Early Development Planning Leads to Affordable Systems

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Overview

- Cost and Affordability in Context
- Early Systems Engineering, Early Developmental Planning and Affordability
- Early Planning & Development Challenges of Complex Systems
- Early Systems Engineering, Integrated MS&A Tools and Affordability
- Integrated MS&A Tool Example - Integrated System and Cost Modeling (ISCM) Tool Suite
- Affordability Goals vs Should Cost and Cost Growth Containment
- Early Developmental Planning Affordability Assessment Example
- Early Developmental Planning and Affordability Assessments Application “Foot Print”
- Summary
Affordability in Context – Defense Acquisition Guidebook

- **Affordability:** The degree to which the life-cycle cost of an acquisition program is in consonance with the long-range modernization, force structure, and manpower plans of the individual DoD Components, as well as for the Department as a whole

  - DoD Directive 5000.01, E1.1.4. Cost and Affordability, states: All participants in the acquisition system shall recognize the reality of fiscal constraints. They shall view cost as an independent variable, and the DoD Components shall plan programs based on realistic projections of the dollars and manpower likely to be available in future years. To the greatest extent possible, the Milestone Decision Authority (MDA) shall identify the total costs of ownership, and at a minimum, the major drivers of total ownership costs. The user shall address affordability in establishing capability needs.

Reference: Defense Acquisition University, DEFENSE ACQUISITION GUIDEBOOK, Chapter 3 -- Affordability and Life-Cycle Resource Estimates
Cost and Affordability in Context - DODI 5000.02

• **Cost:** “… prepare an AoA study plan to assess preliminary materiel solutions, identify key technologies, and estimate life-cycle costs.” …. “The AoA shall focus on identification and analysis of alternatives, measures of effectiveness, cost, schedule, concepts of operations, and overall risk.” …. “At Milestone A, the DoD Component shall submit a cost estimate for the proposed solution(s) identified by the AoA.”

• **Affordability:** “An affordability determination results from the process of addressing cost during the requirements process and is included in each CDD using life-cycle cost or, if available, total ownership cost.” Required at Milestone B upon entry into the EMD Phase.

So currently, Cost and Affordability are **NOT required until the AOA (Cost) and Milestone B (Affordability) ….. well after Early System Engineering and Early Developmental Planning**

“Should Cost” ≠ “Affordability as a Requirement”

● “The two are compatible, but they must be balanced differently across the product life cycle. The emphasis prior to Milestone B should be on defining and achieving affordability targets. Past this point, the emphasis shifts to defining and achieving should-cost estimates.”

● “Affordability as a requirement …… establish quantified goals for unit production cost and sustainment costs for our products, driven by what the Department or Service can pay ….. set these goals early and use them to drive design trades and choices about affordable priorities.”

● “Affordability analysis is based upon the budgets we expect to have for the product over its life cycle and provides a design constraint on the product we will build, procure, and sustain.”

Air Force Early Systems Engineering and Affordability

Capability Planning (DOTMLPF)

Development Planning (prospective material solutions)

ICD
DCR
JROC
AFROC

User Needs, Validated Requirements
• JCIDS Outputs (if available)
• Capability shortfall
• Others

Trade Space Characterization

Where is Cost Estimating and Affordability in the Process?

Initial Concepts Review
Candidate Solution Sets Characterization

Candidate Solution Sets Selection

Programmatic Analysis

Final Concept Review

Release Approval

Cost Estimating

Affordability Assessment

First Cost Estimate per DODI 5000.02 at AoA and Affordability Requirement is not until Milestone B!

Affordability Assessments during Early Developmental Planning

Air Force Early Systems Engineering Process

- Trade Space Characterization
  - Candidate Solution Sets Characterization
  - Programmatic Analysis

Early, Concurrent, Iterative Affordability Assessments

- Part of the Early Systems Engineering Process and Developmental Planning combined w/ Modeling, Simulation & Analysis (MS&A)
- Integrated and Iterative MS&A Tools with Collaborative Environment
  - System (and Subsystem) Performance, Cost, Schedule, and Risk
  - Historical and Knowledge Databases with Information Analytics
  - Ongoing, Transparent MS&A Information Control
  - Programmatic and Technical Accountability
- Connect and Integrate: PEOPLE – PROCESS – TOOLS
Traditional Planning, Development & Design Approach

Early Planning & Development Challenges of Complex Systems

What is the current planning, development & design process?

Mission/System Requirements
- Operational Assumptions, Conditions & Constraints
- Size, weight, power
- New technology insertion
- Performance
- Schedule
- Cost/Affordability

Feedback

IPT Plan/Develop/Design

Satellite Bus Analysis/Design
Payload Analysis/Design
Propulsion Analysis/Design
Launch/Orbital Analysis
Operations/Sustainment Analysis
Cost/Schedule/Risk Analysis

Communication & Approval Challenges

Slow And Expensive!
Integrated Planning, Development & Design Approach

Improvement to Early Planning & Development Challenges of Complex Systems

*Integrated iterative MS&A tools provide:*

- Historical & Knowledge Databases
- Integration Core Module
- User Interface Module
- Bus Module
- Payload Module
- Propulsion Module
- Launch/Orbital Module
- Operations & Sustainment Module
- Cost/Schedule Risk Module

Mission/System Requirements

- Operational Assumptions, Conditions and Constraints
- Size, weight, power
- New technology insertion
- Performance
- Schedule
- Cost/Affordability

Potential Solutions

In Days / Weeks Not Months

Networked Collaborative Engineering

Feedback
Early Systems Engineering, Integrated MS&A Tools and Affordability

Capability Planning (DOTMLPF)

- User Needs, Validated Requirements
  - JCIDS Outputs (if available)
  - Capability shortfall
  - Others

Trade Space Characterization

Integrated System and Cost Modeling (ISCM) Tool development sponsored and supported by AFRL/RZST and AFRL/RVES

Development Planning (prospective material solutions)

ICD
DCR
JROC
AFROC

AoA Study Guidance

MDD

CCTDs

Final Concept Review

Programmatic Analysis

AfA

Release Approval

Initial Concepts Review

Candidate Solution Sets Characterization

Candidate Solution Sets Selection

IsCM Tool

Integrated MS&A Tool Suite

Affordability Assessment

Integrated System and Cost Modeling (ISCM) Tool Suite Overview

Rapid Trade Space Optimization for the Complete Life-cycle in Days / Weeks

Launch Vehicles

Conceptual Design – Trade Studies (Performance Driven)
- Vehicle Design
- Propulsion Systems
- Trajectory Analysis (POST)

Space Vehicles

Spacecraft / Satellites
- Enhanced SMAD
  - Space Vehicle Design
  - Space Vehicle Propulsion
- Orbit Propagation
- Radiation Exposure
- Detector Response

DDT&E Costs
- Life Cycle Cost
- Forecasts & Schedules
- TRL
- Cost Growth & Risk

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Operations & Maintenance Costs

SMAD
- CESMO
- Labor Model

Concept of Operations (ConOps)
- Mission
- Infrastructure
- Resources and Schedules

Historical/Knowledge Database

Existing LV Database
Integrated & Iterative Affordability Assessments through ISCM Tool Suite

Performance - Cost - Schedule - Risk

- Links system performance with total Life Cycle Cost estimates
- Provides trade study traceability so that process is repeatable
- Addresses the principal cost/affordability drivers
  - Technology maturity and cost growth
  - System design and complexity
  - Mission requirements and constraints
  - Design, Development, Test and Evaluation (DDT&E) concepts
  - Operations and Sustainment (O&S) concepts
  - Change in Production Quantities Ordered
- Addresses key aspects of a system acquisition and management
  - Planning & Development
  - Technology (existing and proposed)
  - Engineering, Design & Manufacturing
  - Production
  - Operations & Sustainment
  - Disposal
- Level of risk identified with each estimate
Affordability, Should Cost and the Decision-Cost Curve

Iterative System Affordability Assessments

Should Cost “Bottoms Up”

Cumulative LCC

- Percent of Baseline LCC Incurred
- Percent of Baseline LCC Committed
- Cost to Identify & Resolve a Defect, and Incorporate Change

Early Systems Engineering & Developmental Planning

ISCM Tool Suite

Material Solutions Analysis  Technology Development  Engineering & Manufacturing Development  Production & Deployment  Operations & Support

Development  Integration  Verification  Fielding  Operation

Adapted from Boeing study on ICBM Life Cycle Cost, 1973
Affordability Goals vs Should Cost and Cost Growth Containment

• Current and past Initial Cost Goals at ATP have resulted in unacceptable Cost Growth
• Need to establish a more realistic Cost Goal at ATP w/ Affordability Assessments
• Collapsing the curves reduces overall Cost Variability (Growth) for more manageable acquisition programs (Added Benefit: Potentially eliminates Nunn-McCurdy violations)
Early Development Planning
Affordability Assessment for
System Block Upgrades

- Iterative Affordability Assessment using ISCM Tool Suite provided real time input for Early Development Planning

![Funding Profile for Program Changes](image)

**Desired/Expected Funding Profile without Peaks and Valleys**
Developmental Planning and Affordability Assessments “Foot Print”

Guidance

- National Security Strategy
- National Military Strategy
- National Defense Strategy
- Guidance for the Development of the Force
- JOpsC
- AF Operating Concepts
- AFSPC/CC Vision

Assessment

Joint CBA

- JOpsC

Output

- Joint Gaps/Shortfalls
- Way ahead recommendation
- Initial Capability Document (ICD)

Decision/Action

- Concept/Material Dev Decision
  - Non-Material Solution
  - Information Technology
  - Upgrade
  - Breakout/Transformational
- Analysis Guidance

AF CRRA

- AF Operating Concepts

AFSPC IPP

- AF Functional Concepts

AFSPC POM

AOA

Solution Recommendation

Summary

Currently, Cost and Affordability are NOT required until the AOA (Cost) and Milestone B (Affordability) ...... well after Early System Engineering and Early Developmental Planning

DoD (Ashton Carter) Direction: “Emphasis prior to Milestone B should be on defining and achieving affordability targets. Past this point, the emphasis shifts to defining and achieving should-cost estimates.”

Affordability Assessments combined w/ Integrated MS&A Tools can provide significant insight during Early Systems Engineering and Developmental Planning to establish System Affordability Targets

The ISCM Tool Suite is an example of an integrated MS&A Tool currently in use that is supporting Early Systems Engineering And Developmental Planning

- ISCM Tool Suite details presented by Dr. Deganit Armon during Track 5 - Modeling & Simulation in Acquisition on Wednesday (26 October 2011) at 10:50 am
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