Enterprise Visibility And Management of Operating and Support Costs (EVAMOSC)

Sean Black
Operations Research Analyst
Office Secretary of Defense, Cost Assessment and Program Evaluation (OSD CAPE)
15 September 2020

1

Purpose

This presentation explains the use of a data lake to improve DOD operating and support cost collection, analysis, and reporting. Cloud technologies enable CAPE to meet its mission while also improving upon existing data collection methods.

- VAMOSC Data
  - Definition & History
  - Example
  - Potential Improvements
- CAPE Cloud Computing Environment
  - Architecture
  - Current Employment
- EVAMOSC Roadmap

Current State of VAMOSC

OSD CAPE

What is VAMOSC today?

- Each Military Department (USAF, Army, Navy) has a unique VAMOSC system

- Primary sources of operating and support (O&S) cost data, dating back to mid-1990s which maps data to weapon system vs budget line item

- Data warehouses accessible via the Internet, **however technology limits data collection**

- Programmatic, financial, personnel, inventory, usage, and maintenance data

Why do we have it?

- 1975: Deputy Secretary of Defense directed Services to collect weapon system O&S costs

- 2009: Weapon System Acquisition Reform Act (WSARA) requires DOD to report **major defense acquisition programs (MDAP) O&S costs** to Congress. VAMOSC systems host these reports.

- Recent policy changes require the DOD to improve O&S cost visibility

CAPE publishes a DOD-wide O&S taxonomy / Cost Estimating Structure (CES)[*]

* See back-up slide 21 for complete CAPE CES

Recent Policy

Sec. 836, National Defense Authorization Act (NDAA) '18:

"The Director of Cost Assessment and Performance Evaluation shall be responsible for *developing* and *maintaining* a database on:

- operating and support estimates,
- supporting documentation, and
- *actual operating and support costs for* **major weapon systems**."

Section 832, NDAA '19:

1. *Develop a common data repository for all sustainment-related data similar to DAVE [Defense Acquisition Visibility Environment].*
2. *Create and implement common data definitions, structure, and business rules for sustainment cost data.*
3. *Provide a consistent, predictable funding stream for O&S cost databases, prioritizing department-wide accessibility.*
4. *Develop a common data structure, taxonomy, dictionary for all three VAMOSC systems.*
5. *Establish a common logon for the VAMOSC systems and CADE.*

Sec. 879, NDAA '19:

provide a briefing for fiscal years 2020, 2021, and 2022 on the current product support estimates for each **major weapon system** by year for the entire life cycle, funding requested, and *expenditures*. The Briefing is to include summary of ***improvements made to data collection and cost estimating***.

The EVAMOSC Mission

OSD CAPE

EVAMOSC is a **data platform** for actual O&S cost data of major weapon systems that leverages recent improvements in the DOD's O&S **data landscape** in order to meet emerging requirements for senior leader decision support and the O&S data community.

EVAMOSC will serve as the DOD's **authoritative source of O&S cost data** for major weapon systems. The system will operationalize data definitions, taxonomy, and business rules collaboratively defined by the DOD Cost Community and codified in policy.

Current Capability Gaps
- Limited Reporting frequency
- Data lineage and missing data

Data Collection Challenges
- Over 100, uniquely designed data sources
- No common enterprise data schema (even within each service)
- Source data access limitations

CAPE will make methodical improvements (no magic bullet)

VAMOSC Users

Two main user groups, Budgeters and Cost Estimators, utilize financial and maintenance data for different purposes.

1. **Budgeters** require historical data that reflects impact to buying power
   - Estimate the funding needed for entire portfolio of weapons
   - Supply surcharges relevant to future budgets
   - Estimates built for major commands
   - Rarely estimate below major weapon system
2. **Cost Estimators** require historical data that models weapon-specific costs
   - Estimate a single weapon system life cycle cost
   - Back out supply surcharges to normalize data (direct cost analysis)
     - Estimating via analogous systems
     - Developing cost estimating relationships (CERs) for components

Budgeters rely more on financial data while Cost Estimators rely more on maintenance data. VAMOSC systems serve both user groups.

EVAMSOC must collect both maintenance and financial data from all services, then present it with a common structure

Example Aircraft Component Repair Costs

OSD CAPE

Definition: 3.2 Depot Level Repairable (DLR)[*]

- Repaired at the depot level of maintenance (central repair facility)
- Removed and replaced with another item from inventory

Information needed

- Recorded maintenance action; type of aircraft and part removed
  - Maintenance management database(s)
- Direct labor and material, transportation, storage, overhead costs
  - Supply management database, general ledger
- Aircraft inventory information
  - Operations database(s), maintenance management database(s)

Calculations

- Component 'A', in a fiscal year (FY): $\sum (price_A \times quantity_A) = $ annual cost A
- Map component A-Z to the appropriate aircraft; sum costs
- Capture FY and type of funding for inflation assumptions

[*] See back-up slide 21 for complete CAPE CES
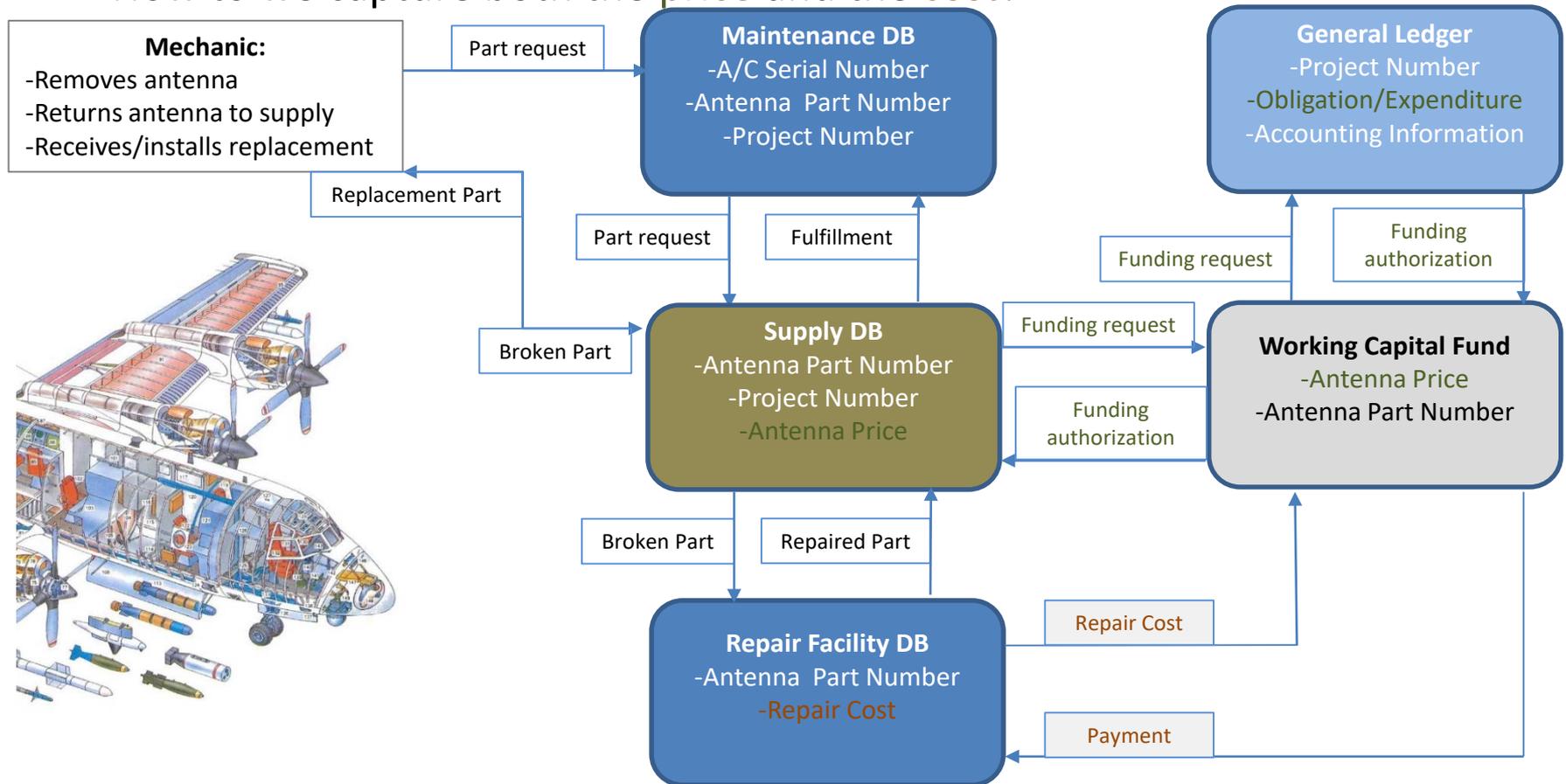
VAMOSC Considerations

Two main data sources that produce a different result

- Maintenance Data
  - Actual demand (maintenance actions) determines quantity
  - *Actual repair cost* for an item
    - labor + materiel + transportation
  - Fiscal year set at time of **component repair**
  - Total depot level repair costs = ∑ quantity ordered X (*repair cost)*
- Financial Data
  - Supply *price* reflects the expected demand
    - estimated repair cost + supply surcharge
  - Fiscal year set at the time of **component requisition**
  - Total depot level repair costs = ∑ quantity ordered X (*price)*

Example: Navy P-3 Orion*

OSD CAPE

- Supply system charges the unit (aircraft custodian) a price
- Repair facility charges the supply system a repair cost
- Working capital fund pays the repair facility (possibly different fiscal year)
- How to we capture both the price and the cost?

Mechanic:
-Removes antenna
-Returns antenna to supply
-Receives/installs replacement

Part request

Maintenance DB
-A/C Serial Number
-Antenna Part Number
-Project Number

General Ledger
-Project Number
-Obligation/Expenditure
-Accounting Information

Replacement Part

Part request

Fulfillment

Funding request

Funding authorization

Broken Part

Supply DB
-Antenna Part Number
-Project Number
-Antenna Price

Funding request

Funding authorization

Working Capital Fund
-Antenna Price
-Antenna Part Number

Broken Part

Repaired Part

Repair Cost

Repair Facility DB
-Antenna Part Number
-Repair Cost

Payment

* Diagram reflects a notional model. System interfaces do not replicate actual Department of Navy systems/processes

US Navy VAMOSC Aircraft DLR Costs

OSD CAPE

Navy Approach: Use cost factor (not maintenance data)

- Flight time (X) cost/hour pricing factor for each type of aircraft
- Navy flight operations **budgeting** system creates an annual cost report
- Navy VAMOSC collects the data and applies the CES to the report
- Navy Aircraft Depot Level Repairable Examination
  - Cost to Navy units' operations & maintenance (O&M) account
  - Reflects both supply price + cost recovery fee (to working capital)
  - Cost data driven by flight time (not maintenance performed)
- Potential Drawbacks
  - Does not map actual (economic) repair costs
  - Potential data collection disruptions (FY19)
  - Delayed reporting due to manual audit process
  - Supply price fluctuations impact annual costs

Alternative Approach Examined

OSD CAPE

Gather the source maintenance and supply data

- Multiply item quantity by (number of parts ordered) by:

Repair labor + repair materiel + transportation	Economic Cost
Add supply overhead + working capital recovery fee	Financial Cost

Create a common data model to allow analysis of:

- Normalize cost analysis across DOD platforms

- Estimate – Budget – Execution feedback

- Labor/Materiel cost trends by component & aircraft type

- Actual component repair costs by aircraft type vs derived cost

- Historical economic vs financial cost

  – Do we over/under fund?

  – How does demand impact supply pricing?

Common Data Model - shared data language, with standardized schemas, that enables consistency of data, and its meaning, across applications

Example: Common Data Model (1 of 2)

The Army repairs tanks in Anniston AL (ANAD), and helicopters in Corpus Christi TX (CCAD). How do we parts cost/overhaul?

∑ (parts repair cost / quantity of tanks[or helicopters])

- CCAD: 1 aircraft; 1 work order (WO)
  - Map WO to the aircraft serial number
  - Subcomponents (i.e. rotor blades) receive a production order (PO) tied to the WO
- ANAD: 1 tank; multiple work orders
  - Some subcomponents receive an individual PO tied to a single WO
  - Other subcomponents receive their own WO tied to tank serial #

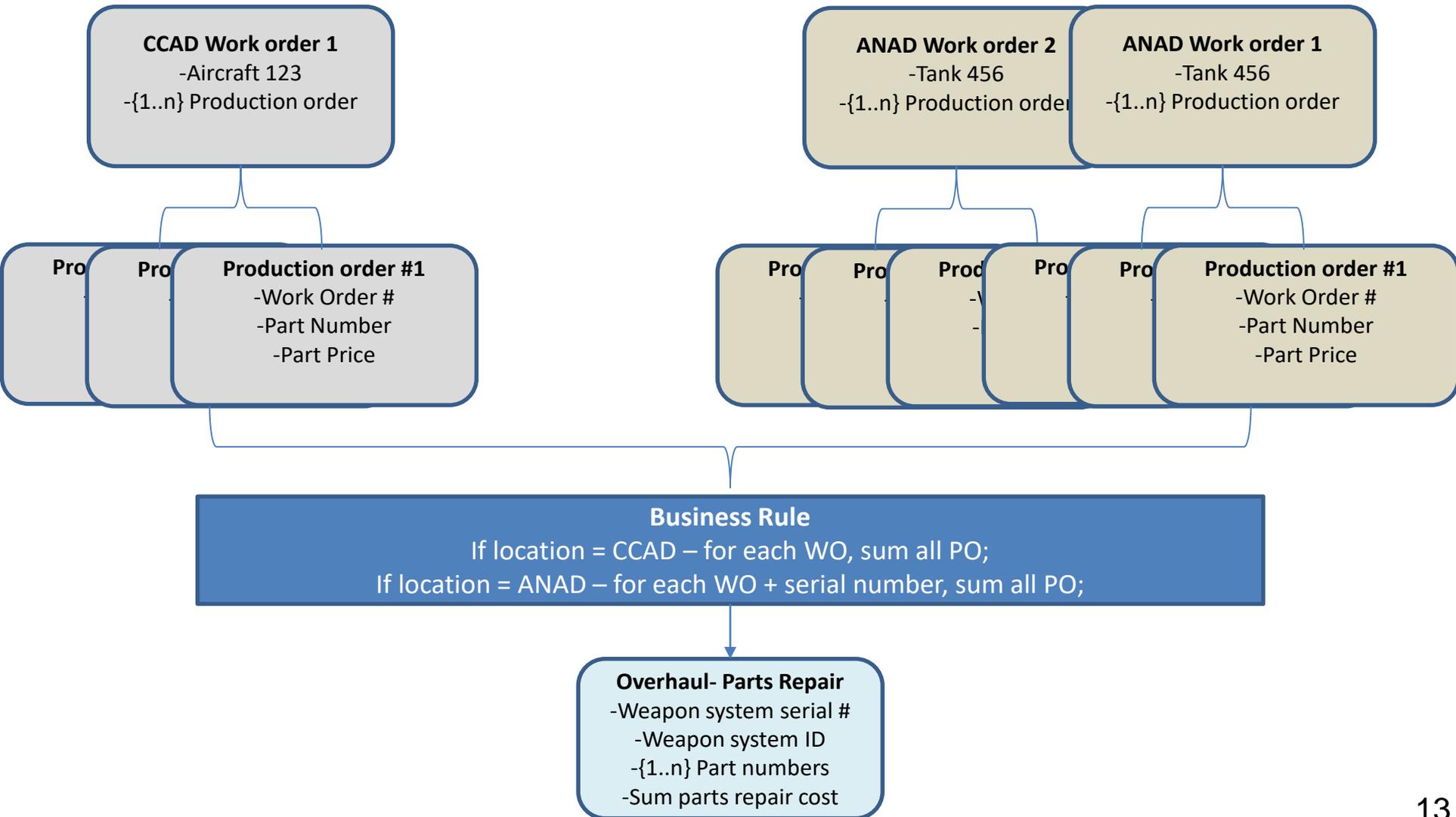**The tank cost requires a different business rule than the helicopter cost**

- If you count all WO(s): over-count main battle tank repair quantity
- If you count all PO(s): under-estimate main battle tank repair cost

The EVAMOSC CDM will unify the Army's use of WO/PO (as well as equivalent term in other services' databases)

Example: Common Data Model (2 of 2)

Notional solution: unify the PO/WO term as "Overhaul- Parts Repair"

CCAD Work order 1
-Aircraft 123
-{1..n} Production order

ANAD Work order 2
-Tank 456
-{1..n} Production order

ANAD Work order 1
-Tank 456
-{1..n} Production order

Pro Pro **Production order #1**
-Work Order #
-Part Number
-Part Price

Pro Pro Prod Pro Pro **Production order #1**
-Work Order #
-Part Number
-Part Price

Business Rule
If location = CCAD – for each WO, sum all PO;
If location = ANAD – for each WO + serial number, sum all PO;

Overhaul- Parts Repair
-Weapon system serial #
-Weapon system ID
-{1..n} Part numbers
-Sum parts repair cost

13

Potential Process Improvements

OSD CAPE

Legacy VAMOSC Systems	EVAMOSC Solution
Require feeder systems to produce conformal reports (push model)	Collect raw data and transform it (pull model)
• Modify a 'live' system	• No disruption to 'live' system
• Custom 'fixes' for inconsistent ERP implementation	• **Common data model (CDM)** with a single data dictionary
• Data lineage maintained by feeder system	• Data lineage maintained by EVAMOSC
• Requires local SME inputs	• Centralized SMEs
• Changes to feeder system interface disrupt collection	• Collection / transformation of raw data creates persistence

The data lake allows us to collect source data in its native state and transform it into a CDM.

EVAMOSC Data Activities

A data lake enables CAPE to analyze unstructured data vs.
requiring source data owners to first implement an enterprise-wide schema
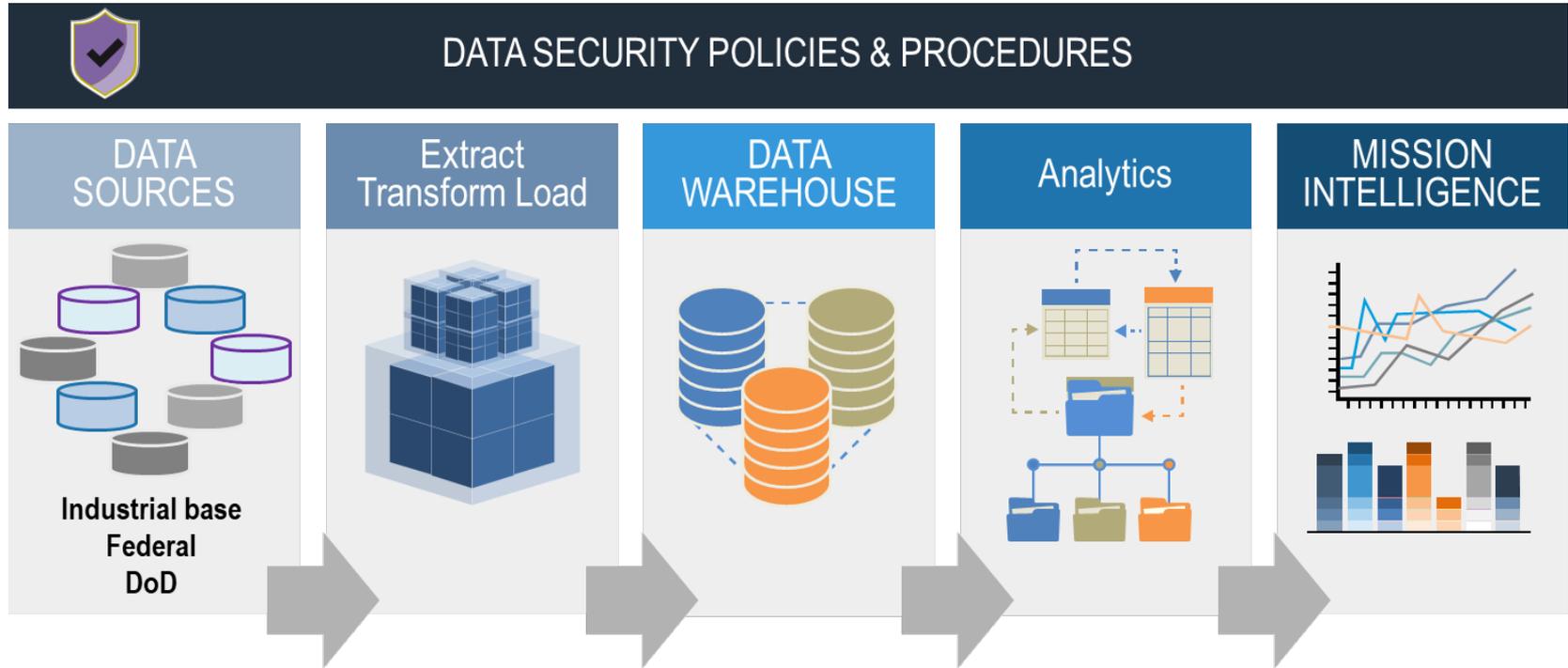
Terminology (for the purpose of this brief)
- Data Lake (unstructed data): collection of **raw** data from multiple systems
- Data Warehouse (structured data): raw + meta data -> common data model

Technology benefit: By decoupling the raw data (lake) from the business analytics/intelligence functions (warehouse) organizations gain flexibility to change analytic tools as needed, with little switching cost

EVAMOSC Data Discovery Environment (EDEN)

OSD CAPE

CAPE currently operates an EVAMOSC prototype environment

- Encourages responsible use of open source
- Utilizes infrastructure as a service model*
- Provides data security*
- Cloud Agnostic
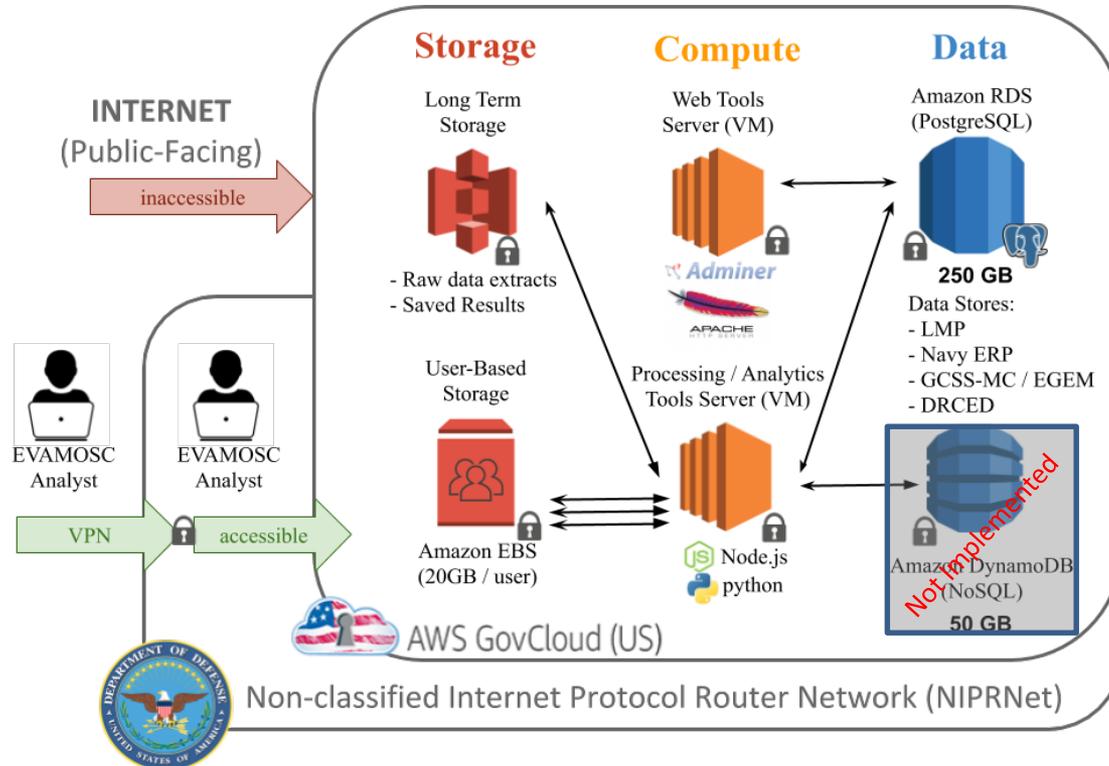
*See backup slide 20

EDEN Use Case

OSD CAPE

Major overhaul maintenance cost (CAPE CES 3.4)

- Theory: The SAP plant maintenance module would contain the expected costs (labor, materiel, etc..) by project number and map these costs to a work center with an associated end item (i.e. the ship's hull number)

- US Navy Enterprise Resource Programing (Navy ERP) database
  - Data collected– All FY17 data from over 100 tables in Navy ERP
  - Conclusion: Navy ERP does NOT implement plant maintenance

- US Army Logistics Modernization Program (LMP) database:
  - Date collected– All FY18 data from a standard report ('metrics report')
  - Conclusion: Army LMP does implement plant maintenance

- Army LMP implemented SAP for the purpose of managing overhaul repairs to include cost. Navy ERP implemented SAP to manage finance but not supply or maintenance details.

Data discovery in EDEN enabled CAPE to **quickly** compare US Army and US Navy overhaul maintenance data, on a single, **inexpensive**, platform

Summary

OSD CAPE

- CAPE EVAMOSC plans for incremental improvements over time
  - Data lake approach has potential to improve VAMOSC data collection
  - Potential to support additional use-cases
  - Likely to improve reporting frequency
- Planning Considerations for Cloud Technology
  - Organization goals, data requirements, in house capability
  - Determine degree of shared responsibility with CSP
- POC information
  - Sean Black, OSD CAPE
  - sean.c.black6.civ@mail.mil
  - Office: 571-372-4289 (Pentagon) / Government Mobile: 571-286-0227
- Comments, feedback, similar experiences, questions?

Backup Section

System Responsibility

OSD CAPE

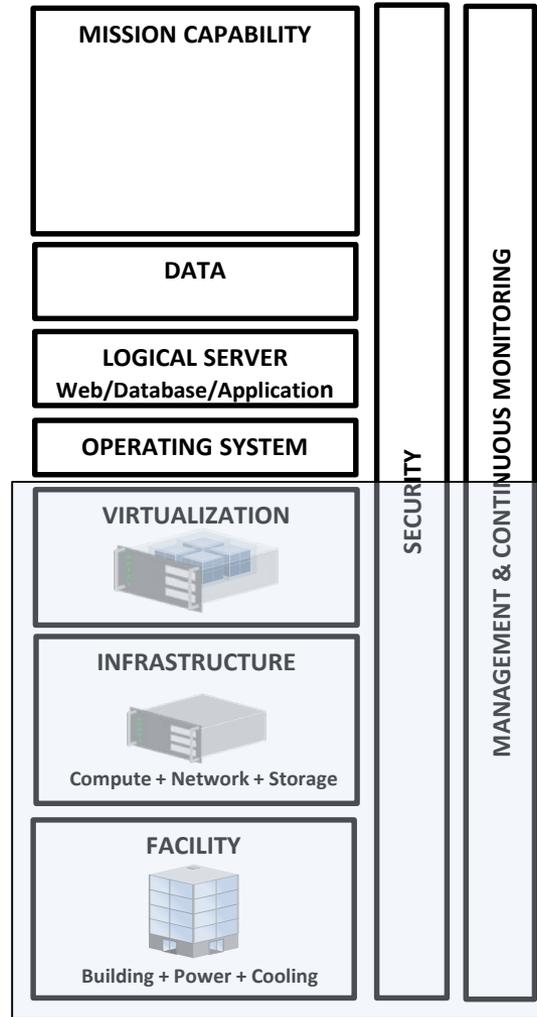**Amazon Web Services**
FedRAMP Authorized Since 06/21/2016

CloudCheckr
CloudCheckr for Government provides the AWS security, audit, and visibility tools to help fulfill the infrastructure portion of the Audit and Accountability (AU) standard outlined in NIST SP 800-53.
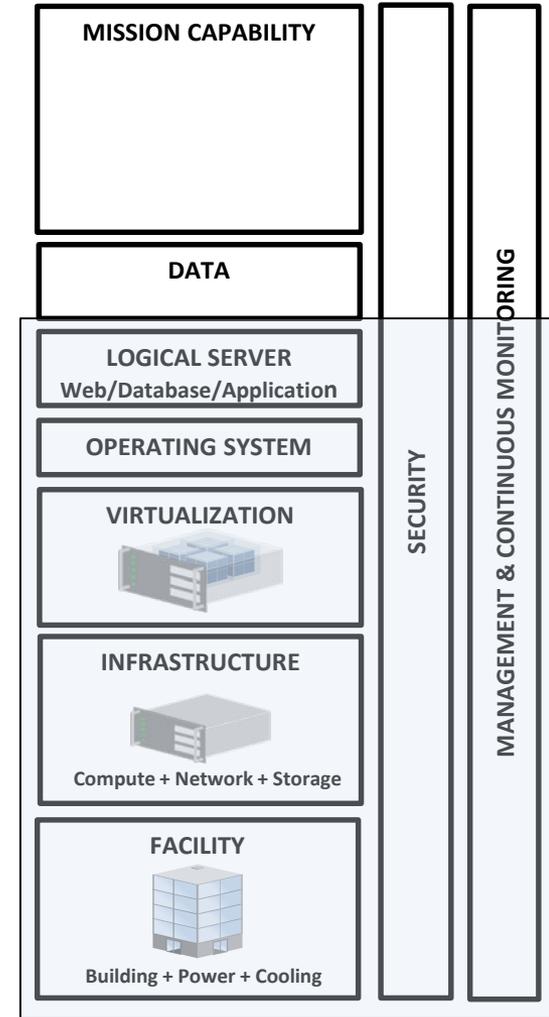
Army C5ISR –
CyberSecurity Service Provider
The CSSP shall protect against, defend, and respond to suspicious or malicious cyber activity associated with network traffic entering or exiting the Mission Owner's Virtual Private Cloud

Infrastructure as a Service

- MISSION CAPABILITY
- DATA
- LOGICAL SERVER — Web/Database/Application
- OPERATING SYSTEM
- VIRTUALIZATION
- INFRASTRUCTURE — Compute + Network + Storage
- FACILITY — Building + Power + Cooling
- SECURITY
- MANAGEMENT & CONTINUOUS MONITORING

Platform as a Service

- MISSION CAPABILITY
- DATA
- LOGICAL SERVER — Web/Database/Application
- OPERATING SYSTEM
- VIRTUALIZATION
- INFRASTRUCTURE — Compute + Network + Storage
- FACILITY — Building + Power + Cooling
- SECURITY
- MANAGEMENT & CONTINUOUS MONITORING

EVAMOSC-Common Taxonomy/Common Login

OSD CAPE

Common Cost Elements based on OSD CAPE O&S Guide

Common Non-Cost Elements that accommodate differences among ships, aircraft and ground vehicles

Element	Cost Element Description	Element	Cost Element Description
1.0	Unit-Level Manpower	4.0	Sustaining Support
1.1	Operations	4.1	System Specific Training
1.2	Unit-Level Maintenance	4.1.1	System Specific Operator Training
1.3	Other Unit-Level	4.1.2	System Specific Maintenance Training
2.0	Unit Operations	4.1.3	System Specific Other Support Training
2.1	Operating Materiel	4.2	Support Equipment Replacement and Repair
2.1.1	Energy (Fuel, Electricity, etc.)	4.3	Sustaining/Systems Engineering
2.1.2	Training Munitions and Expendable Stores	4.4	Program Management
2.1.3	Other Operational Material	4.5	Information Systems
2.2	Support Services	4.5.1	Tech Refresh
2.3	Temporary Duty	4.5.2	License Fees
2.4	Transportation	4.5.3	Maintnenance
3.0	Maintenance	4.6	Data and Technical Publications
3.1	Consumable Materials and Repair Parts	4.7	Simulator Operations and Repair
3.2	Depot Level Reparables	4.8	Other Sustaining Support
3.3	Intermediate Maintenance (Ext to Unit-Level)	5.0	Continuing System Improvement
3.3.1	I-Level Consumable Materials & Repair Parts	5.1	Hardware Modifications
3.3.2	I-Level Government Labor	5.2	Software Maintenance
3.3.3	I-Level Contractor Maintenance		
3.3.4	Other I-Level Maintenance		
3.4	Depot Maintenance		
3.5	Other Maintenance		
3.6	Other Contractor Maintenance *		

Element	Non-Cost Element Description
A.1	Number of Systems
B.1	Flying Hours (FH)
B.2	Steaming Hours (SH)
B.3	Steaming Hours Underway (SHU)
B.4	Steaming Hours Not Underway (SHNU)
B.5	Miles Driven
C.1	Fuel Consumed (Gallons)
C.2	Fuel Consumed Underway (Gallons)
C.3	Fuel Consumed Not Underway (Gallons)
C.4	Fuel Consumed Auxiliary (Gallons)
D.1	System Age

Metric	Metric Description
M-1	Total Cost Reported per Aircraft/Ship/System
M-2	Total Cost Reported per FH/SHU/Mile Driven

Primary Common Cost Metrics used by the cost community

* 3.6 Other Contractor Maintenance element added to better identify contractor cost

- VAMOSC utilizes a common reporting taxonomy (CAPE Cost Element Structure)
- EVAMOSC enables a common source for all DoD VAMOSC data