Torpedo Enterprise Advanced Modeling and Simulation (TEAMS): Case Study Status

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Outline

• Why TEAMS?
  • The Problem
  • The Solution
• The Process: TOGAF 8.1.1 ADM
• The Method: Model Driven Architecture
• The Results: Organizations Looking to TEAMS
• TOG/OMG Synergy Update
• Overall TEAMS Goals
Why TEAMS?

- **Problem:** Modeling & Simulation Business Model – Obsolete
  - Monolithic
  - Stove pipes
  - Single developers
  - No communication

- **Solution:** Foster Collaborative M&S Development Environment
  - Standardize M&S architecture framework and component models
  - Reduce the technology development timeline
  - Increase model content, implementation efficiency and reuse
  - Reduce cost
The Process: TOGAF ADM

The Open Group: IT Consortium
Offers Consortia Services

TOGAF:
The Open Group
Architecture Framework

ADM:
Architecture Development Method
The Process: TOGAF Phase A

The Open Group Architecture Framework Architecture Development Methodology

Architecture Vision:
- Establish M&S Consortium
- Determine Stakeholders
- Achieve consensus on problems and solutions

TOGAF Phase A

Manages standards
Configuration Control Board

Executive Steering Group
Oversees consortium, develops requirements

Develops/maintains standards
PROCESS IPT

Develops common software environment
FRAMEWORK IPT

Develops taxonomy, content and interface
Technical Design IPT

As currently funded
The Process:
TOGAF Phase B

The Open Group Architecture Framework Architecture Development Methodology

Business Architecture:
The TEAMS consortium had detailed discussions about strategic business drivers that influence modeling and simulation.

I = information; P = policy; $ = funding; WS = weapon system
The Process: TOGAF Phase C

The Open Group Architecture Framework Architecture Development Methodology
Information Systems Architecture- 2 components

TEAMS Applications architecture
- Baseline simulations – provide components
- Generate TEAMS Compliant interfaces for Components
- Reinsert standardized components into simulations

TEAMS Data architecture
- Attributes : inputs and outputs between component classes
- UML Collaboration diagrams: control flow and data flow
- Gap analysis: ensure data descriptions directly correlate to interface APIs

Common Architecture Framework
The Process:
TOGAF Phase D

The Open Group Architecture Framework Architecture Development Methodology

TEAMs Technology Architecture Process:
- Define use cases
- Define Ontology Groupings
- Define major concepts as classes
- Define static relationships between classes
- Define key attributes for the classes
- Define methods that link the classes
- Define dynamic relationships between classes
- Define representative scenarios
- Perform gap analysis on missing classes and relationships

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<thead>
<tr>
<th>Name</th>
<th>System Emulation of Broadband Weapon</th>
<th>Loss of Array Element</th>
<th>Performance Assessment of Signal Processing Algorithms</th>
<th>Future Weapon System Parametric Analysis</th>
<th>Virtual Torpedo w/ HWIL Pursuing Real Target on Real Range</th>
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</thead>
<tbody>
<tr>
<td>Objective</td>
<td>Exercise Operational Weapon System That Will Be Tested During Op &amp; Tech Eval</td>
<td>Engineering Evaluation of Robustness of Specific Subsystem Design to Damage</td>
<td>Evaluate Effect of Candidate Algorithms on System Performance Within Fleet-Approved Scenarios Before Next Stage of Design</td>
<td>Assess Performance Metrics, e.g. Pk, TTH Based on Input Environment and Platform Performance Parameters</td>
<td>Cost-Effective Training @ High Realism</td>
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<tr>
<td>Attributes</td>
<td>Not Real-time Highest Detail</td>
<td>High Detail Within Restricted Scope Not Real-time</td>
<td>Fast Results - Many Repetitions &amp; Scenarios (25 Reps/Scenario) Moderate Detail</td>
<td>Simplified Inputs Very Fast Results - Many Reps to Explore Parameters &amp; Distributions (1000's) Low Detail</td>
<td>Real-time HLA Connectivity</td>
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<tr>
<td>Sim Level</td>
<td>Engineering</td>
<td>Engineering</td>
<td>Engagement</td>
<td>Engagement</td>
<td>Engagement</td>
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The Method: Model Driven Architecture (MDA)

MDA Computational Independent Model (CIM)

MDA Platform Independent Model (PIM)

MDA Platform Specific Model (PSM)

Working Software

8. Environment
- Sound Velocity Profile (SVP)
- Surface Wave
- Bottom Characteristics
- Boundary Characteristics
- Bathymetry
- Bottom Scatter Strength
- Environmental False Targets

1. Propagation
- Ray Tracing
- Bottom Scattering

2. Platform/Vehicle and Tracking
- Location
- Orientation
- Time/Space/Position Information (TSPI)
- Kinematics

3. System Components (Platform/Torpedo)
- Propulsion
- Sonar

4. G&C – Signal Processing Chain
- Command and Control
- Tactics

5. Targets
- Highlights
- Active Sources
- Non-Acoustic

6. Data Interchange
- Precision
- Units
- Errors
- Tolerances
- Uncertainty

7. Simulation Run Info & Management
- Time
- Events

9. Model Description
- Fidelity
- Level of Detail
- Validity
- Launchers
- Submarine and Surface Ship Classes
- Inter-platform Communication (relationships)
The Method: Model Driven Architecture (MDA)
The Method: Model Driven Architecture (MDA)

TEAMS Interface Definition Languages for Interoperable Components
TEAMS Implementation Planning

In-situ Environmental Data via Web Services

TRM Propagation Tool ‘PETE’

Jackson Bottom Model via CORBA

Fey Rey Propagation Model via HLA*

NAVOCEANO SIPRNET Web Site

Applied Physics Lab University of Washington

Defense Modeling and Simulation Office
<table>
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<tr>
<th>Organization</th>
<th>Interest Points</th>
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| The Open Group                                                             | - International organization, developers of TOGAF architectural framework  
- Wants TEAMS as test case for TOGAF 8.1.1 and 9.0  
- Interest in using TEAMS to test synergy between DoDAF and TOGAF frameworks  
- Wants TEAMS for its process to incorporate Ontologies (relationships of components) |
| OMG (Object Management Group)                                               | - International organization, developers of several business communications standards  
- Wants TEAMS as test case for their TOGAF/ Model Driven Architecture (MDA) synergy effort                                                                 |
| The Open Systems Joint Task Force of the Office of Secretary of Defense (OSD) | - The Open Systems Joint Task Force of the Office of Secretary of Defense (OSD)  
- Wants to convert TEAMS UML artifacts to the newly approved SysML standard to demonstrate utility of the new standard |

**The Results:**

TEAMS is quickly yielding *highly visible* and *transitionable* results.
Phase A: TOG/OMG Synergy Examples
Phase B:
TOG/OMG Synergy Examples
Phase B: TOG/OMG Synergy Examples
Overall TEAMS Goals

- Modeling and Simulation Community Collaboration
- Standardized architecture framework
  - Conceptual model
  - UML requirements specifications
- Standardized model interfaces
  - Interchangeable components
  - UML requirements specifications
  - XML schema – extend to other applications
  - OWL ontology – semantic descriptions
- Documented standards and requirements
- Cost effective process to achieve interoperability and composability
- Business model for future cross-organization M&S funded efforts