WBS vs CES: Navigating Different Structures for Software Systems

Bakari Dale and Brad Dahlin

Presented at the 2018 ICEAA Professional Development & Training Workshop - www.iceaaonline.com

Agenda

- The Challenge:
  - Developing a WBS for AIS/DBS Sustainment activities
  - Generating the WBS Data Dictionary
  - Mapping to MIL-STD-881D
- The Basics: Background and Definitions
  - Work Breakdown Structure (WBS) Overview
  - Cost Element Structure (CES) Overview
  - Product Breakdown Structure (PBS) Overview
- MIL-STD-881D updates for AIS/DBS programs
- Conclusion

The views of the presenter do not necessarily represent those of Headquarters, Department of the Army.

The Challenge

- Understanding the recent updates to the AIS/DBS WBS and CES structures

- Through this brief we will answer the following questions:
  - How to differentiate between a WBS, PBS and CES?
  - What were the events leading to the current WBS/CES solutions?
  - How does the WBS Data Dictionary serves as the lynch pin to understanding the problem?
  - Can the AIS/DBS WBS be mapped to MIL-STD-881D?

The Basics - Overview

- Work Breakdown Structure (WBS):
  - A product-oriented family tree composed of hardware, software, services, data, and facilities. A WBS displays and defines the product, or products, to be developed and/or produced. It relates the elements of work to be accomplished to each other and to the end product. (MIL-STD-881D)
- Product Breakdown Structure (PBS):
  - The hierarchical breakdown of the products such as hardware items, software items, and information items. A PBS is different from a Work Breakdown Structure (WBS) in that it outlines products to be built or bought instead of work to be done. (*NASA Systems Engineering Handbook*)
- Cost Element Structure (CES):
  - This breakdown structure groups costs into system-specific and appropriation-discrete cost elements. (*Department of the Army Cost Analysis Manual*)
  - A set of i) mutually exclusive and ii) exhaustive categories of cost that serve as the structure of (basis for) a cost estimate. Similar to a contract work break down structure and a work breakdown structure. Many CESs are standardized for use within DoD (and also in industry. (CEBOK)

The key differentiator is the focus; Work, Product, or Cost

The Basics – WBS (MIL-STD-881D-Appendix J)

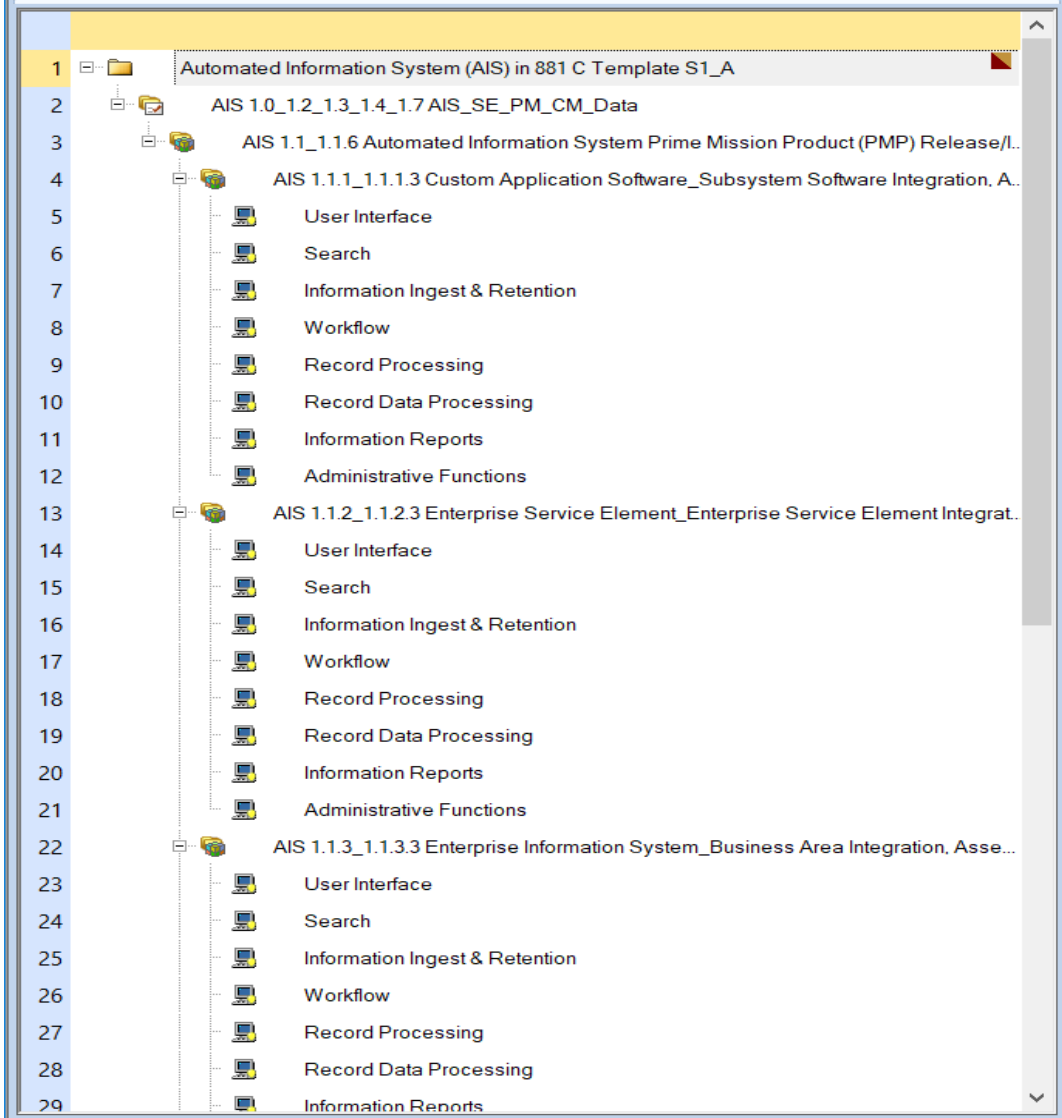
WBS #	Level 1 ⇐ Level 2 ⇐ Level 3 ⇐ Level 4
1	Information Systems (IS)/Defense Business Systems (DBS) (Investment)
1.1	IS/DBS Development/Customization/Configuration
1.1.1	Custom Application 1…n (Specify)
1.1.1.1	Subsystem Hardware (Specify)
1.1.1.2	Subsystem Software CSCI 1…n (Specify)
1.1.1.3	Subsystem Software Level Integration, Assembly, Test, and Checkout
1.1.2	Enterprise Service Element 1…n (Specify)
1.1.2.1	Enterprise Service Element Hardware (Specify)
1.1.2.2	Enterprise Service Element Software CSCI 1…n (Specify)
1.1.2.3	Enterprise Service Element Integration, Assembly, Test, and Checkout
1.1.3	Enterprise/Management Information System 1…n (Specify)
1.1.3.1	Business Area Hardware (Specify)
1.1.3.2	Business Area Software CSCI 1…n (Specify)
1.1.3.3	Business Area Integration, Assembly, Test, and Checkout
1.1.4	External System Interface Development 1…n (Specify)
1.1.4.1	External System Interface Hardware (Specify)
1.1.4.2	External System Interface Software CSCI 1…n (Specify)
1.1.4.3	External System Interface Integration, Assembly, Test, and Checkout
1.1.5	System Level Hardware (Specify)
	. . .
1.12	Operational Infrastructure/Site Activation By Site 1…n (Specify)
1.12.1	Initial Hardware Procurement
1.12.1.1	End User Equipment
1.12.1.2	Cybersecurity Equipment
1.12.1.3	IT Infrastructure and Enterprise Software Equipment
1.12.1.4	Other 1…n (Specify)
1.12.2	Initial Software License Procurement
1.12.2.1	End User Software License
1.12.2.2	Cybersecurity Software Licenses/Services
1.12.2.3	IT Infrastructure and Equipment
1.12.2.4	
	. . .

WBS Benefits

- Separates work elements into their component parts
- Clarifies relationships between the parts, the end product, and the tasks to be completed
- Facilitates effective planning and assignment of management and technical responsibilities
- Helps track the status of technical efforts, risks, resource allocations, expenditures, and the cost and schedule of technical performance
- Provides a common basis and framework for the EVM system and the IMS, facilitating consistency in understanding program cost, schedule, and performance

The Basics - PBS

Simple | Detailed



PBS Benefits

- Similar to WBS (reduces complex project/product into manageable components)
- Hierarchal structure
- Focuses on the product
- Main product subdivided into smaller systems
- Primarily composed of the physical elements

The Basics – SW CES

CES #	Nomenclature
1.0	Investment
1.1	Program Management
1.2	Concept Exploration
1.2.1	Engineering Analysis and Specification
1.2.2	Concept Exploration Hardware
1.2.3	Concept Exploration Software
1.2.4	Concept Exploration Data
1.2.5	Concept Exploration Documentation
1.2.6	Concept Exploration Testing
1.2.7	Facilities
1.2.8	Other
1.3	System Deployment
1.3.1	System Design and Specification
1.3.2	Prototype & Test Site Investment
1.4	System Procurement
1.4.1	Deployment Hardware
1.4.2	System Deployment Software
1.4.3	Initial Documentation
1.4.4	Logistics Support Equipment
1.4.5	Initial Spares
1.4.6	Warranties
1.5	Outsource Investment
1.5.1	Capital Investment
1.5.2	Software Development
1.5.3	System User Investment
1.6	System Implementation & Fielding
1.7	Upgrades
1.8	Disposal & Reuse

CES Benefits

- Appropriation phased structure lends itself well to LCCE development
- Aligns with the defense acquisition management process (including milestone decision reviews) and the PPBES (including MDEPs and budget forms).
- When combined with the WBS with the CES forms a structure that provides the primary means for ensuring the consideration of all appropriate costs.

The Basics – Side-by-Side Comparisons

Work Breakdown Structure

WBS #	Level 1 Level 2 Level 3 Level 4
1	Information Systems (IS)/Defense Business Systems (DBS) (Investment)
1.1	IS/DBS Development/Customization/Configuration
1.1.1	Custom Application 1…n (Specify)
1.1.1.1	Subsystem Hardware (Specify)
1.1.1.2	Subsystem Software CSCI 1…n (Specify)
1.1.1.3	Subsystem Software Level Integration, Assy, Test, & Checkout
1.1.2	Enterprise Service Element 1…n (Specify)
1.1.2.1	Enterprise Service Element Hardware (Specify)
1.1.2.2	Enterprise Service Element Software CSCI 1…n (Specify)
1.1.2.3	Enterprise Service Element Integration, Assy, Test, & Checkout
1.1.3	Enterprise/Management Information System 1…n (Specify)
1.1.3.1	Business Area Hardware (Specify)
1.1.3.2	Business Area Software CSCI 1…n (Specify)
1.1.3.3	Business Area Integration, Assembly, Test, and Checkout
1.1.4	External System Interface Development 1…n (Specify)
1.1.4.1	External System Interface Hardware (Specify)
1.1.4.2	External System Interface Software CSCI 1…n (Specify)
1.1.4.3	External System Interface Integration, Assy, Test, & Checkout
1.1.5	System Level Hardware (Specify)
1.2	System Level Integration
1.3	Systems Engineering
1.4	Program Management
1.6	Data Management
1.7	System Test & Evaluation
1.8	Training
1.9	Data
1.10	Peculiar Support Equipment
1.11	Common Support Equipment
1.12	Operational Infrastructure/Site Activation By Site 1…n (Specify)
1.12.1	Initial Hardware Procurement
1.12.1.1	End User Equipment
1.12.1.2	Infrastructure Equipment

Cost Element Structure

CES #	Nomenclature
1.0	Investment
1.1	Program Management
1.2	Concept Exploration
1.2.1	Engineering Analysis and Specification
1.2.2	Concept Exploration Hardware
1.2.3	Concept Exploration Software
1.2.4	Concept Exploration Data
1.2.5	Concept Exploration Documentation
1.2.6	Concept Exploration Testing
1.2.7	Facilities
1.2.8	Other
1.3	System Deployment
1.3.1	System Design and Specification
1.3.2	Prototype & Test Site Investment
1.4	System Procurement
1.4.1	Deployment Hardware
1.4.2	System Deployment Software
1.4.3	Initial Documentation
1.4.4	Logistics Support Equipment
1.4.5	Initial Spares
1.4.6	Warranties
1.5	Outsource Investment
1.5.1	Capital Investment
1.5.2	Software Development
1.5.3	System User Investment
1.6	System Implementation & Fielding
1.7	Upgrades
1.8	Disposal & Reuse

881D AIS/DBS Formats (9 April 2018)

AIS/DBS WBS Structures:

- Appendix B - Electronic/Generic Systems
- Appendix J - Information Systems/Defense Business Systems

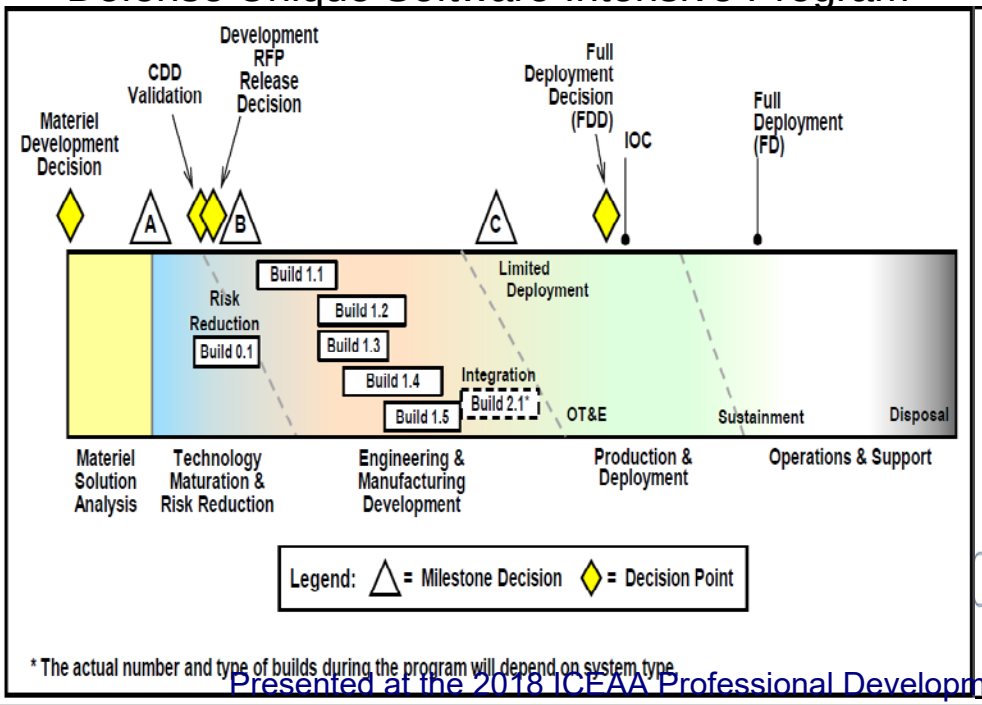
881D Changes to Appendix J:

- Changed the title of Automated Information Systems (now Appendix J) to Information Systems/Defense Business Systems to reflect DoDI 5000.75: "Business Systems Requirements and Acquisition."
- Added a Sustainment Structure for Information Systems/Defense Business Systems (Appendix J) to recognize the overlap of acquisition and sustainment activities on the acquisition contract. For IS/DBS, this structure should be used to appropriately reflect sustainment activities on IS/DBS

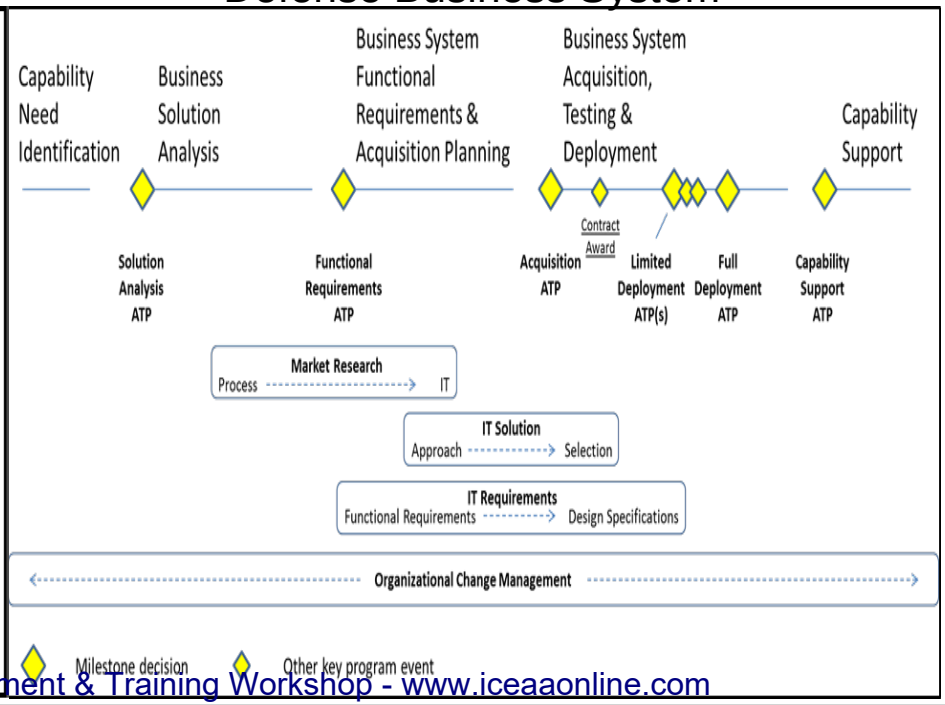
Acquisition Lifecycle – MAIS & DBS

- ACAT Thresholds (MAIS/DBS)
  - ACAT IA: $40M single year; $165M in Investment; $520M lifecycle; or Special Interest
  - ACAT IIA: N/A
  - ACAT IIIA: An AIS program that is not a MAIS program (ACAT IA)
  - BCAT I: FYDP > of $250M, or designated as a priority
  - BCAT II: FYDP > $50M, or designated as requiring Chief Management Officer (CMO) certification
  - BCAT III: Does not meet criteria for BCAT II

Defense Unique Software Intensive Program

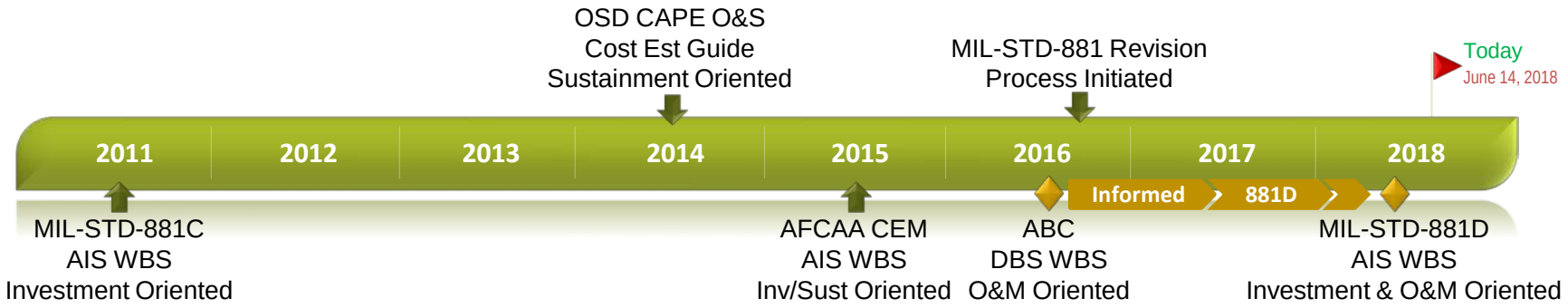


Defense Business System



The views of the presenter do not necessarily represent those of Headquarters, Department of the Army.

AIS/DBS WBS – Evolution & Challenge



Answering the Challenge:

Task: Assigned to develop a solution to catalog and validate sustainment related costs (e.g. patches, hosting, RICE-FW object refinement, external requirements) for Army Enterprise Resource Programs

Challenges/Constraints:

- Defense Business Systems under 5000.75 following a new acquisition lifecycle
- DBSs do not follow the typical warfighter AIS solution set
- DBSs are composed of large and complex COTS solutions requiring trade-off decisions between out of the box COTS capabilities and costly Business Process Reengineering
- Unique roles and responsibilities of the Lead Systems Integrator not replicated within warfighter systems

The views of the presenter do not necessarily represent those of Headquarters, Department of the Army.

WBS Data Dictionary – The Key to Mapping

- WBS Dictionary Attributes (per the GAO Cost Estimating and Assessment Guide)
  - *A WBS dictionary is a document that describes, in brief narrative format, what work is to be performed in each WBS element.*
  - ***A properly defined WBS dictionary is necessary to avoid inconsistencies.***
  - *The WBS dictionary should state where the functional elements fall within the products and how the statement of work elements come together to make specific products*
- This step was absolutely critical:
  - To ensure DBS data is properly captured moving forward
  - Lay the foundation for a common structure that can both address the unique attributes of DBS systems and allow the programs to easily map to 881D

ARMY DBS WBS mapped to 881D (Sustainment)

PRICE COST ESTIMATION SOLUTIONS

ARMY DBS O&M WBS

WBS #	Nomenclature
1.2	OPERATIONS AND MAINTENANCE
1.2.1	Program/Project Management
1.2.2	Systems Engineering
1.2.3	Business Process Re-Engineering/ Change Manage
1.2.4	Help Desk/Service Desk Support
1.2.5	Annual Operations Procurement
1.2.6	Central Data Center Operating S
1.2.7	Technology Refresh/Upgrade
1.2.7.1	Update Development (System Sof
1.2.7.2	Life Cycle Updates Procurement
1.2.7.3	Central Data Center Updates
1.2.7.4	System Hardware
1.2.7.5	Other Technology Refresh/Upgrade
1.2.8	System Maintenance
1.2.8.1	Hardware Maintenance
1.2.8.2	Software Maintenance
1.2.8.3	Other System Maintenance
1.2.9	System Documentation & Related Data
1.2.10	System Data Maintenance
1.2.11	Site Operations
1.2.11.1	System Operation/Sustaining Engineering Personnel
1.2.11.2	Facilities Lease & Maintenance
1.2.11.3	Communications/Network
1.2.11.4	Recurring/Sustainment Training
1.2.11.5	Environmental & Hazardous Material Storage & Handling
1.2.11.6	Miscellaneous Support
1.2.12	Cybersecurity
1.2.13	Other Operations & Maintenance

Common WBS solution for DBS Army and DoD programs

Similar Structures & Data Dictionaries

MIL-STD-881D (Sustainment)

WBS #	Nomenclature (Sustainment)
2.0	Information Systems/DBS (Sustainment)
2.1	Program Management
2	Systems/Sustainment Engineering
	Change Management
	Help Desk
	Data Cleansing/Data Maintenance
	System/Database Administration
	IT Infrastructure/Network Maintenance Support
.1	IT Infrastructure Hardware/Equipment Maintenance
	IT Infrastructure Software License Support Services
2.7.3	IT Infrastructure Management
2.7.4	Other IT Infrastructure Support 1…n (Specify)
2.8	Operational Hardware Refresh/Upgrade
2.8.1	End-User Equipment
2.8.2	Cybersecurity Equipment
	T Infrastructure and Enterprise Services Equipment
	ther (Specify)
	Operational Software License Refresh/Update
2.9.1	End-User Software License
2.9.2	Cybersecurity Software Licenses/Services
2.9.3	IT Infrastructure and Enterprise Software Licenses/Services
2.10	Cybersecurity Maintenance Management
2.10.1	Cybersecurity Compliance Operations and Tracking
2.10.2	Follow-on Cybersecurity Test and Evaluation
2.10.3	Cybersecurity and IT Certification and Accreditation
2.11	Follow-on User Training
2.12	System Independent Verification and Validation
2.13	Continuing System Improvements
2.14	AW/Safety/Networthiness Certification
2.15	Facilities

Conclusion

- Recent efforts improved the WBS solutions available to track DBS sustainment costs
- WBS mapping effort have resulted in improved consistency in 881D; Appendices B and J.
- Advantages of the Common WBS for Defense Business Systems:
  - Allows for cost accounting to be consistent across the various PEGs to support the PPBE process
  - Now able to look at shared services of the ERPs in an effort to reduce sustainment costs across the enterprise.
  - This common structure has set the foundation to easily map ERPs to 881D and to transition new ERPs to 881D.
- The ability to differentiate between a CES and WBS boils down to your understanding of the WBS data dictionary and how it is applied to a Product, Work, or Cost.

The views of the presenter do not necessarily represent those of Headquarters, Department of the Army.