Missile Operations and Support Simulation (MOSS) Method

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Missile Operations and Support Simulation (MOSS) Method

Modeling Objective:
Model and Analyze Hardware Stockpile over Multiple years or Program Life-Cycle to Predict Repair, Readiness, Cost, etc…

- Basic Needs
- Solution through MOSS
- Follow-on Work
Basic Needs to Assess Stockpile
Life-Cycle Repair, Readiness, Cost, etc...

Account for...

- Maintenance, Testing, Training, Operational Tempos
- Dynamically Changing Utilization of Inventories
- Hardware Reliability in Diverse Environments
- Reliability Growth and Wear-out
- Upgrade / Retrofit Programs
- Effectiveness of Test Equipment
- Expediency of Logistics Supply and Transport Chain

*Factors Interact to Affect
Repair, Readiness and Cost*
Discrete Event Simulation Path

Benefits
- Systems Approach
- Track/Update Items through Process
- Easily Characterize Random Variables
- Easy to Capture System Dynamics
- Easy to Characterize Complicated Process Flows

Cons
- Non-Repeatability Model Build
- Difficult Validation & Verification
- Still Relatively High Cost

Actual Experimentation On Hardware (Surveillance)

Computer Simulation

Closed-form Math Modeling (Equations and Spreadsheets)

Better and Cheaper Software Technologies are Driving Simulation Costs Down
MOSS: Raytheon Simulation-Based Method for Modeling O&S Processes of Military Fielded Inventory

Purpose – Predictive Analyses

• Readiness of Inventory (Stored & Deployed)
• Estimate O&S Cost
• Logistics Pipeline Capacity Requirements
• High Fidelity Estimate of Depot Returns over System Life-Cycle for Maintenance Planning and Warranty Analysis
Elements of MOSS

Common Attributes, Common Blocks, and Sub-Models

- Common Attributes: Characteristics of Missile–Items that are Prevalent for Most Missile O&S Systems

- Common Blocks: Provide Functionality that is Prevalent in Most O&S Systems. Stored in Libraries

- Sub-Models: General Arrangements of Common Blocks that provide Higher Level, More Complex Functionality

Common Blocks, Attributes and Sub-models provide Pre-Validated Mathematics, Are Re-Usable and Streamline O&S Modeling

Also Promote Model Repeatability
Common Blocks of MOSS To Help Define Static Logistics Network

Common Blocks Contain Pre-Validated Logic and Math, and They Are Stored in Libraries to Promote Re-Use

Set Failure Variates → Other Parts of Model (Accumulate Duty Cycles) → BIT Test → Warranty Check
MOSS Modeled System
An Example

Life Cycle States/Environments
MOSS Broad-Block Approach

Model the Static Life Cycle Network from Flow Diagram

Production schedule → Transport

Field Storage

Start Deploy

End Deploy

BIT to Schedule Or Event

Sched MNTNC Due?

Pass → Yes

Fail → No

Scheduled MNTNC

Transport

Repair

Back to Storage or Deploy
MOSS Broad-Block Approach → Apply Sub Models (Arranged Common Blocks) for Specific Functionality

Sub-Model for Stockpile Availability Applied

- Production schedule
  - Enter RFI Resource
  - Set Failure Variates
  - Transport
  - Start Deploy
  - Field Storage
    - When Needed
  - End Deploy
  - BIT
    - Fail
    - Pass
  - Sched MNTNC Due?
    - No
  - Back to Storage or Deploy
  - Yes
  - ITEM
    - Relinquishes RFI Resource
  - STOCKPILE AVAILABILITY
    - Tracks the Contents of Global RFI Resource And Calculates The Population Statistic
MOSS Broad-Block Approach → Apply Sub Models (Arranged Common Blocks) for Specific Functionality

Now Apply Sub-Model for Operational Availability

- Item
- Value

Enter RFI Resource, Zero Downtime Attribute

Set Failure Variates

Transport

Field Storage

Start Deploy

*Observe Ao

End Deploy

*Observe Ao

Sched MNTNC Due?

Yes

No

Back to Storage or Deploy

Stockpile Availability

Operational Availability

Calculates Overall Ao For Population

Tracks the Contents of Global RFI Resource And Calculates The Population Statistic

Augment Downtime Attribute (Current Simulation Time – TimeStamp)

Item Relinquishes RFI Resource, TimeStamp Item

BIT

Fail

Pass

Operational Availability

Calculates Overall Ao For Population

*Observe Ao

Operational Availability

Back to Storage or Deploy

11/1/2006 | Page 11
MOSS Method Addresses Needs

1) Larger-Scope System Approach Compared to Spreadsheets and Equations
   • Can Track and Update Items as They Move through Process
   • Can Easily Characterize Random Variables
2) Easy to Capture Dynamic State Changes
3) Easy to Characterize Complicated Process Flows
4) Standardized Logistics Tool Set in Pull-Down Menu
5) Tools are Pre-validated
6) Tool Set Induces Repeatable Structure, Level of Detail, and Speed of Creation for Future Models

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Benefits of MOSS - Summary

“Environmental Fidelity” equates to High Fidelity Prediction
Tracks and Accumulates Time Spent in Various Environments for Each Item in the Inventory. Accurate Estimate of Duty Cycle → Accurate Failure Prediction

Integration of Analyses

Re-usable and Repeatable
Common Blocks are Pre-defined, Pre-validated and Stored in Pull-Down Library. Attributes and Sub Models are Pre-defined

“Transparent” Interface
MOSS Models are Designed For Making the System more Understandable Through use of Time-based Statistics and Charts, Graphics, Hierarchy and Animation.

The Act of Building Models with the MOSS Method Aids and Promotes Model Verification and Validation
Follow-On Work: Enable Direct Life-Cycle / Mission Trade Analyses

**DESIGN** → Inherent Reliability – Service Life – Maintainability and Testability

**LOGISTICS** → Maintenance – Upgrades – Training – Pipeline Infrastructure – Forward Supply & Readiness

**PERFORMANCE** → End-Game Mission Effectiveness and Holistic Cost for Mission Success

- Design Costs
- O&S Costs

Benefit: “Cradle-to-Target” Insight into Performance & Cost
Shortfall: Vertical Chain. Real World can be Horizontal
Follow-On Work: Integrate Logistics Modeling with Other Initiatives

Integrate Logistics / Mission Performance Modeling and Simulation

Example: Total Asset Visibility and Prognostics could Update Predictive Models with Actual Field Data