Integrating Sustainability Into Weapon System Acquisition Within The Department Of Defense (DoD)

Remmie Arnold, CCEA, Technomics
Walt Cooper, Technomics
Special thanks to our sponsor Paul Yaroschak, ODUSD (I&E)

Date: Thursday June 12, 2014
Track: Life Cycle Costing
Room: Matchless

Agenda

1. Executive guidance
2. Describe Sustainability
3. Why Sustainability Matters
4. Draft version of "DoD Guidance – Integrating Sustainability into DoD Acquisitions"
5. Initial pilot efforts and analyses
6. Way forward

Technomics

Slide 2

Executive Guidance on DoD Sustainability

- Executive Order 13514—Federal Leadership in Environmental, Energy and Economic Performance (05 Oct 2009) establishes an integrated strategy for sustainability in the federal government.

- The Strategic Sustainability Performance Plan (SSPP) includes goals for efficiency and reductions in energy, water, solid waste, and the use of hazardous chemicals and materials.

- Better Buying Power initiative establishes affordability goals

Technomics

Slide 3

Sustainability Described

- Simply put, the capacity to endure
- Global context: A durable and self-sufficient balance between social, economic, and environmental factors
- DoD Acquisition context: Wise use of resources to minimize mission, human health, and environmental impacts and associated costs during the life cycle
- Differs from "sustainment" – DoD term for support needed to operate and maintain a system over its lifetime

Technomics

Slide 4

The Importance of Sustainability

- The DoD acquires weapons systems that must be sustained for decades
- Resources are at a premium and in many cases dwindling
- To meet mission requirements well into the future while reducing life cycle costs, systems must be made more sustainable
- Acquisition personnel must fully understand life cycle impacts and the costs of systems to avoid inadvertently pushing costs "downstream"

Technomics

Slide 5

Current Sustainability Related Guidance

- DoDI 5000.4: Cost Analysis Requirements Document (CARD): Provides the "what"
  - 1.2.1x.2 "Environmental Conditions"
  - 1.2.3 "Human Performance Engineering"
  - 1.2.4 "System Safety"
  - 10.4 "Environmental Impact Analysis"
- DoD O&S Cost Estimating Guide: Provides the "how"
  - Maintenance costs related to the environment
  - Disposal (including hazardous waste)
  - Worker safety

Technomics

Slide 6

Current Sustainability Related Guidance

Army Cost Analysis Manual: Chapter 6

- Provides high level guidance for environmental cost considerations
- Maps environmental costs to Army CES elements
- Does not provide guidance on methodology for calculating costs

Technomics

7

Portions of O&S Costs That Sustainability Investments Might Affect

Principle	O&S Cost Element Most Likely Affected	Portion of O&S costs from which cost reductions might take place (%)	Effect of a 5 to 10% reduction (%)
Utilize low-impact materials	Unclear	Not addressed	Not addressed
Optimize system-wide energy consumption	2.1– Operating Material	5 to 25	Not addressed
Improve system and component design • Durability • Standardization • Minimized over-design	3.0 – Maintenance (all second-level elements) 5. 1– Hardware Modifications or Modernization	20 to 70	1 to 7
Minimize life cycle waste	3.0 – Organizational, intermediate, and depot-level consumables and reparables	20-60	1 to 6
Minimize life cycle pollution	6.1 – Installation Support	1 to 5	< 1

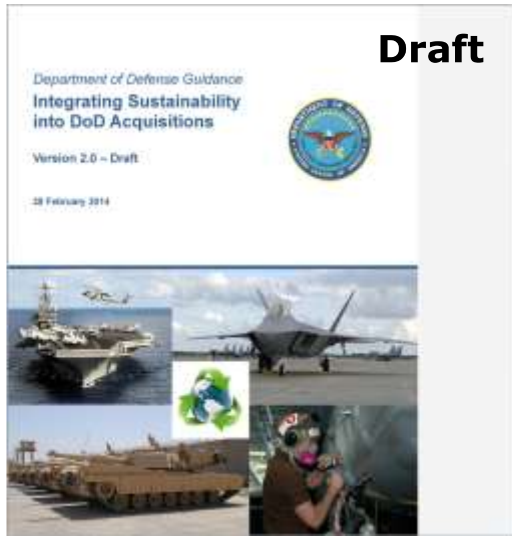
If investing based on improving designs and minimizing life cycle waste could reduce costs by 5 to 10% within associated O&S cost elements, then overall O&S costs could be reduced by as much as 2 to 13%.

Technomics

Slide 8

4. Sustainability Analysis Guide

- Introduces Sustainability Analysis and provides guidance on how to use the results to better inform tradeoff, design, and supportability decisions
- Life Cycle Assessment (LCA) compares human health & environmental impacts
- Life Cycle Costing (LCC) captures costs associated the impacts & other direct costs throughout the life cycle



Technomics

Slide 9

Guide – Streamlined LCA (SLCA)

- **Mission (Resource Availability)**: Includes impacts to resource reserves that, if depleted or unavailable, could negatively affect the ability of defense personnel to complete the mission
- **Human Health**: Includes health impacts to defense personnel or surrounding communities that could increase internal or external costs
- **Environmental Health**: Includes impacts to natural cycles (e.g., the earth's hydrological cycle), ecosystems, or wildlife that could increase internal or external costs

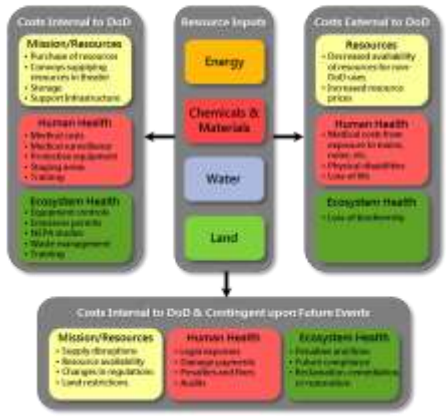
SLCA Framework

Technomics

Slide 10

Guide – LCC

- Provides high-level overview of guidance for developing life cycle costs, reviews established methods to estimate life cycle costs
- Provides additional guidance for calculating sustainability related costs not traditionally assigned to the system because they are:
  - Not visible in aggregated costs (Internal to DoD)
  - Contingent upon future activities or events that may or may not happen
  - Tied to the resulting impacts borne by society and the environment (External to DoD)



LCC Framework **Draft**

Technomics

Slide 11

Steps in Sustainability Analysis

Draft

- Step 1: Define the Scope of the Analysis
  - Establish the functional unit and system boundary for the chosen alternatives
  - The functional unit defines the capability of each alternative in comparable units
- Step 2: Develop a Life Cycle Inventory: List all relevant system inputs (resources) and outputs (emissions) that fall within the boundary established in STEP 1
- Step 3: Estimate Life Cycle Impacts: Applying the Guides predefined scoring factors
- Step 4: Estimate Sustainability-related Costs: Use results from Steps 1 and 2 to identify potentially hidden costs both internal and external to the DoD
- Step 5: Synthesize Results and Iterate

Technomics

Slide 12

5. First Pilot Efforts

- Purpose: Quantify differences in life cycle costs and human health/environmental impacts between chrome and non-chrome primer design alternatives for:
  - Acquisition of 573 aircraft (System 1)
  - Acquisition of 117 aircraft (System 2)
- Identify information availability: Where does life cycle cost data reside and at what level of detail?
- Test underlying methodologies for cost and impact estimates:
  - What barriers arise in trying to identify life cycle costs and impacts?
  - How can methods be used to scale cost and impact analysis across the entire acquisition process?

Technomics

Slide 13

Conclusions about LCC

- Need to consider "cost clusters"
  - Determine the group of costs with highest impact and work backwards to cost drivers that can be mitigated/eliminated
- Need to improve granularity and scope of cost accounting
  - In most cases the standard DoD O&S cost structures too aggregated and miss hidden costs.
  - VAMOSC historical data difficult to work with.

Technomics

Slide 14

Additional Analyses

For four systems…

- Develop activity profiles for 4 MDAPs:
  - 2 Aircraft
  - Ship
  - Tracked Vehicle
- Estimate activity profiles
- Compare sustainability costs to life cycle estimates

Technomics

Slide 15

Activity Profiles

- Attributes
  - Energy
    - Energy consumed by the system when operating and when in overhaul/availability
    - Amounts obtained from VAMOSC and OSMIS systems
  - Water
    - Water used by crew members and consumed by sub-systems, e.g., onboard cooling sub-systems, propulsion sub-systems
    - Water consumed in washdowns during routine maintenance and overhauls
  - Chemicals & materials: oils, lubricants and paints
  - Land
    - Conservation, pollution prevention, and natural resources management
    - Maintenance of training ranges
- Fleet sizes and OPTEMPOs extended from FY 2012 inventories, except for System 3, for which we included a growth ramp
- Only the O&S phase of the life cycle – 30 years for all 4 MDAPs

Technomics

Slide 16

Notional Activity Profile for System 3

- Energy
  - 2,600 steaming hours underway @ 1,045 gal/steaming hour underway
  - 1,000 steaming hours not underway @ 250 gal/steaming hour not underway
  - 60 ships in Year 1, ramping to 70 ships at Year 11
  - Standard price of F-76 ($3.61) from DLA-Energy
- Water
  - Used Army Quartermaster Planning Guide for per-person consumption rates
  - Water for washdowns extrapolated from Army Quartermaster Planning Guide
- Chemicals & materials
  - Oils and lubricants: 2% of energy costs
  - Paint
    - Surface area ~80,000 ft^2; based on length (506ft), width (beam = 66ft) and height (3x draft = 93ft)
    - Paint Cost per ft^2 = $0.24
    - Labor Cost per ft^2 = $3.35
    - Facilities Cost per ft^2 = $2.62
    - Topside Painting Frequency = 2 times per year
    - Hull Painting Frequency = 1 time every 7 years
- Land: N/A

	$M		Year 1		Year 2		Year 3	...		Year 29		Year 30		Total
[redacted]	Energy	$	642.7	$	653.4	$	664.1	...	$	749.8	$	749.8	$	21,903.7
	Water	$	0.6	$	0.6	$	0.6	...	$	0.7	$	0.7	$	19.6
	Chemicals & Materials	$	36.8	$	37.4	$	38.0	...	$	42.9	$	42.9	$	1,252.9
	Land Use													

Technomics

Slide 17

Preliminary Findings

- Development of activity profiles
  - Dominated by energy attribute… Amounts consumed readily available, along with standard prices
  - Water, chemicals & materials, land – require research and assumptions
- Cost estimates of activity profiles
  - Energy and water are straightforward
    - Energy data can be found in sources such as VAMOSC and OSMIS
    - Guidance on water consumption can be found in the Quartermaster's "Water Planning Guide"
  - Chemicals & materials and land require research and assumptions
- Life cycle cost estimates related to sustainability
  - Access to estimates is an issue for contractors
  - That said, we were able to assemble O&S cost estimates for MDAPs of interest and estimate sustainability costs as a portion of total O&S costs

Technomics

Slide 18

Chemicals/Materials and Land Use Impacts

Field level actual costs, with sustainability related impacts (such as corrosion repair and training facility upkeep), are not captured in a way that allows for easy use in estimating future costs.

- Results are reliant on SMEs (how we estimated frequency of painting System 3)
- Results are reliant on assumptions (how we estimated land use at Location 1)
- Can created useful views of costs – from "50k feet"
- Greater investment – time and money – will be needed to create a more precise estimate

Technomics

Slide 19

Challenges

- Establishing an empirical data base
- Improving granularity in current cost collection systems without creating onerous reporting requirements
- Gaining top-level leadership support

Technomics

Slide 20

6. Way Forward

- Continue pilot efforts to wring out methods for sustainability analysis – four more projects identified
- Develop standardized reporting procedures for collection of sustainability costs
- Increase empirical data to be used as a foundation for developing cost estimating relationships and cost factors

Technomics

Slide 21