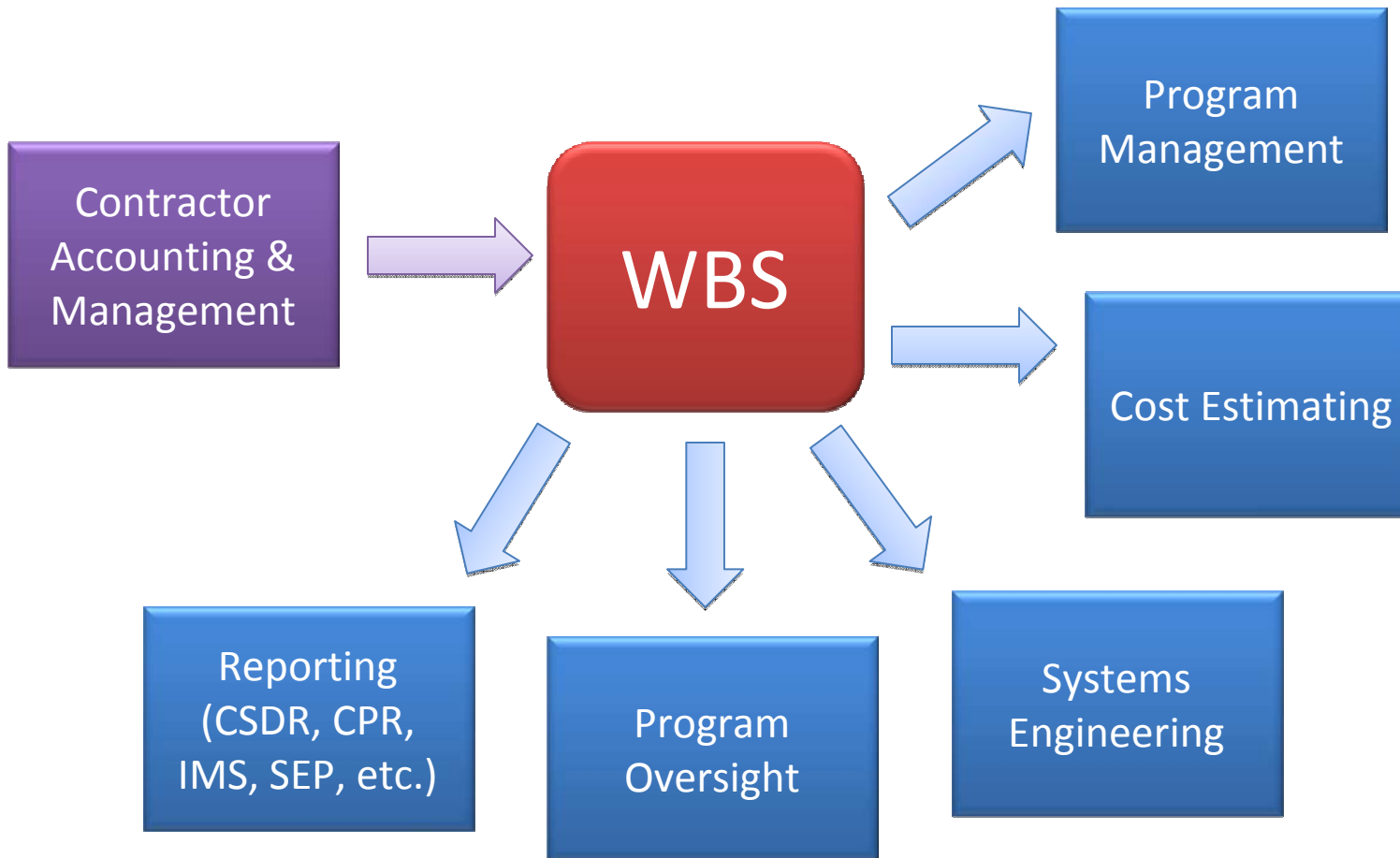
Consider: WBS developed prior to RFP & Award

WBS: A Question of Balance

- ## WBS development requires balance between:

  - ### Program Management and Cost Estimating

    - Must meet current needs, but also have a long view

  - ### Standardization and Flexibility

    - New MIL-STD-881C adds a structure for adding program-specific elements; is it enough?

  - ### Government data needs and Contractor processes

    - Accurate data requires WBS to have a close tie to contractor accounting system, but not at the expense of data utility
    - Level of detail requested may incur large reporting burden
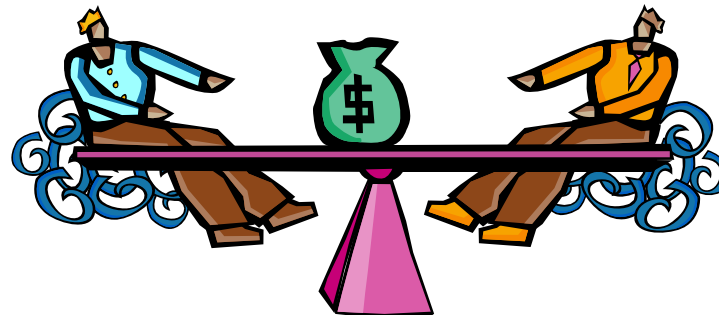
WBS Development Aberrations

- WBS development rules and guidance do not detail implementation for some common scenarios
  - Operations & Support (O&S)
  - Programs with multiple variants
  - Technology Development
  - Non-contract costs

Aberrations – O&S

- ## MIL-STD-881C focuses on acquisition
- ## Contractor Sustainment Report (CSR, 1921-4) contains O&S reporting structure
  - ### Not a product-oriented WBS
  - ### But: MIL-STD-881C WBS elements can be added where appropriate
    - e.g. under "CONSUMABLES AND REPAIR PARTS" include Propulsion, Flight Control, Electrical etc.
  - ### Matches forthcoming O&S Cost Estimating Guide from OSD/CAPE

Aberrations – Multiple Variants

Two-Variant Examples: Notice that tracking of **Common HW/SW** and **Common Elements** is key

Option 1 WBS:

1.1 Variant A HW

1.2 Variant B HW

1.3+ SE/PM, Data, Training, etc.

OR

Option 2 WBS:

1.1 Common HW

1.2 Var. A-Specific

1.3 Var. B-Specific

1.4+ SE/PM, Data, Training, etc.

OR

Option 3 WBS:

1.1 Aircraft HW
1.2+ Aircraft SE/PM, Data, Training, etc.

Common Report

Variant A Report

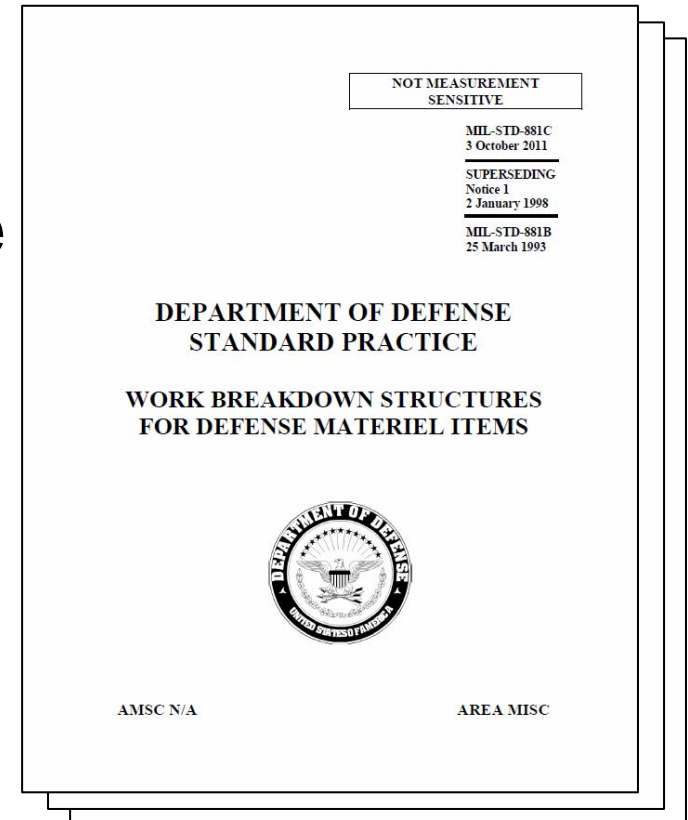**Variant B Report**

Other Aberrations

OSD CAPE

- ## Technology Development phase

  - It is difficult to build a product-oriented WBS when the product is not well-defined

  - WBS can be built at high-level, but detail some stakeholders desire may be lost

- ## Non-contract Program costs

  - Not addressed in MIL-STD-881C and no consistent framework exists

  - e.g. Program Office, Labs, Government-Furnished Equipment

MIL-STD-881C Overview

OSD CAPE

- **Issued October 2011**
  - Supersedes and cancels MIL-HDBK-881A

- **Overarching document for use in all DoD acquisitions**

- **Documents the process for building a WBS**

- **Includes definitions for common elements and eleven commodity types**

NOT MEASUREMENT SENSITIVE

MIL-STD-881C
3 October 2011

SUPERSEDING
Notice 1
2 January 1998

MIL-STD-881B
25 March 1993

DEPARTMENT OF DEFENSE STANDARD PRACTICE

WORK BREAKDOWN STRUCTURES FOR DEFENSE MATERIEL ITEMS

AMSC N/A

AREA MISC

New in MIL-STD-881C

- Three new Appendices added
- WBS defined below Level 3 for most commodities
  - Space to Level 5
  - Sea Systems and Surface Vehicles remain at Level 3
  - All others to Level 4
- All elements and definitions reviewed and updated
- Includes a construct for expanding WBS for program-unique items and new technologies
  - Elements called "Other [Component] 1…n (Specify)" and similar
- WBS elements contain a standard numbering scheme

MIL-STD-881C Challenges

- **Implementation Requirements**
  - New start programs all use MIL-STD WBS
  - Existing contracts continue with approved WBS
  - All programs re-evaluated at new award & milestone
- **Standard numbering of WBS elements**
  - Should be maintained as part standardization
  - However, often lost with use of 1…n construct

MIL-STD-881C Challenges

OSD CAPE

- Using the 1…n Construct
  - 243 instances of expandable elements across appendices
  - These cannot all be implemented the same way

Wake Up!
It's time to go to School!

"1...n Construct: The Basics"

OSD CAPE

A: Related set of elements

WBS Element Code	MIL-STD 881C Appendix A WBS Element Name
1.0	F-51 Fighter
1.1	Air Vehicle
…	…
1.1.7	Furnishings and Equipment
1.1.8	Air Vehicle Software Release 1...n
1.1.9	Air Vehicle Integration, Assembly, Test, and Checkout

WBS Element Code	Implementation A WBS Element Name
1.0	F-51 Fighter
1.1	Air Vehicle
…	…
1.1.7	Furnishings and Equipment
1.1.8	Air Vehicle Software Releases
1.1.8.1	Air Vehicle Software Release 1
1.1.8.2	Air Vehicle Software Release 2
1.1.8.3	Air Vehicle Software Release 3
1.1.9	Air Vehicle Integration, Assembly, Test, and Checkout

B: Independent components

WBS Element Code	MIL-STD 881C Appendix A WBS Element Name
1.0	F-51 Fighter
1.1	Air Vehicle
1.1.1	Airframe
1.1.1.1	Airframe Integration, Assembly, Test and Checkout
1.1.1.2	Fuselage
1.1.1.3	Wing
1.1.1.4	Empennage
1.1.1.5	Nacelle
1.1.1.6	Other Airframe Components 1...n (Specify)
1.1.2	Propulsion

WBS Element Code	Implementation B WBS Element Name
1.0	F-51 Fighter
1.1	Air Vehicle
1.1.1	Airframe
1.1.1.1	Airframe Integration, Assembly, Test and Checkout
1.1.1.2	Fuselage
1.1.1.3	Wing
1.1.1.4	Empennage
1.1.1.5	Nacelle
1.1.1.6	Stealth Special Airframe Part A
1.1.1.7	Stealth Special Airframe Part B
1.1.2	Propulsion

"1…n Construct 202"

WBS Element Code	MIL-STD-881C Appendix H WBS Reporting Elements
1.0	UAV System
1.1	Air Vehicle
1.2	Payload
1.2.1	Payload Integration, Assembly, Test and Checkout
1.2.2	Survivability Payload 1...n (Specify)
1.2.3	Reconnaissance Payload 1...n (Specify)
1.2.4	Electronic Warfare Payload 1...n (Specify)
1.2.5	Armament/Weapons Delivery Payload 1...n (Specify)
1.2.6	Payload Software Release 1...n
1.2.7	Other Payload 1...n (Specify)

UAV Payloads: Are they a single system or not?

WBS Element Code	Implementation A WBS Reporting Elements
1.0	UAV System
1.1	Air Vehicle
1.2	Payload
1.2.1	Payload IAT&CO
1.2.2	Survivability Payloads
1.2.2.1	Survivability Payload 1
1.2.2.2	Survivability Payload 2
1.2.2.3	Survivability Payload 3
1.2.3	Reconnaissance Payload 1
1.2.4	Electronic Warfare Payload 1
1.2.5	Armament/Weapons Delivery Payload 1
1.2.6	Payload Software Release 1
1.2.7	Other Payload 1

Or

| WBS Element Code	Implementation B WBS Reporting Elements
1.0	UAV System
1.1	Air Vehicle
1.2	Payload
1.2.1	Payload IAT&CO
1.2.2	Survivability Payload 1
1.2.3	Survivability Payload 2
1.2.4	Survivability Payload 3
1.2.5	Reconnaissance Payload 1
1.2.6	Electronic Warfare Payload 1
1.2.7	Armament/Weapons Delivery Payload 1
1.2.8	Payload Software Release 1
1.2.9	Other Payload 1

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"1…n Construct 303"

WBS Element Code	MIL-STD-881C Appendix B WBS Reporting Elements
1.0	Electronic System
1.1	Prime Mission Product (PMP) 1...n (Specify)
1.1.1	PMP Subsystem 1...n (Specify)
1.1.1.1	PMP Subsystem Hardware 1...n (Specify)
1.1.1.2	PMP Subsystem Software Release 1...n
1.1.1.3	Subsystem Integration, Assembly, Test and Checkout
1.1.2	PMP Software Release 1...n (Specify)
1.1.2.1	Software Product Engineering
1.1.2.2	Computer Software Configuration Item (CSCI) 1...n
1.1.2.3	Subsystem Integration, Assembly, Test and Checkout
1.1.3	PMP Integration, Assembly, Test and Checkout
1.2	Platform Integration, Assembly, Test and Checkout
1.3	System Engineering

WBS Element Code	Implementation C WBS Reporting Elements
1.0	Electronic System
1.1	Prime Mission Product
1.1.1	PMP Subsystem A
1.1.1.1	PMP Subsystem A Hardware
1.1.1.2	PMP Subsystem A Software
1.1.1.3	Subsystem A IAT&CO
1.1.2	PMP Subsystem B
1.1.2.1	PMP Subsystem B Hardware
1.1.2.2	PMP Subsystem B Software
1.1.2.3	Subsystem B IAT&CO
1.1.3	PMP Software
1.1.3.1	Software Product Engineering
1.1.3.2	CSCI 1
1.1.3.3	Subsystem IAT&CO
1.1.4	PMP IAT&CO
1.2	Platform IAT&CO
1.3	System Engineering

When Parent has 1…n Construct, maintain the level, repeat all Children
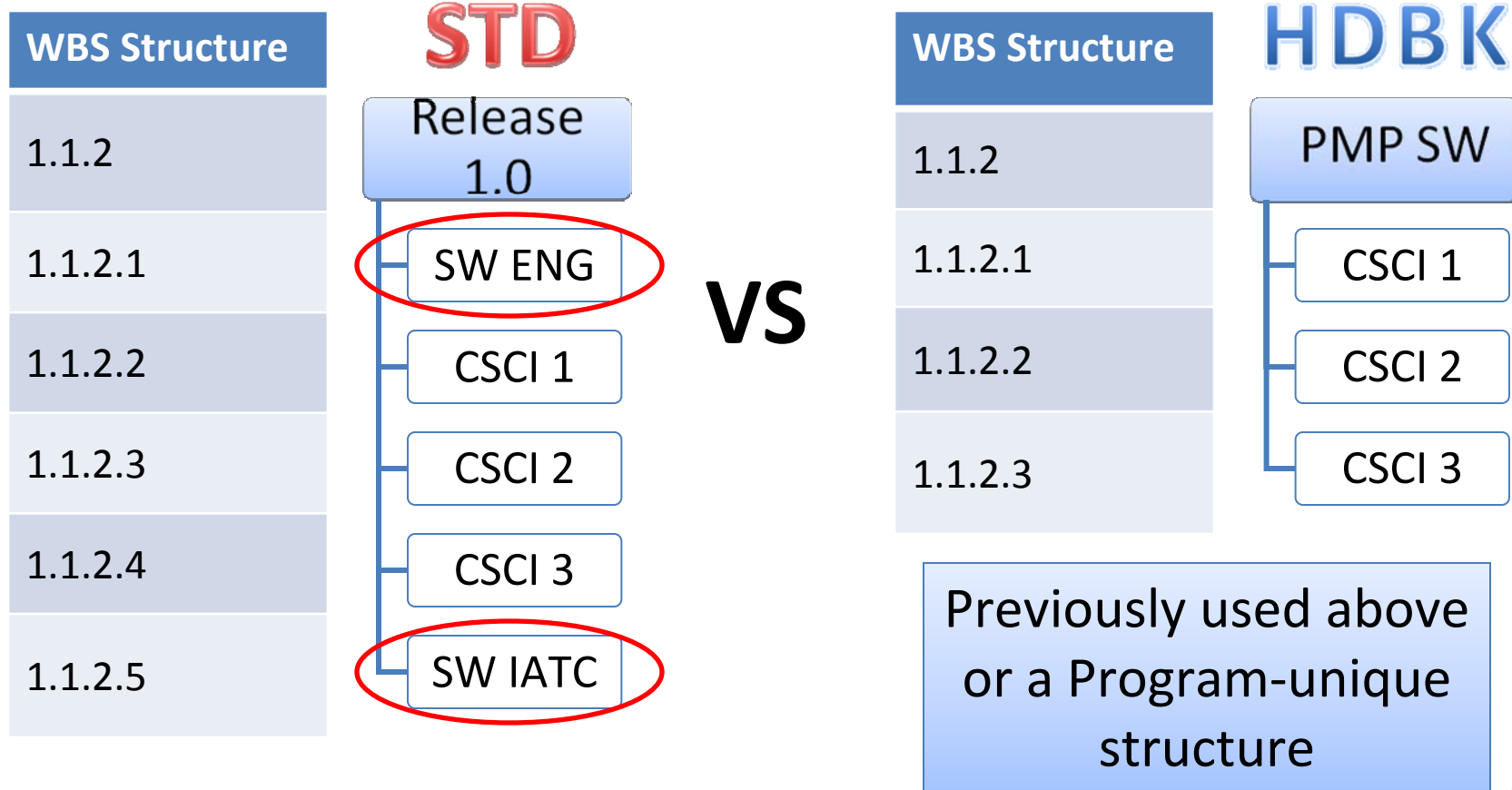
Take care when defining PMPs and Subsystems
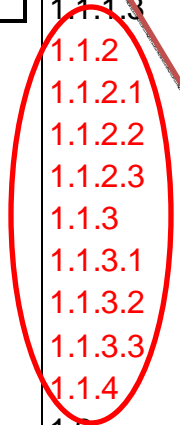
Software in MIL-STD-881C

- Appendix B provides a standard structure for lower-level software elements

Summary

OSD CAPE

- The WBS must balance the needs of numerous stakeholders

- MIL-STD-881C increases both flexibility and standardization in WBS development, though these can conflict

- Implications of MIL-STD-881C rollout are still being realized