Enterprise Analysis and Cost Optimization System (EACOS)

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“Modeling for Sustainment”
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The Essence of EACOS is "Life Cycle Optimization"
Achieving the Greatest Collective Benefits for the Fleet within Cost & Other Constraints

Fleet Drivers / Problems / Issues / Roadmaps

Other Requirements & Constraints

Enterprise Analysis and Solutions

Total Available Funding (by FY and Type)

Resource Analysis Decision Support System (RADSS)

Data Analysis
Scenario Analysis
Sensitivity Analysis
Portfolio Planning

Balanced Investment Portfolio

Weighted Decision Criteria & Standards

Availability
Mission Capable Rate
Readiness

Total Ownership Costs

Combat Capability

Other
EACOS Background

- **Objectives**
  - Identify *drivers* affecting fleet availability and system modernization / operating & support costs
  - Identify and model solutions, investment options, and scenarios that provide:
    - Optimized improvement in aircraft fleet availability
    - Optimized combat capabilities
    - Optimized approaches to modernization and sustainment
    - Optimized approaches to Fleet Viability
    - Reductions in total ownership cost
    - Best return on investment
  - Bottom line is to achieve the greatest collective benefits within constraints, thus realizing optimum investment strategies and an *Optimized and Balanced Budget and Execution Portfolio* for the fleet

- Northrop Grumman has *completed* EACOS implementations for the C-5, B-1B, A-10, F-16, & B-2 fleets, plus a Cross-Fleet Pilot Project
Complicating Factors

Increasing Ownership Costs

- Reliability & Maintainability Problems
- Structural Problems
- Parts Supply Problems
- Changing Mission & Performance Requirements

Decreasing Mission Capable Rates Availability
The EACOS Approach

What is it?

Enterprise Analysis and Cost Optimization System

Logistics Information Systems

Operations  Inventory / Supply  Maintenance  Reliability

Related Cost Data

Improved Readiness / Availability  Reduced Total Cost of Ownership

WHAT IT DOES

Baselines System
Identifies necessary improvements
Allows modeling & prediction of Improvements
Optimizes Investments

System Design
Mission Profiles
The EACOS Approach

Baseline Availability → Identify Drivers → Examine Problem Areas

Identify Possible Solutions \( A = f(x,y) \)

**X:** Hardware / Software changes at the component or system level

**Y:** Policy / process changes to the support infrastructure

Prioritize Solutions with RADSS

Optimized Investment Portfolio

A Repeatable Process!
The EACOS Approach

- Phase I: Enterprise Analysis
  Baseline Fleet and Identify “Drivers & Solutions” (Investment Candidates):
  - Fleet Availability
    - Mission / Operations profile (Operations, Training, MC Rates, Flying Hours)
    - Reliability (Inherent Failures, Mission Aborts, Mean Time Between Failures)
    - Maintainability (Not Mission Capable Maintenance, Maintenance Manhours)
    - Supportability (Not Mission Capable Supply, Flow Days)
  - Maintenance Concepts (Field, Depot, Phase, and Analytical Condition Inspections)
  - Supply Concepts (Supply Chain Management, Defense Logistics Agency)

- Phase II: Cost Optimization System
  - Define Decision Goal
  - Identify and Weight Decision Criteria and Standards (to generate “Benefit Scores”)
  - Evaluate Investment Candidates (Phase I Analysis, Roadmaps, etc.)
    - Analyze Data (Show Stoppers, Correlations, Constraints)
    - Identify Global and Boolean Constraints (for Linear Program optimization)
  - Load Data into Resource Allocation Decision Support System (RADSS)
    - Run RADSS to generate Benefit Priorities and Benefit-to-Cost ratios
    - Conduct Sensitivity and Scenario Analysis
  - Select Optimum Solution Set to achieve greatest collective Benefits vs. Constraints
Fleet Availability Baseline & Required Improvements
Mathematically Modeling the Effects of Investments

Probability that Aircraft are Mission Capable

Current Mission Capable Aircraft

Future, Higher Mission Capable Requirement

Current Available Aircraft

Need 83 A/C Mission Capable

63 A/C Mission Capable Today

Probability

# Aircraft
Monthly Status of an “Average Aircraft”

<table>
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<tr>
<th>Day</th>
<th>62.4% MC Rate</th>
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<tbody>
<tr>
<td>1</td>
<td>Mission Capable 15.1</td>
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<tr>
<td>2</td>
<td>Fully Mission Capable 9.7</td>
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<tr>
<td>3</td>
<td>Flying Time 1.64 days</td>
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<tr>
<td>4</td>
<td>9.6 Sorties per Month</td>
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<tr>
<td>5</td>
<td>39.4 Hours per Month</td>
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<tr>
<td>6</td>
<td>4.1 Hours per Sortie</td>
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<td>7</td>
<td>PMCB 2.7</td>
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<td>8</td>
<td>PMCM 1.5</td>
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<td>9</td>
<td>PMCS 1.2</td>
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<td>10</td>
<td>Partially Mission Capable 5.4</td>
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<tr>
<td>11</td>
<td>Not Mission Capable 9.1</td>
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<tr>
<td>12</td>
<td>NMC Maintenance 4.8</td>
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<tr>
<td>13</td>
<td>NMCM Unscheduled 4.1</td>
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<td>NMCMS .7</td>
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<tr>
<td>15</td>
<td>NMC Both 2.4</td>
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EACOS identifies “Drivers” to Fleet Availability and Ownership Costs

EACOS then models “Solutions” to all “Drivers” (including related Investment Costs) and Predictive Results
Sample of Hundreds of "Drivers" and "Solutions"
EACOS Phase II: Investment Optimization

Resource Allocation Decision Support System
A Complete, User-Friendly, Integrated “Portfolio Planning and Management System”

RADSS

Windows Database Management
(M/S Access)

Data Bases
Reports and Graphics

Enhanced Analysis and Decisions

GOAL: Rate NAVFAC Southwest Environmental Site Clean-Up Projects to allow Optimization of Total Benefits to Constrained Costs

CRITERIA

Safety Risk Performance Lifetime Supportability Special Factors Versatility

ALTERNATIVES

Fuel Cells
Solar Cells
Nuclear Reactor

Data Bases

Customized AHP Decision Model (s)
Broad Range of RADSS Applications

Tailored to Individual Customer Requirements
RADSS™ Architecture

“Portfolio Planning via Decision Modeling”

- Benefits
- Benefits / Cost
- Prioritization
- Maximization
- Optimization
- Analysis Tool
- Scenarios
- Sensitivities
- Audit Trail
- Reports
- Graphics
Criteria, Constraints, and Rules

- RADSS supports both Qualitative and Quantitative Decision Criteria and Standards
- RADSS supports multiple Constraints
  - Global (Total or annual budgets)
  - Category (On classifications)
  - Minimum or maximum (Cost or resource levels)
  - Additive (The more stringent constraint takes precedence)
- RADSS supports Boolean Rules
  - Include (Alternatives are funded regardless of their cost or benefit)
  - Exclude (Alternatives are not funded regardless of their cost or benefit)
  - Linked (Dependent alternatives are linked to independent alternatives)
  - One or None (Only one alternative of a group – or none – are funded)
  - All or None (Either all alternatives in a group – or none -- are funded)
Sample EACOS Decision Model

**Decision Goal**
Increase aircraft availability and mission capability while minimizing cost

- **EACOS Decision Model**
  - **Availability** 40%
  - **Capability** 40%
  - **Life Cycle Costs** 20%

  - **Availability** 40%
    - Maintenance 45%
      - Scheduled MMH/FH 60%
      - Unscheduled MMH/FH 40%
    - Supply - MICAPS 25%
    - Depot 30%

  - **Capability** 40%
    - Capability Improvement
      - Pilot Workload 25%
      - Situational Awareness 10%
      - Supportability 10%
    - Return on Investment - ROI 40%
    - Savings Magnitude - RTOC 60%

  - **Life Cycle Costs** 20%
    - Depot 10%
      - Scheduled 10% (Same sub criteria as basic)
      - Unscheduled 90% (Same sub criteria as basic)
    - Capability 10%
      - Pilot Workload 70%
      - Situational Awareness 15%
      - Supportability 15%
    - Life Cycle Cost 30%
      - Return on Investment - ROI 40%
      - Savings Magnitude - RTOC 60%

**RADSS Optimization via Constraints**

Max Funding per Block
(or by 3600, 3400, 3010)

Min Funding per Block

A, B, C, D

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Sample EACOS Decision Model

Decision Goal

Improve aircraft availability, combat capability, control cost, and improve fleet viability through_____

Availability 30 %

Capability 28 %

Viability 24 %

Life Cycle Costs 18 %

- Return on Investment--ROI 46 %
- Savings Magnitude--RTOC 54 %

Capability Improvement 39 %

- Avionics 41 %
- Low Observables 36 %
- Weapons 23 %

Situational Awareness 28 %

Pilot Workload 20 %

C2ISR 13 %

Supportability 29 %

- NMC Hours 45 %
- Maintenance Obsolescence 23 %
- MICAPS 32 %

MC Rate Change 27 %

Maintenance 26 %

- Unscheduled MMH/FH Maintain with Less 65 %
- Maintain with Less 35 %

Depot Days 18 %

- PDM Days 50 %
- Mod Line Days 50 %
Sample PBL Decision Model Application

Decision Goal

Improve aircraft availability, combat capability, control cost, and improve fleet viability through____

Investment Decision Models can also include Performance Based Logistics Criteria tailored to each Fleet:

- Operational Availability
- Mission Reliability
- LCC System Cost per Unit of Usage
- Logistics Footprint
- Logistics Response Time
EACOS Phase II: Investment Optimization Process

RADSS Decision Process

1. Define Decision Goal

2. Identify Decision Criteria
   • Weight the Criteria
   • Create & Weight Standards

3. Identify Decision Alternatives

4. Collect Criteria Data for each Alternative

5. Analyze Data & Identify
   • Show Stoppers
   • Positive Outliers
   • Correlations
   • Constraints

6. Load & Execute RADSS
   • Unconstrained
   • Multiple Constraints
   • Multiple Scenarios

7. Examine Results & Make Final Adjustments
   • Benefit Prioritizations
   • Benefit to Cost Ratios (ROI)
   • Sensitivity Analyses
   • Scenario Analyses

Select Optimum Solution Set

Resource Analysis Decision Support System (RADSS)

- Benefits / Value
- Benefits / Cost
- Prioritization
- Maximization
- Optimization
- Analysis Tool
- Scenarios
- Sensitivities
- Audit Trail
- Reports

Data Export
- Iterative Analysis

Solution Set

Show Horses

Selection Iterations

Show Stoppers
Delta Mission Capable Rate vs. Cost
Delta RTOC versus Cost
Scenario #9 - Medium Cost Boolean Rules

- Selected “High- Contribution” candidates for “Automatic” Funding
  - A003 - Interior MTI Alternatives: Two Primary (Demolition)
  - A004 -
  - FA006 -
  - A012 - Inboard Fixed Trailing Edge Structure (H.T.E.) and Ribs Alt

- Linked Candidates
  - A003 -
  - A004 -

- “One-or-None” Groups
  - A002 -
  - A003 -
  - A005 -
Medium Cost Alternatives ($25M - $200M)
Cumulative Effects of Funding Scenario #9

20% Funding Scenario – Funds 8 Candidates for $327M
Predictive Nature of Funded Scenario(s)

- Funding of a single Investment Candidate will result in calculated changes to the metrics contained in the EACOS Fleet Decision Model, i.e., deltas to:
  - Availability / Mission Capable Rate
  - Scheduled / Unscheduled Maintenance Manhours
  - MICAPs
  - Capability
  - Life Cycle Cost
  - Depot Flow Time
  - Other Metrics applicable to the customized fleet decision model

- Modeling and funding of a group of Investment Candidates within a specified scenario will result in a cumulative delta change to fleet MC Rate, RTOC, etc.
Benefits of the EACOS Process

- Complements / Enhances Current Decision Processes
- Rigorous Enterprise Analysis and RADSS Approach is *highly* Effective
- Allows Modeling & Better Differentiation & Prioritization
- Enhances Marginal Returns on Complex Decisions
- Increases Total Benefits within Constrained Budgets
- Collectively Achieves Greater ROI

**Optimized & Balanced Budget and Execution Portfolio**
Summary

- The RADSS modeling tool **simplifies and optimizes complex investment decisions**
  - Considers decision criteria of all Stakeholders
  - Considers a wide-variety of constraints
  - Considers sensitivity and scenario analysis
  - Results in multiple, customized Investment Portfolios

- **EACOS has broad applications across the Services**
  - All aging systems can benefit from the baselines and EACOS predictive assessments to help support modernization & end-to-end sustainment investment decisions
  - All DoD processes (supply, maintenance, depot, operations) can benefit from EACOS principles & tools
  - Special initiatives can benefit, e.g., Modeling for Performance Based Logistics (PBL) and Aircraft Availability Improvement Program (AAIP)