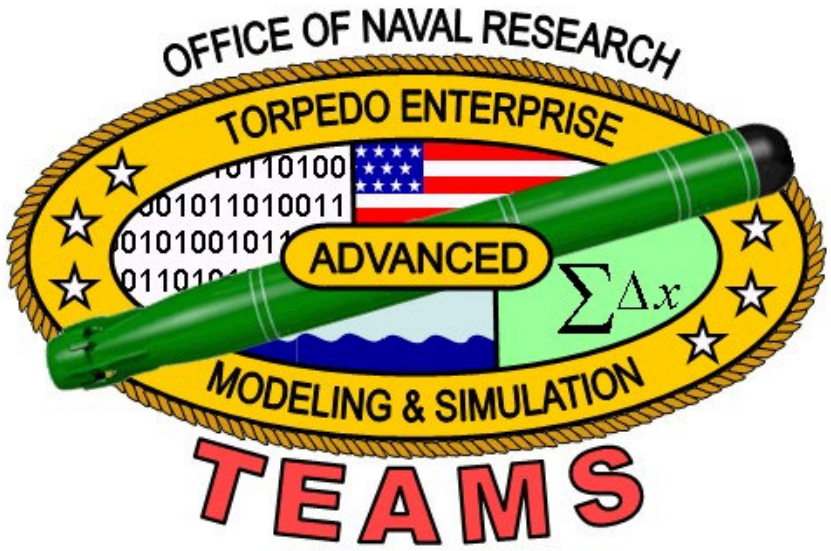
# Torpedo Enterprise Advanced Modeling and Simulation (TEAMS): Case Study Status

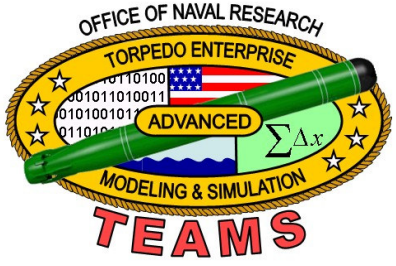
*Presented to:*
Enterprise Architecture
Practitioner's Conference
London, United Kingdom

*Presented by:*
Judy Cerenzia
Applied Research Laboratory
Penn State University

01 December 2006



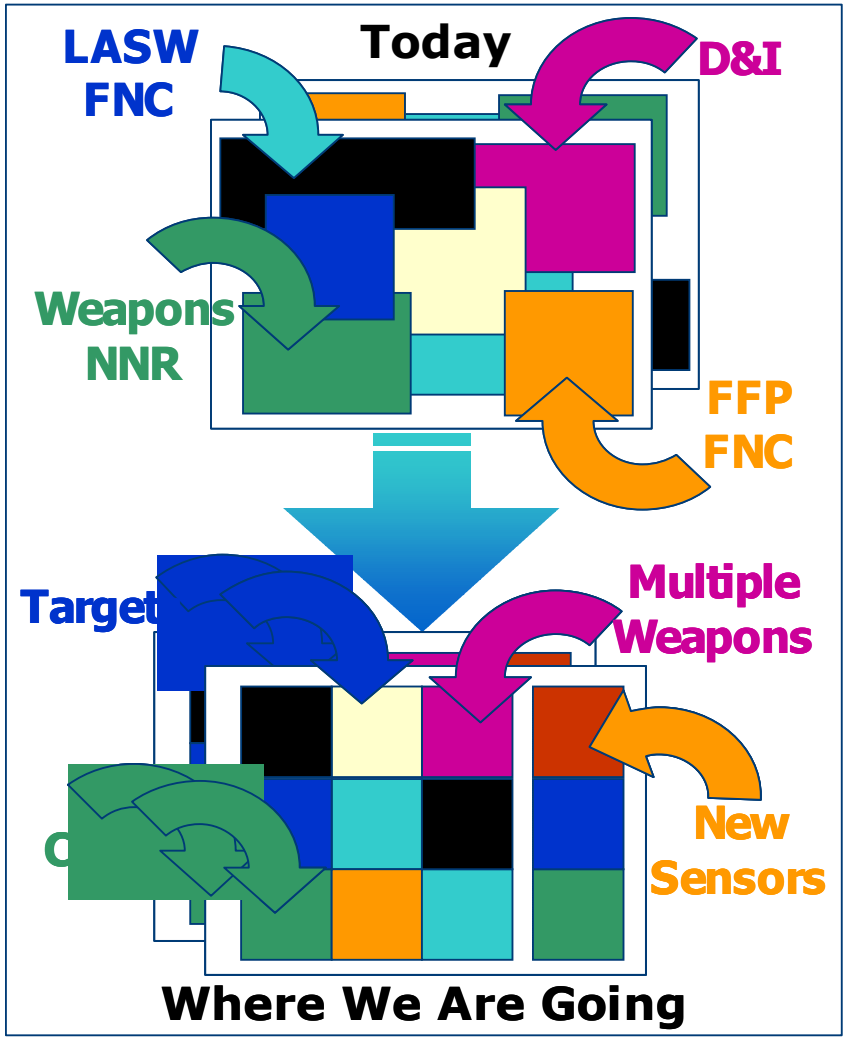
# Outline



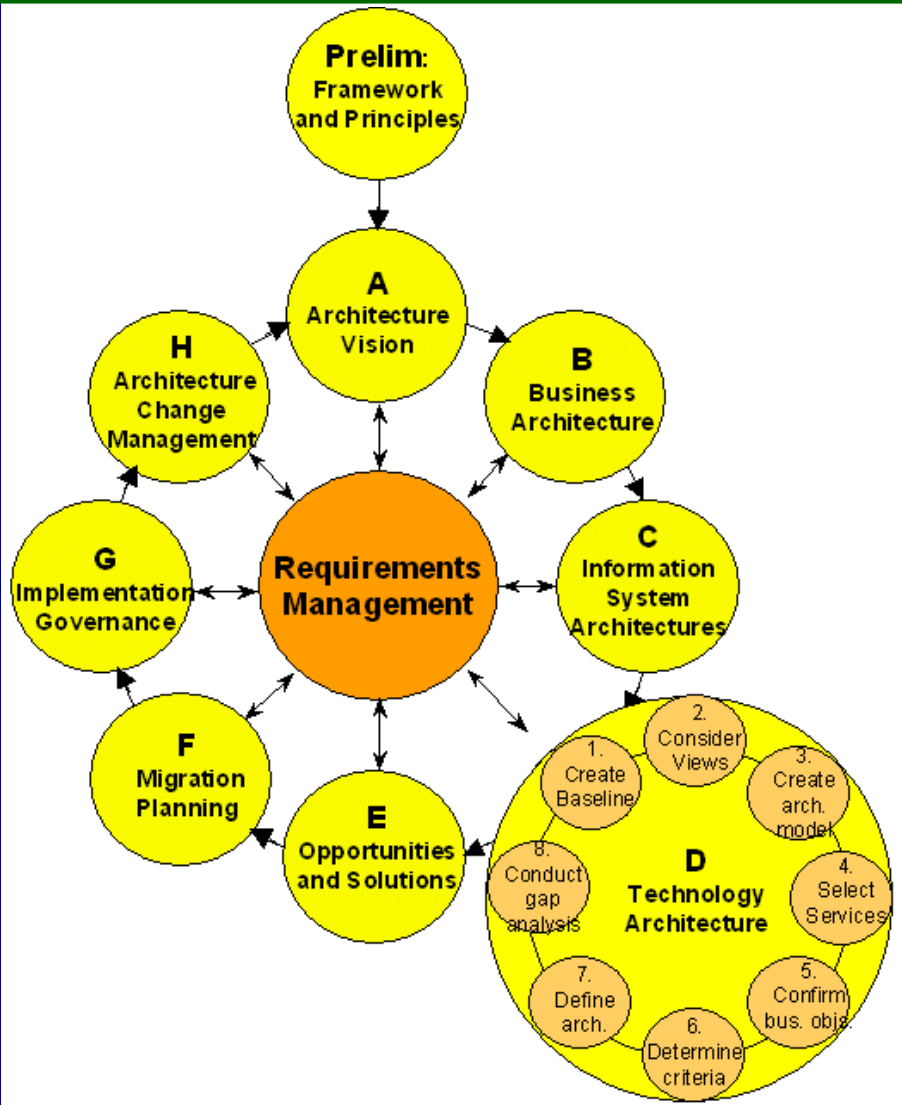

- Why TEAMS?
  - The Problem
  - The Solution
- The Process:  TOGAF 8.1.1 ADM
- The Method:  Model Driven Architecture
- The Results: Organizations Looking to TEAMS
- TOG/OMG Synergy Update
- Overall TEAMS Goals

# 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



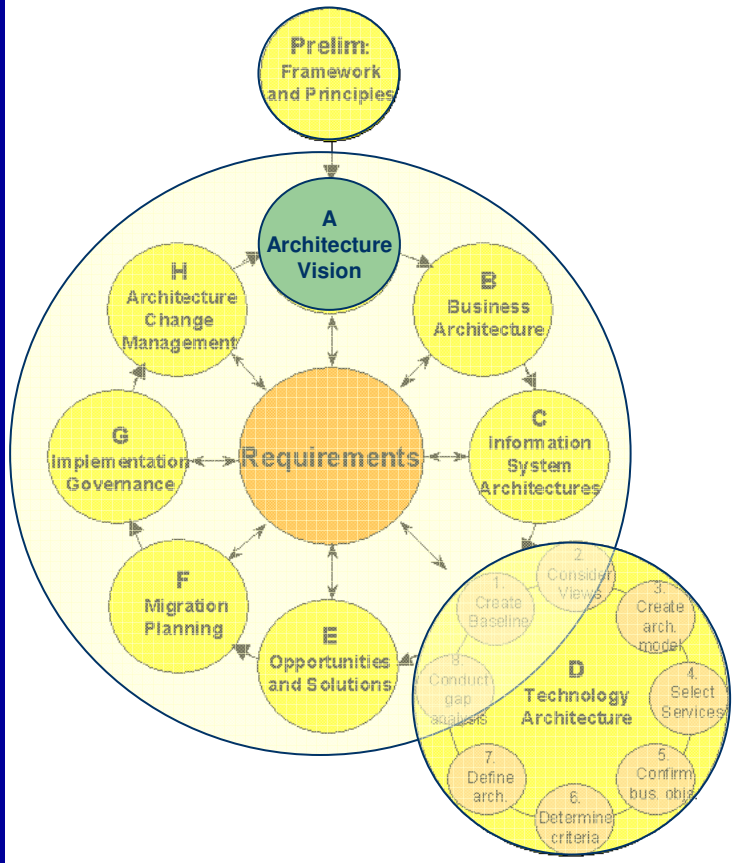

**The Open Group:**
**IT Consortium**
**Offers Consortia Services**

**TOGAF:**
**The Open Group**
**Architecture Framework**

**ADM:**
**Architecture**
**Development Method**

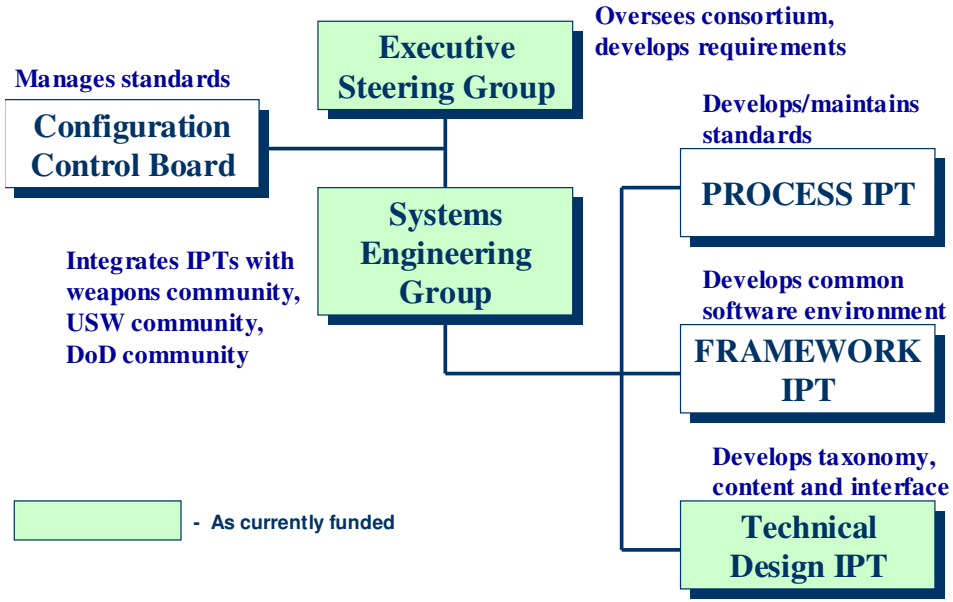
# The Process: TOGAF Phase A

## The Open Group Architecture Framework Architecture Development Methodology



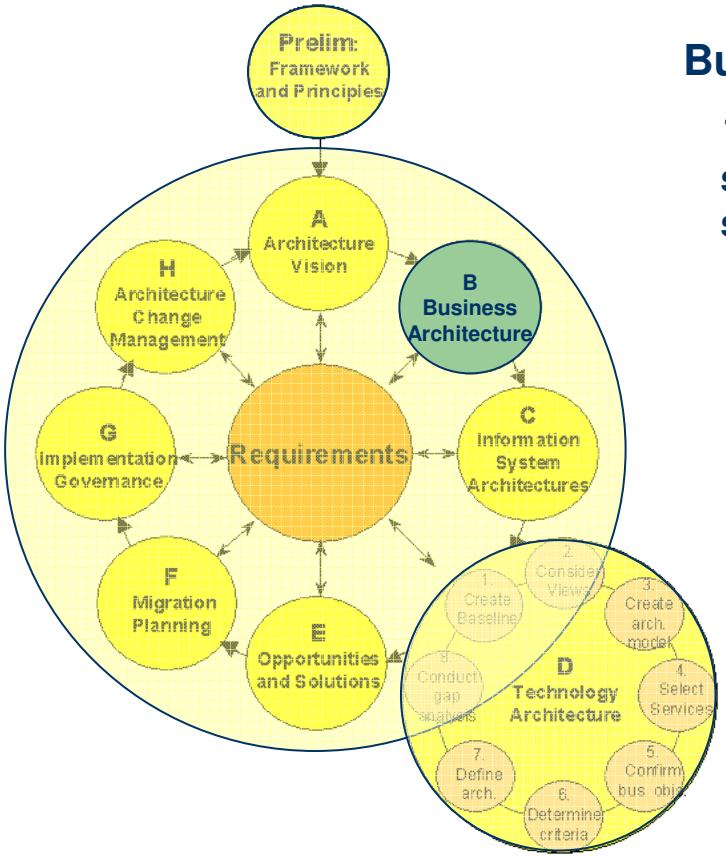

**Architecture Vision:**

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



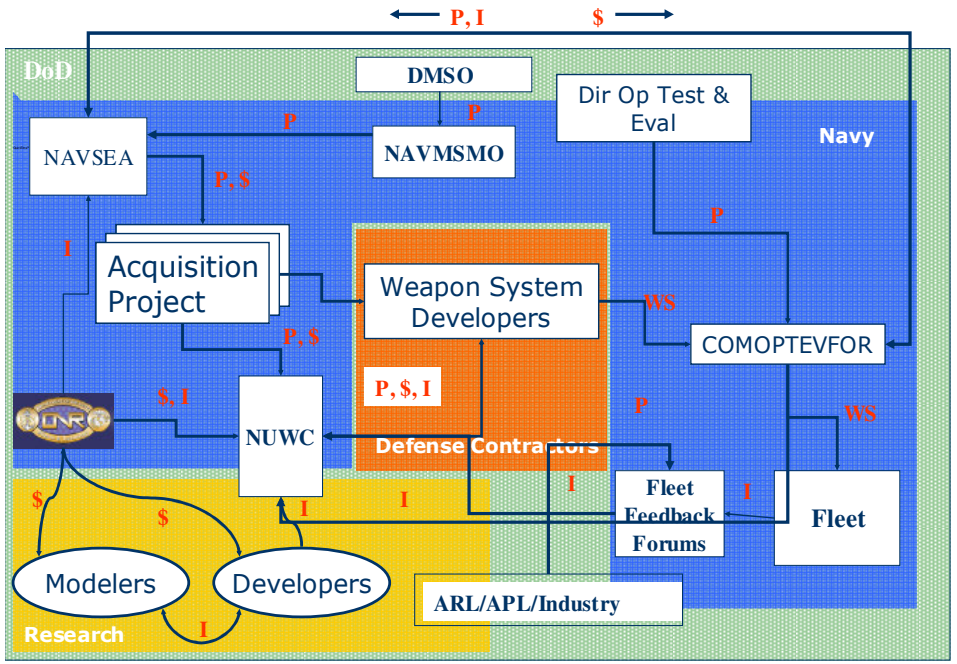
# The Process: TOGAF Phase B

## The Open Group Architecture Framework Architecture Development Methodology




### Business Architecture:

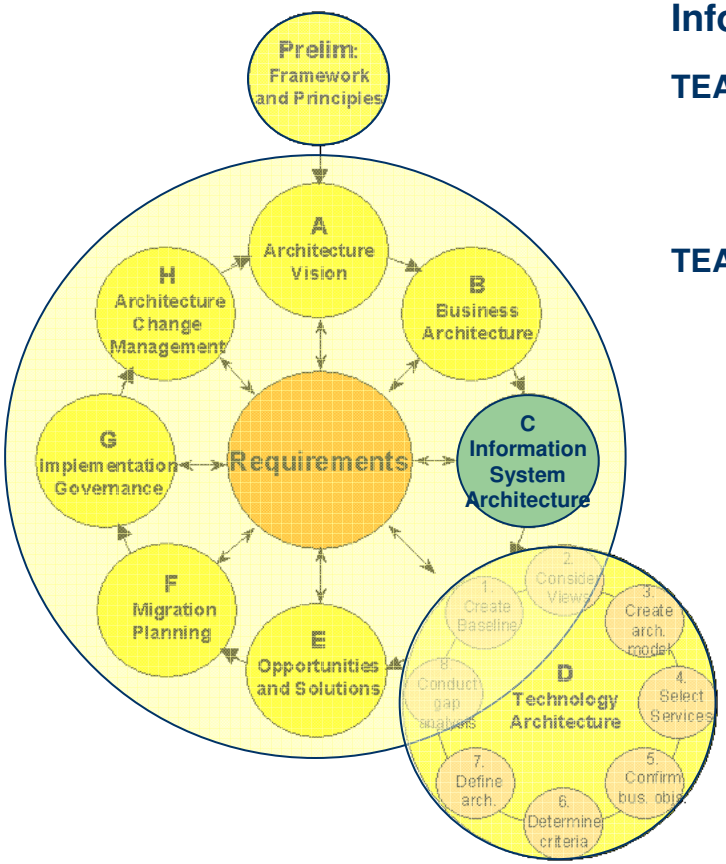
**The TEAMS consortium had detailed discussions about strategic business drivers that influence modeling and simulation.**




I = information; P = policy; $ = funding; WS = weapon system

# The Process: TOGAF Phase C

## The Open Group Architecture Framework Architecture Development Methodology



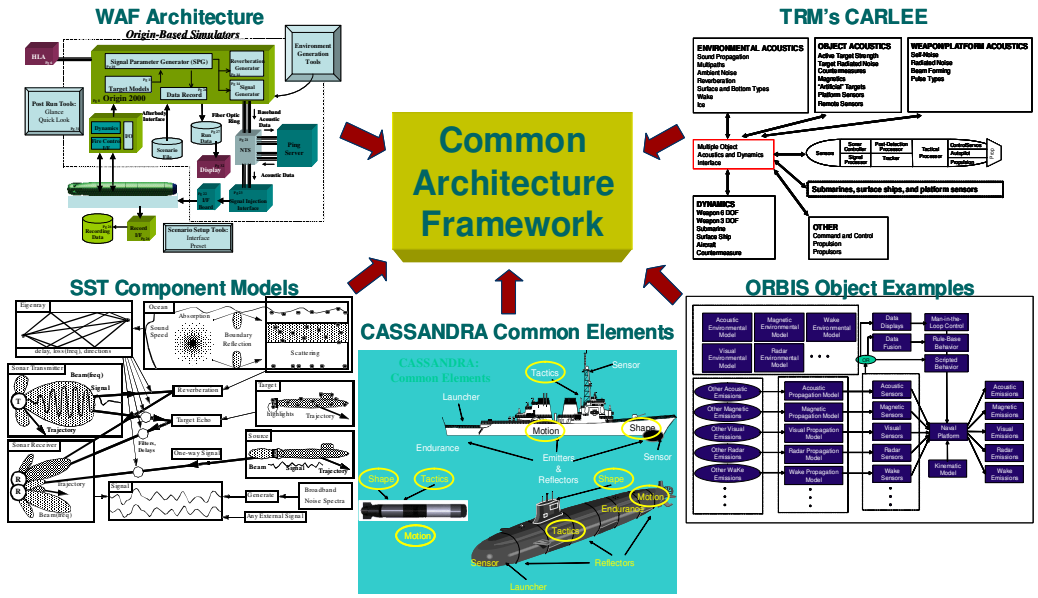

### Information Systems Architecture- 2 components

**TEAMS Applications architecture**

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

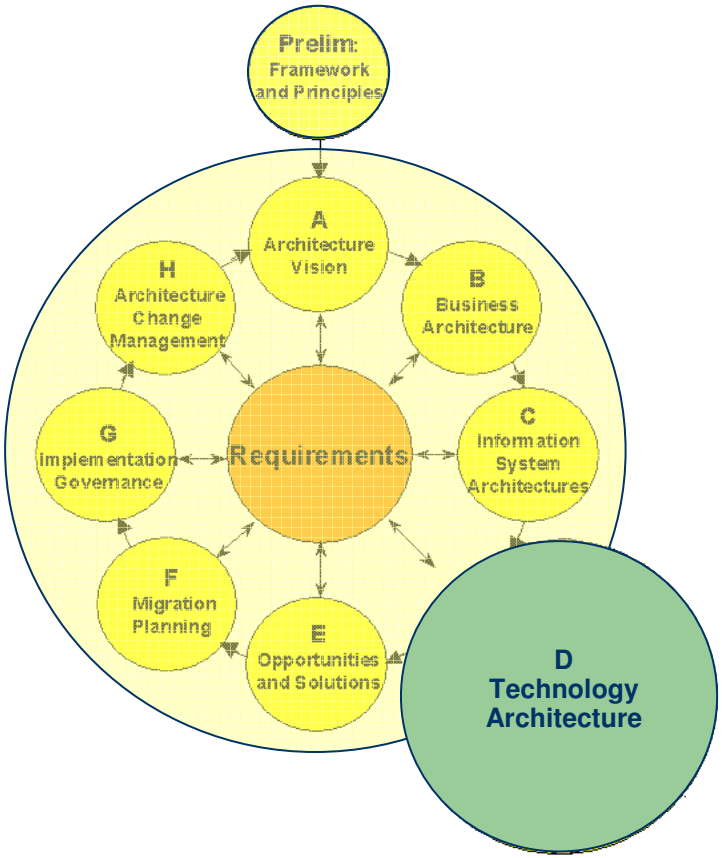
**TEAMS Data architecture**

- 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



# The Process: TOGAF Phase D

## The Open Group Architecture Framework Architecture Development Methodology

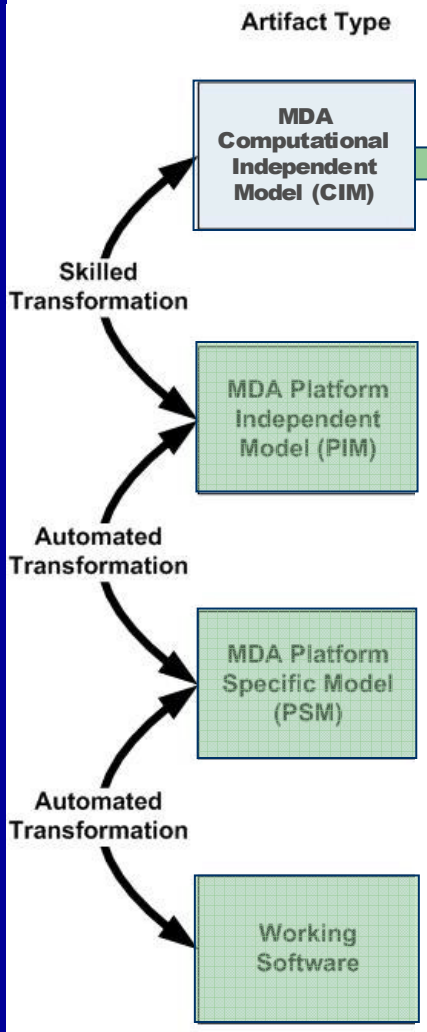



### TEAMS Technology Architecture Process:

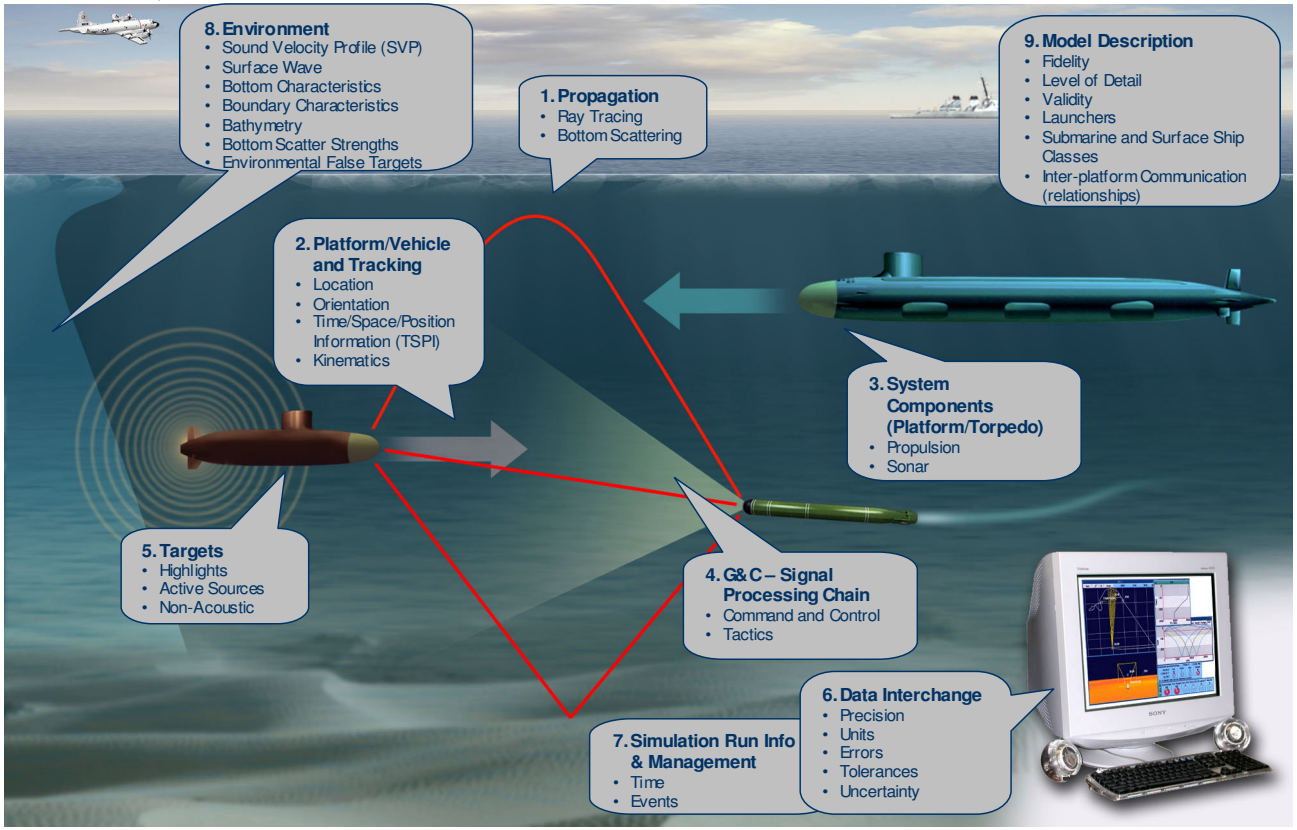
- Define use cases
- Define Ontology Groupings
- Define major concepts as classes
- Define static relationships between classes
- Define key attributes for the classes
- Define methods that link the classes
- Define dynamic relationships between classes
- Define representative scenarios
- Perform gap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

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

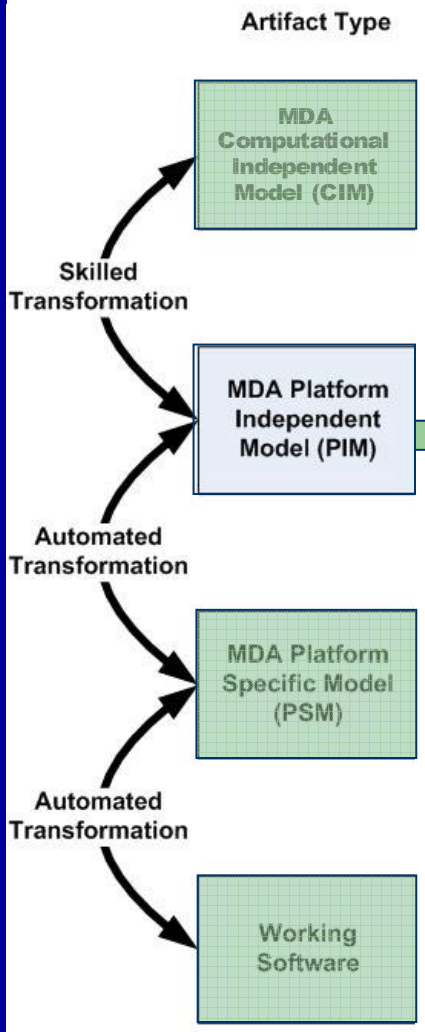
# The Method: Model Driven Architecture (MDA)



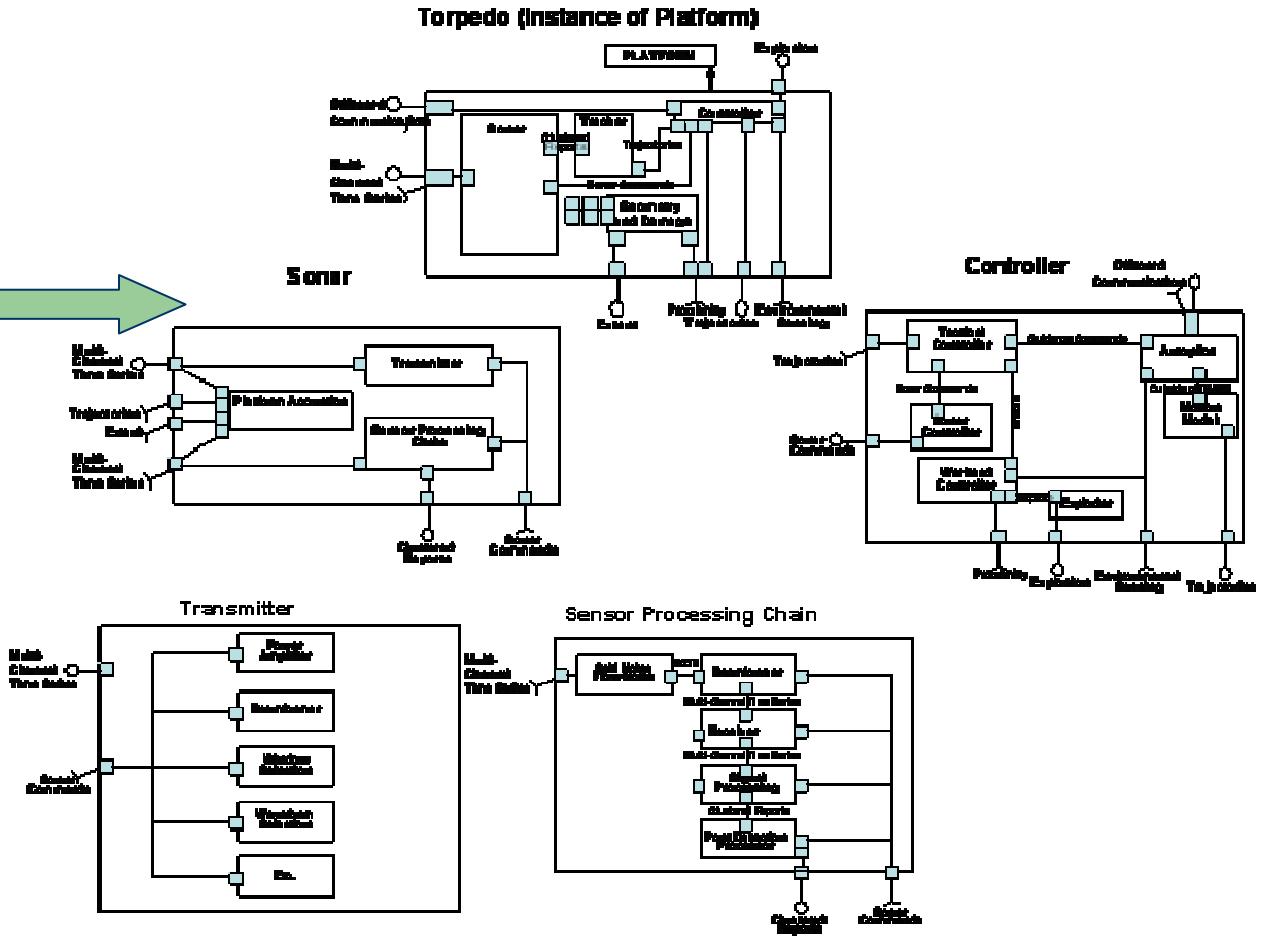

## TEAMS Conceptual Model



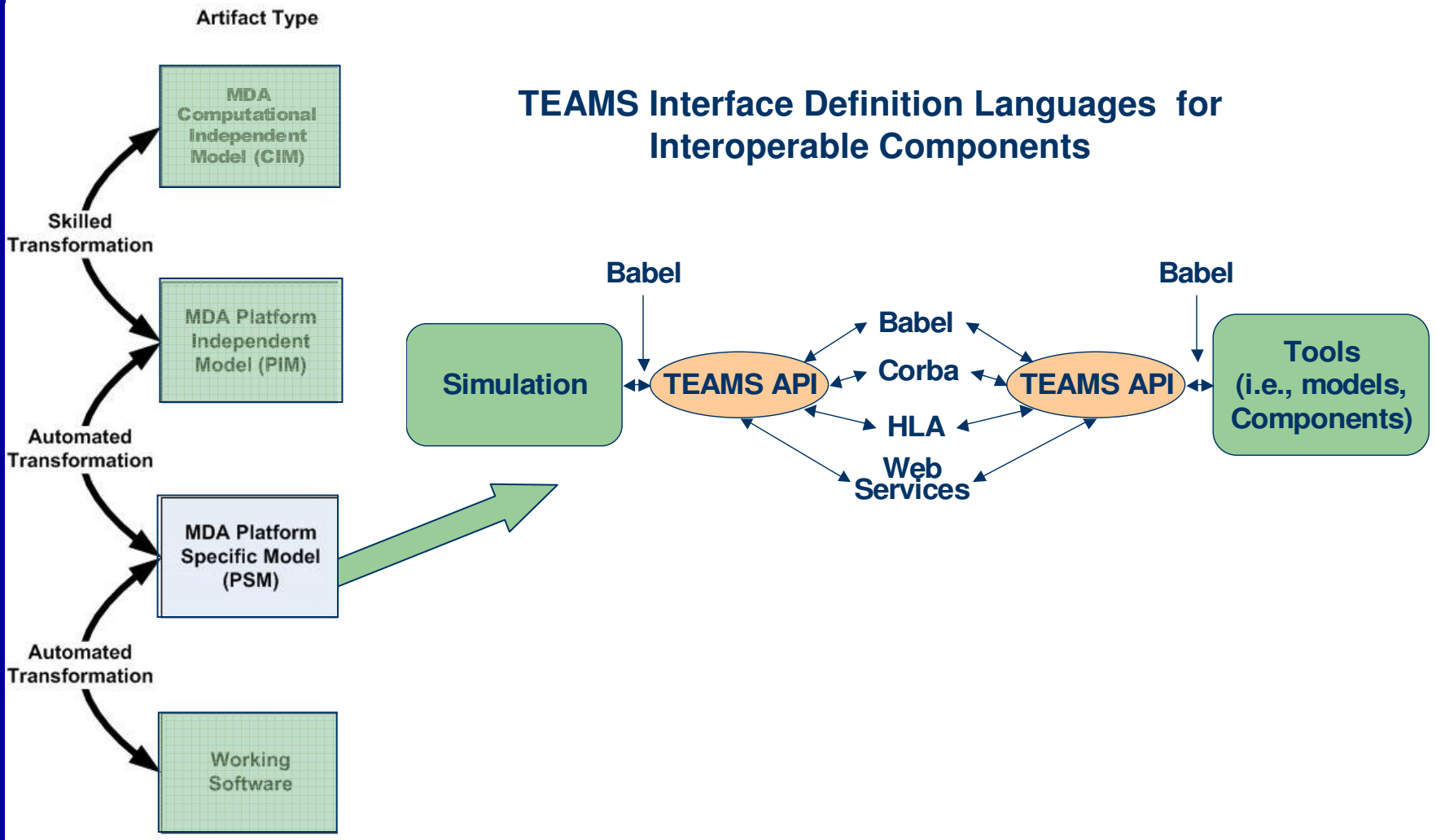
# The Method: Model Driven Architecture (MDA)




## TEAMS UML Component Diagrams

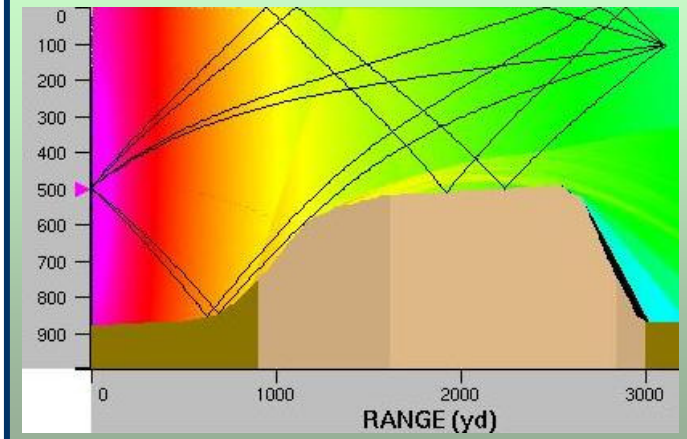


# The Method: Model Driven Architecture (MDA)

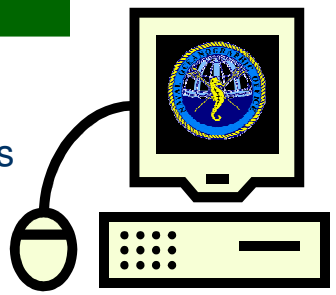


# TEAMS Implementation Planning

**TRM Propagation Tool 'PETE'**




In-situ Environmental Data via Web Services



NAVOCEANO
SIPRNET Web Site

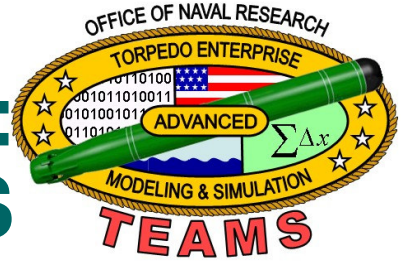
Jackson Bottom Model via CORBA

Applied Physics Lab
University of Washington

Fey Rey Propagation Model via HLA*

Defense Modeling and
Simulation Office

# The Results: Organizations Looking to TEAMS




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**

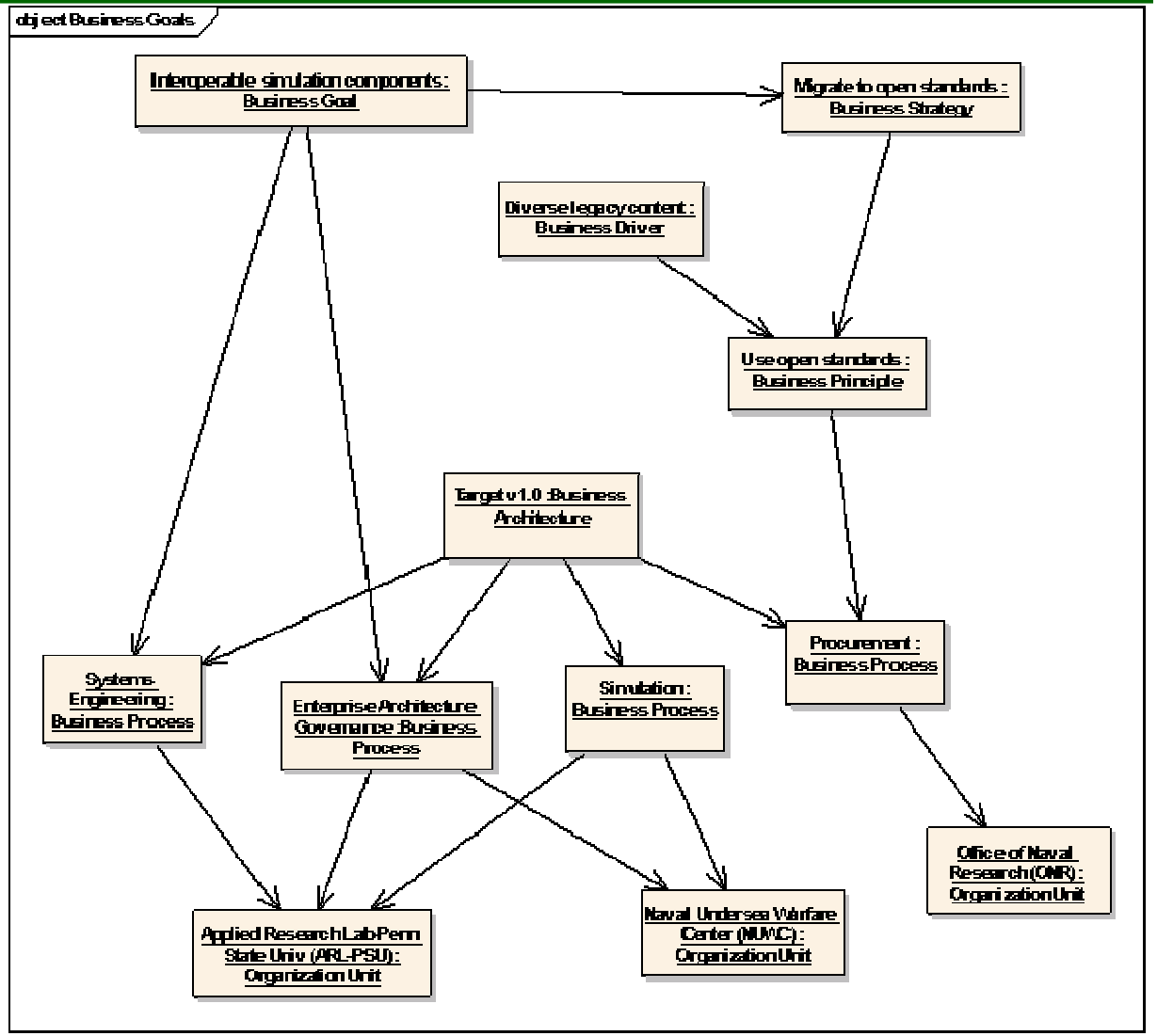
OPEN SYSTEMS
OS
JOINT TASK FORCE

**The Open Systems Joint Task Force of the Office of Secretary of Defense (OSD)**

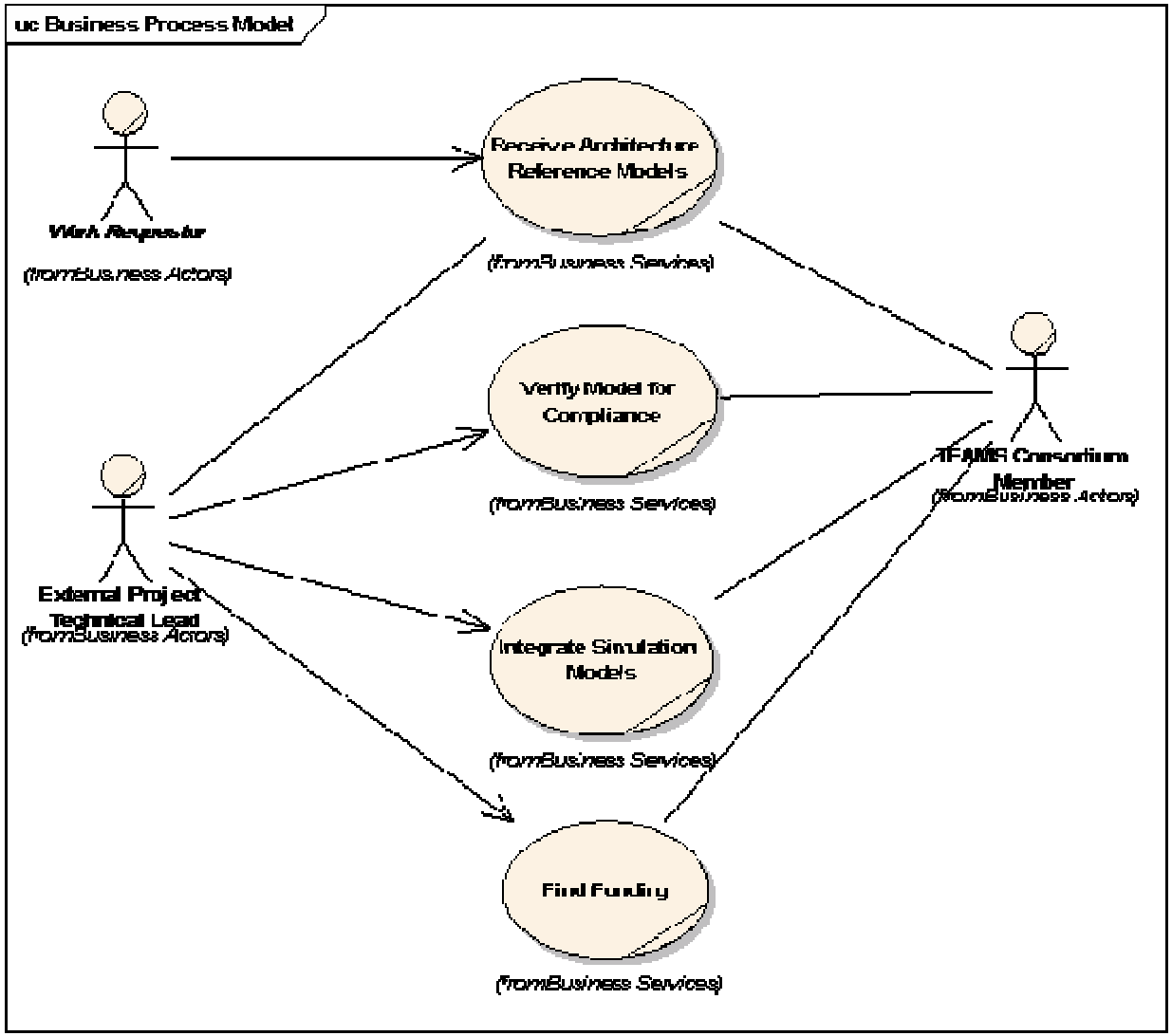
**- Wants to convert TEAMS UML artifacts to the newly approved SysML standard to demonstrate utility of the new standard**

**TEAMS is quickly yielding *highly visible* and *transitionable* results.**

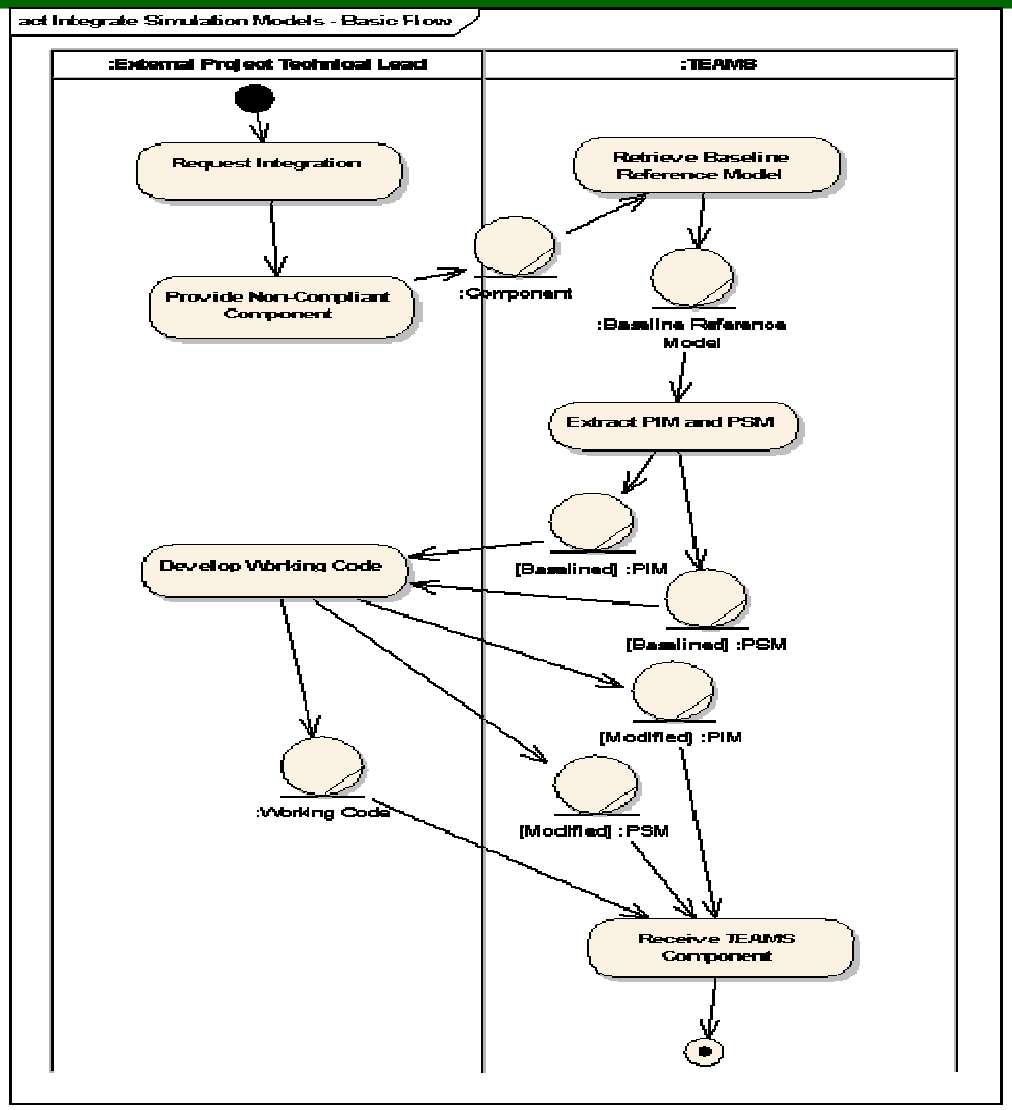
# Phase A: TOG/OMG Synergy Examples



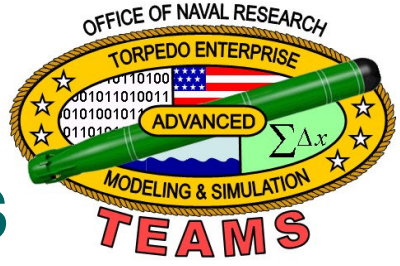
# Phase B: TOG/OMG Synergy Examples



# Phase B: TOG/OMG Synergy Examples



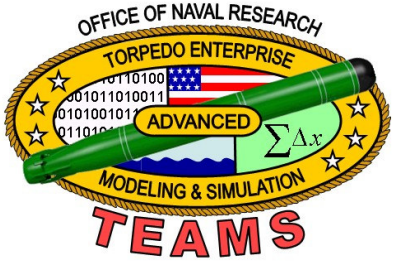
# Overall TEAMS Goals




- 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

DEPARTMENT OF THE NAVY
USN
ONR
Science & Technology

OPEN SYSTEMS
OS
JOINT TASK FORCE


OFFICE OF NAVAL RESEARCH
TORPEDO ENTERPRISE
ADVANCED
MODELING & SIMULATION
TEAMS

NAVSEA
NEWPORT
Undersea Warfare Center Division

PENNSTATE
1855
ARL

THE Open GROUP

DMSO

ARL
The University of Texas at Austin

[dstl]

THE JOHNS HOPKINS UNIVERSITY

OMG
OBJECT MANAGEMENT GROUP

OFFICE OF NAVAL INTELLIGENCE
1882