DOC – Cost Estimating and Analysis Directorate

Kill Vehicle Work Breakdown Structure

Jennifer Tarin, Ph.D.
Paul Tetrault
Christian Smart, Ph.D.
MDA/DO

Approved for Public Release
14-MDA-7774 (9 April 14)

1

DOC – Cost Estimating and Analysis Directorate

Agenda

- Purpose
- Background
- Overview and Comparison of MDA Kill Vehicles
- Developing Alternate Kill Vehicle WBSs
- Description of Alternate Kill Vehicle WBSs
- Path Forward – Proposed Hybrid KV WBS
- Summary

2

Purpose

DOC – Cost Estimating and Analysis Directorate

- **Integrate MDA cost data with the overall DoD Defense Automated Cost Information Management System (DACIMS) database maintained by the Office of the Secretary of Defense (OSD) – Cost Assessment and Program Evaluation (CAPE) Defense Cost and Resource Center (DCARC)**
- **Propose and seek approval for Kill Vehicle (KV) Work Breakdown Structure (WBS) consistent with Military Standard 881C (MIL-STD-881C)**

3

Background

DOC – Cost Estimating and Analysis Directorate

- **MDA Director for Operations instructed MDA/DOC Director to extend support to DCARC to ensure inclusion of MDA cost data in the DoD DACIMS database**
- **Support requires MDA/DOC to work with DCARC on Contractor Cost Data Reporting – heavily dependent on a standard WBS**
- **MDA/DOC identified kill vehicles as a primary product MIL-STD-881C does not address**
- **MIL-STD-881C contains Missile Systems Appendix C which defines the payload element**
  - "Payload" often contains explosive warheads and includes a limited WBS
    - 1.1.8.1 Payload Integration Assembly Test and Checkout
    - 1.1.8.2 Target Defeat Mechanism
    - 1.1.8.3 Target Detection Device
    - 1.1.8.4 Fuse
    - 1.1.8.5 Payload Software Release 1…N
    - 1.1.8.6 Other payload Subsystem 1…N (Specific)

4

Kill Vehicles - Overview

DOC – Cost Estimating and Analysis Directorate

- **Kill Vehicle is a guided weapon that utilizes hit-to-kill technology after separation from a boosting vehicle**
  - Engage and destroy a ballistic missile threat and/or a threat re-entry vehicle
  - "Hitting a bullet with a bullet"
  - MDA kill vehicles use kinetic energy to destroy incoming threats
  - Operate autonomously as a short lived space vehicle
- **MDA is developing and fielding ballistic missiles that are multi-stage solid fuel boosters with kill vehicle payloads, these include:**
  - Ground-Based Midcourse Defense (GMD) Exo-atmospheric Kill Vehicle (EKV)
  - Aegis Ballistic Missile Defense (ABMD) Kinetic Warhead (KW)
  - Terminal High Altitude Area Defense (THAAD) Kill Vehicle (KV)
- **New WBS needs to support existing and new Kill Vehicle technologies that may include common KV component developments**

5

GMD – EKV

DOC – Cost Estimating and Analysis Directorate

- **Ground-Based Interceptor (GBI)**
  - Defensive weapon fielded by MDA
  - Engage and destroy limited intermediate- and long-range ballistic missile threats in space
- **Exo-atmospheric Kill Vehicle (EKV)**
  - Consists of seeker, Divert and Attitude Control System (DACS), communications link, guidance and control system, and computers to support target selection and interception
  - Uses guidance data transmitted from the ground support and fire control system components along with on-board sensors to close with and destroy the target warhead
  - Engages threat outside earth's atmosphere

6

ABMD – KW

DOC – Cost Estimating and Analysis Directorate

- **Standard Missile-3 (SM-3)**
  - Defensive weapon fielded by the U.S. Navy
  - Engage and destroy short- to intermediate-range, unitary and separating, midcourse-phase ballistic missile threats
- **Kinetic Warhead (KW)**
  - Consists of a seeker, DACS, communications link, guidance and control system, and computers to support target selection and interception
  - Uses guidance data transmitted from the Navy's Aegis Ballistic Missile Defense System components along with on-board sensors to close with and destroy the target warhead
  - Engages threat outside earth's atmosphere

7

THAAD – KV

DOC – Cost Estimating and Analysis Directorate

- **Terminal High Altitude Area Defense (THAAD)**
  - Defensive weapon fielded by the U.S. Army
  - Engage and destroy ballistic missiles inside or outside the atmosphere during the final, or terminal, phase of flight
- **Kill Vehicle (KV)**
  - Consists of a fore-cone, seeker, DACS, communications link, guidance and control system, and computers to support target selection and interception
  - Uses guidance data transmitted from Army Navy/Transportable Radar Surveillance components along with on-board sensors to close with and destroy the target warhead
  - Engages threat inside or outside the Earth's atmosphere

8

Comparison of MDA Kill Vehicles

DOC – Cost Estimating and Analysis Directorate

- **Aligns nomenclature differences between EKV, KW, and KV**
- **Identifies high level elements that have the same function**
- **Determines which elements to include or omit from initial KV WBS and define in the dictionary**
- **Results in a comprehensive WBS that efficiently identifies elements which can represent any current or future proposed MDA kill vehicles**

9

Developing KV WBS Alternatives

DOC – Cost Estimating and Analysis Directorate

- **MDA began by blending program KV WBSs requirements to form an initial Agency KV WBS**
  - Established an initial set of MDA kill vehicle required elements
  - Added projected new requirements including Multiple KV or common component developments
- **MDA considered several alternatives in creating the a proposed MIL-STD-881C KV WBS**
  - Simplified Space Systems WBS
  - Missile within Missile Systems WBS
  - Hybrid Missile and Space Systems WBS

10

Alternative I

DOC – Cost Estimating and Analysis Directorate

- **Derives from MIL-STD-881C Appendix F Space Systems**
- **Models kill vehicle from space vehicle and boosting system from launch vehicle; simplified Space Systems WBS**
- **Advantage: evolves from space vehicle WBS which defines essential kill vehicle sub-elements**
  - Predefined by MIL-STD-881C Appendix F
  - Presents a clear trace to the existing MIL-STD-881C
- **Drawbacks**
  - Space Systems WBS includes many extraneous elements
  - Subsystems required to support the space vehicle in exo-atmospheric conditions for long periods include sub-elements unnecessary to kill vehicle
  - Nomenclature differences that are atypical in the kill vehicle community
- **This approach involved modifications that were cumbersome and a complete WBS was NOT developed**

11

Alternative II

DOC – Cost Estimating and Analysis Directorate

- **Derives from MIL-STD-881C Appendix C Missile Systems**
- **Model both kill vehicle and boosting system with the air vehicle WBS; missile within a missile version of the Missile Systems WBS**
- **Advantages: evolves from the air vehicle WBS which defines essential kill vehicle elements**
  - Predefined by MIL-STD-881C Appendix C
  - Presents a clear trace to the existing MIL-STD-881C
- **Drawbacks**
  - Missile Systems WBS includes many extraneous elements
  - Air vehicle WBS contains unnecessary sub-elements and lacks essential sub-elements to kill vehicles
  - Payload WBS needs to include many sub-elements for the kill vehicle to map to the air vehicle
  - Results in multiple “reserve” elements

12

Alternative III – Proposed Hybrid KV WBS

DOC – Cost Estimating and Analysis Directorate

- **Derives from MIL-STD-881C Appendix F Space Systems and Appendix C Missile Systems**
- **Models both kill vehicle and booster from air vehicle in Appendix C; combines space vehicle elements from Appendix F to form a hybrid KV WBS with corresponding dictionary**
- **Advantages**
  - Develops a unique standalone solution to KV WBS
  - Leverages the best qualities of Alternatives I and II
  - Evolves from air vehicle and space vehicle WBS defining essential kill vehicle elements and sub-elements
    - Traces to MIL-STD-881C and kill vehicle is predefined by Appendix C
    - Traces kill vehicle sub-elements to space vehicle sub-elements in Appendix F
- **Drawbacks**
  - Combination of air vehicle and space vehicle elements will not trace easily to existing MIL-STD-881C
  - Some disadvantages of Alternatives I and II remain
  - Requires a combination of new, modified, reused elements and definitions to form hybrid KV WBS
  - Alignment of sub-elements becomes unique to the proposed KV WBS

13

Alternative III – Justification

DOC – Cost Estimating and Analysis Directorate

- **Alternative III advantages outweigh the drawbacks**
- **Foundation of the proposed Hybrid KV WBS traces largely to existing MIL-STD-881C appendices**
  - Missile Systems WBS functions as backbone
  - Space vehicle WBS provides details
- **Proposed KV WBS will be a substitute for payload of Appendix C Missile System WBS**
  - Begin numbering KV WBS with Appendix C WBS 1.1.8 Payload
  - Substitute KV WBS for payload as alternate
- **Proposed KV WBS is representative of MDA current and proposed future kill vehicles**

14

Proposed Hybrid KV WBS

DOC – Cost Estimating and Analysis Directorate

C.3 WORK BREAKDOWN STRUCTURE LEVELS

WBS#	1 2 3 4 5 6
1.1.8	Kill Vehicle
1.1.8.1	Kill Vehicle Structure and Harnesses
1.1.8.2	Divert and Attitude Control System (DACS)
1.1.8.2.1	DACS Integration, Assembly, Test and Checkout
1.1.8.2.2	Divert Subsystem
1.1.8.2.3	Attitude Control System
1.1.8.2.4	Gas Generator/Structure
1.1.8.2.5	Controller Electronics
1.1.8.2.6	Ordnance Initiation Set
1.1.8.2.7	Flight Termination System
1.1.8.2.8	DACS Software Release 1…n
1.1.8.3	Power and Distribution
1.1.8.3.1	Power and Distribution Integration, Assembly, Test and Checkout
1.1.8.3.2	Primary Power
1.1.8.3.3	Power Conditioning Electronics
1.1.8.3.4	Distribution Harness
1.1.8.3.5	Power and Distribution Software Release 1…n
1.1.8.4	Guidance and Control Processing
1.1.8.4.1	Guidance and Control Processing Integration, Assembly, Test and Checkout
1.1.8.4.2	Seeker Assembly
1.1.8.4.3.1	Seeker Integration, Assembly, Test and Checkout
1.1.8.4.3.2	Optical Telescope Assembly
1.1.8.4.3.3	Focal Plane Array
1.1.8.4.3.4	Cooling Assembly
1.1.8.4.3.5	Electronics
1.1.8.4.3.6	Gimbal Assembly
1.1.8.4.3.7	Seeker Software Release 1…n
1.1.8.4.3	Guidance Computer
1.1.8.4.4	Guidance and Control Processing Software Release 1…n

C.3 WORK BREAKDOWN STRUCTURE LEVELS

WBS#	1 2 3 4 5 6
1.1.8.5	Navigation
1.1.8.5.1	Navigation Integration, Assembly, Test and Checkout
1.1.8.5.2	Sensor Assemblies
1.1.8.5.3	Navigation Software Release 1…n
1.1.8.6	Communications
1.1.8.6.1	Communications Integration, Assembly, Test and Checkout
1.1.8.6.2	Communications Subsystem
1.1.8.6.3	Antenna Assembly
1.1.8.6.4	Communications Software Release 1…n
1.1.8.7	Reserved
1.1.8.8	Kill Vehicle Integration, Assembly, Test and Checkout
1.1.8.9	Systems Engineering
1.1.8.10	Program Management
1.1.8.11	System Test and Evaluation
1.1.8.12	Peculiar Support Equipment
1.1.8.13	Common Support Equipment

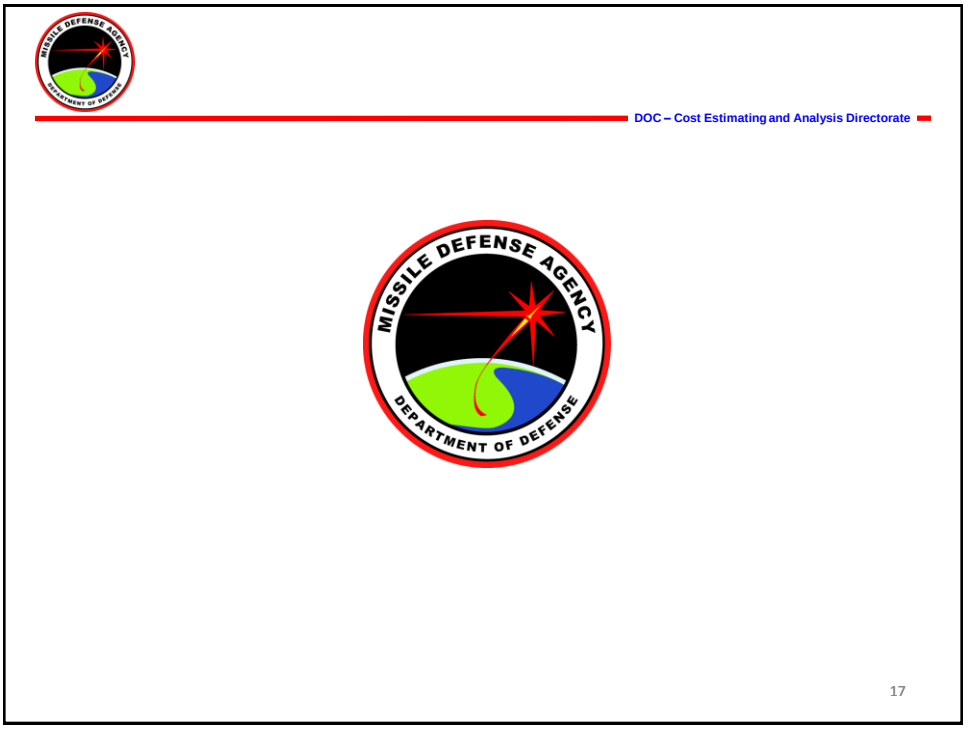
15

Path Forward

DOC – Cost Estimating and Analysis Directorate

- ✓**Distribute to MDA/DOC program Cost Leads for review**
- ✓**Present preliminary MIL-STD-881C WBS concept to OSD CAPE**
  - ✓Incorporate CAPE feedback
- ❑**Route to MDA programs for concurrence / suggestions**
- ❑**Distribute to MDA Prime KV Contractors for concurrence / suggestions**
- ❑**Present to MDA/DO C/CFO**
- ❑**Route Proposed Final to OSD CAPE**
- ❑**Submit to the Office of the Assistant Secretary of Defense for Acquisition, Performance Assessments and Root Cause Analysis (OASD(A))/PARCA for approval and inclusion in MIL-STD-881C**

16


DOC – Cost Estimating and Analysis Directorate
MISSILE DEFENSE AGENCY
DEPARTMENT OF DEFENSE
17