Introduction to the Operating & Support Cost Analysis Model

OSCAM Program Office
Overview to DoNCAS
8 September 2011

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What is OSCAM?

- **OSCAM** – Operating and Support Cost Analysis Model
  - OSCAM is a jointly developed, NCCCA sponsored, family of software tools used to help develop Operating and Support Cost Estimates that meet a wide range of requirements.

  - The US Suite of Models is comprised of:
    - OSCAM Ship v8.0
    - OSCAM Ship v7.0
    - OSCAM Shipboard System v7.0
    - OSCAM Air v3.0
    - OSCAM EFV
    - OSCAM USAF
    - OSCAM JSF

  - OSCAM can be used to support life cycle cost estimates, what-if scenarios, trade-off studies, analysis of alternatives, budget drills and taskings related to platform O&S costs.

  - The OSCAM models are built using System Dynamics.
What is System Dynamics?

• System Dynamics theory models the relationships, behaviors, and influences of entities in the system being studied
• The OSCAM models use System Dynamics to model each month of the life cycle of the platform
• This provides a more powerful technique than traditional methods like Excel based models
• System Dynamics promotes an understanding of O&S processes, O&S costs, and the interdependencies that exist

Example: How much time does it take a traveler to get through airport security?
OSCAM was developed through a strategic partnership between the Naval Center for Cost Analysis (NCCA) and the UK Ministry of Defence (UK MoD) with support from QinetiQ Ltd.

Ministry of Defence
Bristol, United Kingdom
- OSCAM Program Management for UK

QinetiQ Ltd
Farnborough, United Kingdom
- OSCAM Software Development
- OSCAM Web Site Administration
- UK Help Desk

Naval Center for Cost Analysis &
Naval Surface Warfare Center,
Carderock Division
Washington DC, United States of America
- OSCAM Program Management for US
- US Help Desk
How is OSCAM different?

- OSCAM models are a time based simulation which makes it more powerful than Excel based models
  - OSCAM can discretely model depot maintenance periods and account for aging, for example, because of the time based approach

- Model openness
  - OSCAM is not a black box model
  - OSCAM users have complete insight into the equations and relationships that are used via the built-in help functions and model structure document
  - The model facilitates understanding of O&S processes, O&S costs, and the interdependencies that exist

- Historical databases
  - VAMOSC based historical datasets are provided with the OSCAM Ship, OSCAM Sys, and OSCAM Air models. Historical datasets are prepared for most platforms in the Naval VAMOSC database

- Supports a team approach
  - OSCAM encourages a team approach; it can be used throughout the life cycle by logisticians, cost analysts, engineers, etc., because the results offer both cost and non-cost outputs
OSCAM Family Common Features

• Simplified or detailed analysis for major cost elements
• Sensitivity and Uncertainty Analysis
• Throughput facility for additional costs or unique requirements
• Ability to compare multiple model runs
• Delta and Aggregation tools
• Automated tracking of data sources
Additional Potential Model Uses

- **OPTEMPO**
  - OPTEMPO impact on Fuel Consumption
  - OPTEMPO impact on Maintenance Requirements
  - Aircraft Shortfall impact on OPTEMPO
  - Materially Available Vessel Day analysis

- **Aging**
  - Age Impact on Fuel Consumption
  - Age Impact on Maintenance Requirements

- **Maintenance**
  - Impact of Different Maintenance Philosophies
  - Maintenance impact on Personnel Utilization
  - Modernization impact on Aircraft Age and/or Organizational- and Intermediate-Level Maintenance
  - Training Requirements Impact on Maintenance / Availability
  - Overhaul Cycle Impacts on Depot Capacity
  - Overhaul Impacts on System Age
  - Overhaul Requirement Impacts on O / I-Level Maintenance
  - Crewing Level Impacts on Maintenance / Availability

OSCAM Introduction to DoNCAS September 2011
• OSCAM Ship v8.0
  – Appropriate for all types of ships, boats, and submarines, including nuclear
  – Models up to 60 ships at a time
  – Allows scheduling of deployments and explicit planning of depot maintenance cycles
  – Results mapped to 2007 CAIG structure
  – Expanded uncertainty analysis
  – 3 level of detail for inputs
  – Historical VAMOSC datasets provided for 98 ship classes
Ship Example Scenario

• In service platform

• For budgeting purposes, what are the expected O&S costs for the existing LHD 1 and LHA 1 classes for the remaining years of service life?

All information and data in the scenario is fictitious and used for demonstration purposes only.
Parametric Costing Tool (PCT)

- Parametric Costing Tool
  - Updated for Ship v8.0
  - Allows for ROM estimates very early in the design process
  - 4 required inputs: ship type, lightship displacement, propulsion type, cost of fuel (per barrel)
  - Uses CERs built from historical VAMOSC data to project costs for most CAPE O&S cost elements
  - Allows CER values to be overwritten if better information is available
• **OSCAM Sys v7.0**
  - Developed with the UK MoD
  - Models a specific system that may exist on several ship platforms
  - Software, modernization, and ETS are modeled in greater detail than in the ship model
  - Historical datasets provided for 66 systems
• OSCAM Air v3.0
  – Appropriate for both fixed and rotary wing type/model/series (TMS) as well as UAV programs
  – Models deployed and non-deployed aircraft for Active, Reserve, FRS, and “Other” environments
  – Explicitly models squadron and maintenance personnel
  – Simplified and Detailed inputs in a single database structure
  – Historic databases are provided for 21 TMS
Data Management Tool (DMT)

- Each model has its own Data Management Tool
- The DMT is a way to model maintenance data to the lowest level applicable
- DMT is ideal for trade off studies and obsolescence drills
- Ship and Sys DMTs build a tree structure based on Work Breakdown Structure (WBS); Air builds its tree structure based on Work Unit Code (WUC)
- Datasets are not provided with the DMTs but assistance in building a DMT dataset is available
  - A dataset generator tool is available for the Air model
DMT Example Scenario

- PEO F/A-99 wants to upgrade its weapon control systems. The AN/ASQ-228(V)2 TARGET DESIGNATOR SET has been rendered obsolete and needs replacement. The Program Office has a COTS system, the AN/ASQ-3000, ready to be installed and wants to know how to adjust their operating budgets through the FYDP.
  - The AN/ASQ-3000 has an AVDLR $/HR of 10/HR
  - The AN/ASQ-3000 has an Consumables $/HR of $0.25/HR

- The DMT provides a fast and easy way to evaluate this problem with a bottoms up approach.

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Other US OSCAM Models

• OSCAM EFV
  – Bespoke model built by the USMC EFV program office
  – Based on the UK Land model

• OSCAM USAF
  – Built by the C-17 program office but made generic enough for all Air Force programs
  – Based on the Navy Air model

• OSCAM JSF
  – Currently in v1.0
  – For use by all 9 partner countries as a common O&S tool

These models are not managed by NCCA but points of contact can be provided upon request.
User Support for Navy Models

- **US Help Desk** – supported by the OSCAM program office
- **F1 Help functionality** – displays the appropriate influence diagram for each input and/or output which allows the user to trace relationships and interdependencies
- **Structure documents** – contain the influence diagrams and are available for every model and DMT
- **User Guides** – provide direction on how to use the model, available for every model and DMT
- **Automated Tutorials** – “movies” to show how to use the models, available at www.oscamtools.com
- **Historical dataset guide**
  - explain how the datasets are developed and list data processing assumptions and methodologies
Who is currently using OSCAM?

- **Air**
  - Joint Strike Fighter (JSF)
  - Navy Unmanned Combat Air System (N-UCAS)
  - E-2C/D Analysis in Industry
  - EA-18G NCCA Estimates

- **Ship**
  - Littoral Combat Ship (LCS) PLCCE and BCA
  - Joint High Speed Vessel (JHSV) – used by both the Navy and Contractor teams
  - DDG-1000 for Milestone Reviews
  - DDG 51 for Milestone Reviews and ongoing studies
  - Sea Based Strategic Deterrent (SBSD) AoA – Trident replacement program
  - Virginia Class Submarine (VCS) MS III PLCCE update
Who has used OSCAM?

• Ship
  – T-AKE cargo ship source selection – estimate was within 4% of CAIG estimate
  – LHA Replacement program MS B PLCCE – estimate was within 6% of CAIG
  – Maritime Pre-positioned Force (Future) (MPF(F)) – amphibious ship estimates
  – CG(X) Analysis of Alternatives Study – new cruiser program
  – Unmanned Naval Surface Combatant
  – US Coast Guard Deepwater Program

• Air
  – Vertical Takeoff Unmanned Aerial Vehicle (VT-UAV) MS C – both program office and ICE team used OSCAM
The OSCAM Demonstration Version is intended to raise interest in OSCAM by demonstrating some of its capabilities to potential users and to encourage interested analysts to:

- Attend OSCAM training
- Obtain OSCAM Full Version of Ship or Air
- Learn more about OSCAM

The OSCAM Demonstration Version has been simplified for untrained users through provision of a pre-loaded demonstration dataset. This dataset is not specific to any particular Ship Class or Type/Model/Series.

Contact the OSCAM program office if you are interested in a copy.

The Demonstration Version is not intended for actual program analysis.
OSCAM Training Courses

• Three day “hands-on” training courses
  – Includes OSCAM training, the model software, and all subsequent updates as well as access to the US Help Desk
  – **OSCAM Ship and Sys Training Courses**
    ➢ To be held at the Admiral Gooding Center at the Washington Navy Yard
  – **OSCAM Air Training Courses**
    ➢ To be held in Southern MD, near the PAX NAS
  – To register for a course and see the latest training schedule, please visit [www.oscamtools.com](http://www.oscamtools.com)

*The course fee has been waived for the upcoming training courses for government personnel and government sponsored contractors!*
The OSCAM website is one-stop shopping for:

- Model downloads
- Dataset downloads
- Upcoming training course and conference dates
- Training registration
- Model Tutorials
- OSCAM POCs
Points of Contact

OSCAM US Help Desk
OSCAM.NSWCCD@navy.mil

QinetiQ Help Desk
oscam@qinetiq.com

Related Web Sites
www.oscamtools.com  www.vamosc.navy.mil
www.ncca.navy.mil  www.qinetiq.com
BACKUP
To edit the demo dataset, press any of the input form icons. There are separate input forms for:
- Program Profile data
- Personnel data
- Operations data
- Maintenance data
- Training data
- Indirect Support data
- Other data
- Throughput Cost data

To run the model with the demo dataset, press the simulation button. When the Simulation Control Form appears, you simply press the Run button. After the model has run, the Results Screen will be displayed (see following slide).
In the input forms, any data field can be edited. By default, the data source is the record name “Demo Data.” When a field is modified, the record name is highlighted in red and the data source changes to “User.” This is one of OSCAM’s audit trail features. New in v3.0 is the ability to set the data source to whatever the user chooses. The example here shows J. Smith.

As well as its short description, each input field has a long description that provides more information. It is displayed at the bottom of the screen by hovering the mouse over the input field.

The Online Help facility can be accessed by pressing the “F1” key when the cursor is in any input cell. This brings up a window that depicts how that input is used within the model.
The results can be displayed annually or cumulatively. Model results are displayed in both tabular and graphical format. The results table can be expanded and collapsed by clicking the “+” and “-” boxes. Any data line can be displayed in the graph by double-clicking on that line.

Up to 20 result sets can be displayed in the table and graph.
The breakdown structure is defined by the user. Unscheduled maintenance data is entered for components at the lowest level. The DMT then aggregates this data to the aircraft level, where it can be exported to OSCAM for further analysis. Data is entered separately for Aircraft and Engine parts.
While the primary function of the DMT is to create OSCAM datasets, it is also an analysis tool. In this example, the user can identify the major maintenance drivers within the “Aircraft” element. This view shows a comparison of Actions/1,000 Flying Hours:

- Green denotes Actions due to Engine parts;
- Red denotes Actions due to Aircraft parts.
To run the model with the demo dataset, press the simulation button. When the Simulation Control Form appears, you simply press the Run button. After the model has run, the Results Screen will be displayed (see following slide).

To edit the demo dataset, press any of the input form icons. There are separate input forms for:
- Program Profile data
- Operations data
- Personnel data
- Training data
- Organizational and Intermediate level maintenance data
- Depot maintenance data
- Indirect cost data
- Other data
- Throughput data
The Operational Profile allows for scheduling of planned depot maintenance and deployment periods.

The “stoplight” lets a user know if there are problems with the operational profile that will stop the simulation from running. Error messages will appear in the white box.
The Operations data can be entered in Deployment mode (which allows the scheduling of deployment periods) or underway mode. When in underway mode, a speed-state-time profile can be entered as detailed data that will determine the fuel usage of the ship. The detailed inputs are “turned on” through the use of the checkbox.
Personnel data inputs include number of crews per ship and tables that allow input by rank/rate as well as additional crew like Civilian Mariners or contractors. The tables are accessed through the checkbox.
O and I level maintenance are combined into a single sector. The different levels are accessed through tabs.

Detailed level inputs exist for O and I level, but simplified inputs are also available. These allow a user to define O and I level maintenance in terms of any combination of the following:
- $K/ship/year
- $K/month in fleet time
- $K/hour underway.

These inputs increase the flexibility of the model. It is possible to use simplified inputs on the O level and detailed inputs on I level (or vice versa).
The capabilities of depot maintenance contain 3 levels of detail. Simplified calculates depot $K/ship/year and is accessed through the checkbox. Moderate level allows scheduling of depot events on the program profile but requires less detailed cost information. Detailed level is the lowest level of depot data available. Detailed level allows specification of government and/or contractor depot costs.
Table style exist in several areas. These allow for cost profiles to be entered for costs that may vary by year.
Throughput costs allow for the choice of appropriation. This means that throughput costs can be escalated when the cost base year is changed or a results set is converted to Then Year $. The choices reflect current NCCA inflation guidance.
The Uncertainty tool allows the user to choose from 11 different probability distributions.
The breakdown structure is defined by the user. Sample structures might be ESWBS or EIC. Maintenance data is entered for components at the lowest level. The DMT then aggregates this data to the ship level, where it can be exported to OSCAM for further analysis.
While the primary function of the DMT is to create OSCAM data records, it is also an analysis tool. In this example, the user can identify the major sub-system maintenance drivers within the “New Ship”. The view shown here is a comparison of Actions/System/Year.
System Dynamics Example

Hours of daylight

Passengers

Security Personnel

Threat Level

Ticket Prices

Airport Security Pass Through Time

Security Experience Level

X-Ray Machines

Fuel Prices

Summer Wear

Winter Wear

Outside Temperature

Ticket Prices

Security Personnel

X-Ray Machines

Fuel Prices

Summer Wear

Winter Wear

Outside Temperature

Ticket Prices

Security Personnel

X-Ray Machines

Fuel Prices

Summer Wear

Winter Wear

Outside Temperature
Sys Example Scenario

- Updated platform
- All CIWS systems will undergo a major upgrade in the 10th year of service.
  - It will take 5 years to complete all the upgrades
  - 100K SLOC is estimated to be added by the upgrade
  - The upgrade will reduce the effective age of the system by half
  - Estimated cost will not exceed 25% of the original procurement cost
  - After the upgrade the system will require 10% less maintainers
- What are the expected O&S costs for the platform with this anticipated upgrade?

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Air Example Scenario

• New platform
• The Navy had proposed a new helicopter, the ZZ-10, to replace the current AH-1W.
  – ZZ-10 will enter service in 2022 with 12 aircraft per year for 12 years (144 total new helos)
  – 50% will go to active squadrons, 25% to reserve, and 25% to FRS
  – Flying hours and squadron manning will remain the same as the current AH-1W
  – The fuel usage will be 15% more efficient than AH-1W, but AVDLR and Consumables costs are estimated to be +20% for unscheduled work

• What are the estimated O&S costs for the new platform?

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