

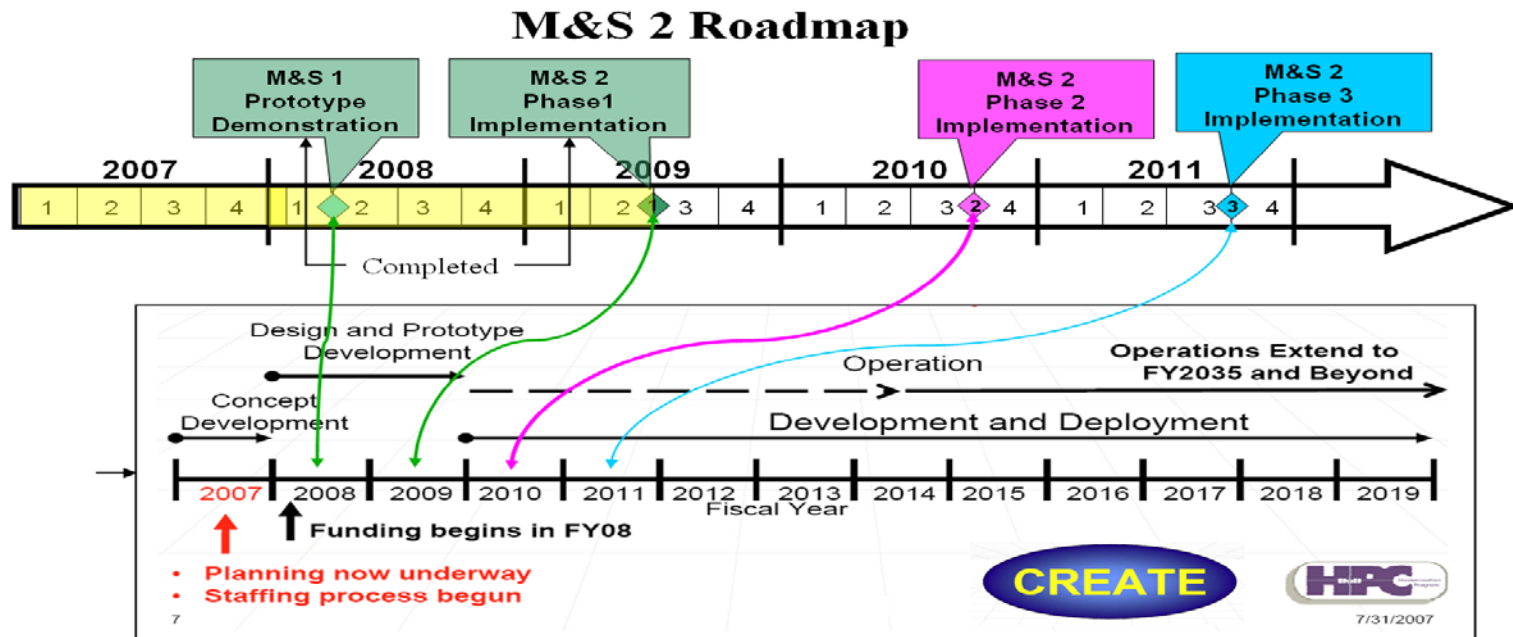
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# NSRP Modeling & Simulation Project 2

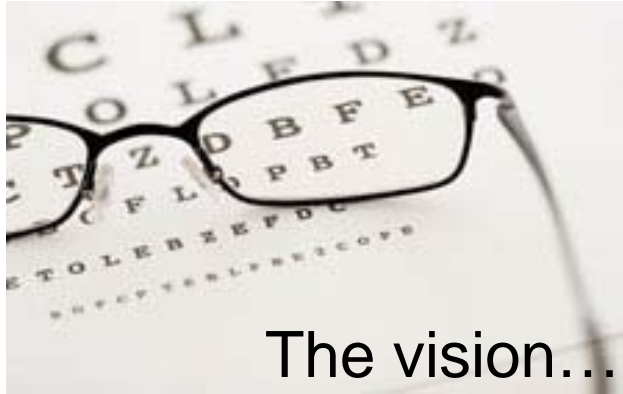
Ron Wood, NGSB-GC  
April 21, 2010

# April 10-11, 2008 ECB Approval

- ✓ The ECB approves Phase 1 with the requirement that prior to award, the project team provide a clear, detailed description of the deliverables for Phase 1.
- ✓ The project team is tasked to report projected cost reductions for analysis that will result from this project at the end of Phase 1.
- **The ECB reserves the right to later award subsequent Phases without re-competing.**



## Modeling & Simulation Vision



***Continue to design, develop and implement modeling and simulation tools and processes that will facilitate affordable ship design, construction, acquisition and repair.***

### Our process will...

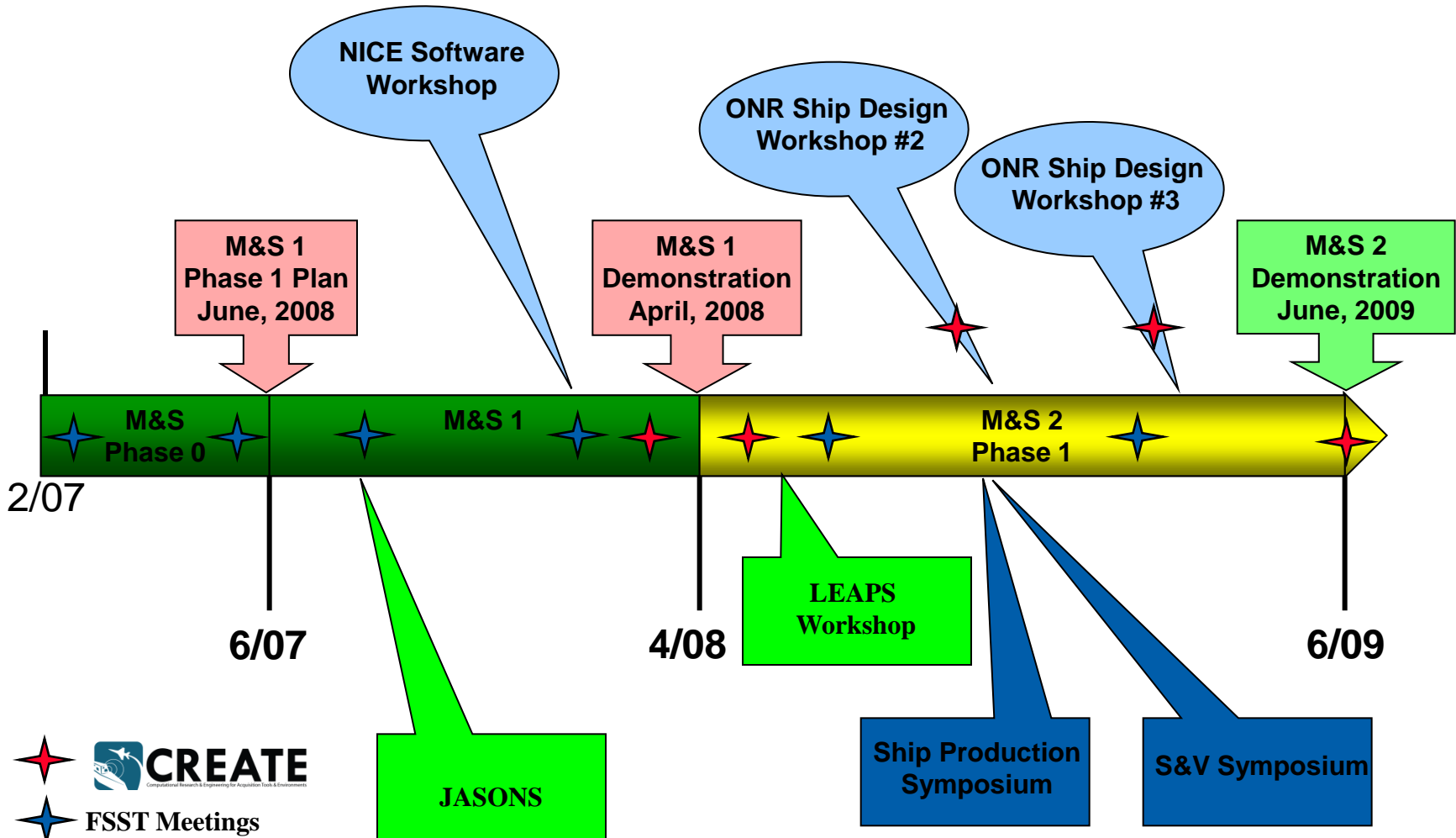
- Enable rapid development of full ship models and simulations
- Support early integration of design and analysis
- Remove cost and greatly improve the ship acquisition process
- Use open architecture, and employment of shipbuilding (and other) ISO STEP standards as appropriate

# Team Members

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- Simulia
- TechnoSoft
- Electric Boat
- Northrop Grumman Shipbuilding Gulfcoast
- Product Data Services

# Modeling & Simulation Timeline and Interactions



FSST Meetings

# Background

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- Large, full-ship analysis ship models are almost always "hand-crafted" by skilled and experienced analysts.
- There is a need to improve upon the time, cost, and skill mix required to create such large-scale ship models.
- There is also a need to execute the analyses in a shorter amount of time once the models are built.
- Finding more efficient methods and tools to use in these two areas was the overall goal of this M&S-2 project.

# Demo Workshop Agenda – June 2009

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- Project Results
  - Submarine Analysis at Electric Boat
  - Surface Ship Analysis at NGSB-GC
  - Automated a number of different types of analyses at both
    - Shock whipping
    - Ship longitudinal strength
    - Submergence and Thermal optimization
    - DDAM optimization
    - Sub concept design
- Overviews of the CREATE Program and the CREATE-SHIPS Project  
(Computational Research and Engineering for Acquisition Tools and Environment)
- CREATE Meshing/Geometry Overview
- Selected Demonstrations/Presentations
  - Simulia
  - TechnoSoft
  - Altair
  - Common Structural Model (CSM) Tool (NSWC/CD Code 6510 and Alion)
  - NEiNastran

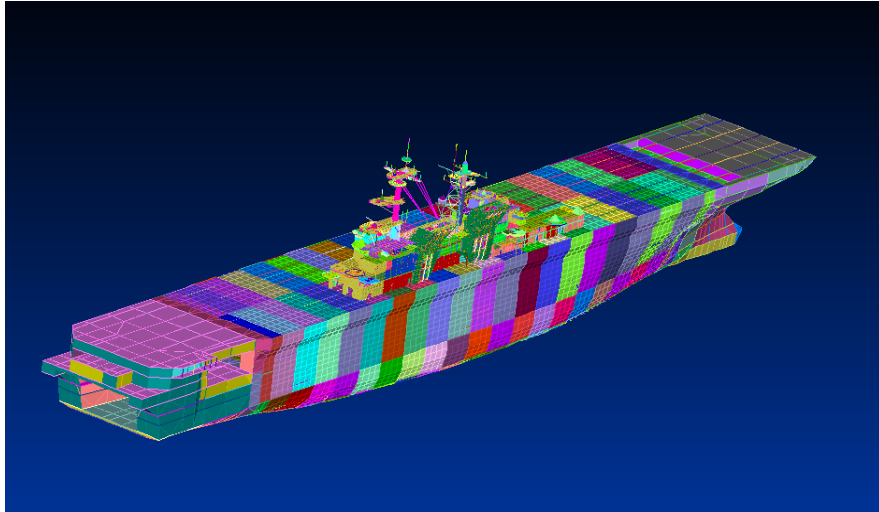
# Demo Attendance (appx 70)

- **Navy**
  - **NRL**
  - **NSWC**
  - **NSWCCD**
  - **NWSCCD - Philadelphia**
  - **ONR**
  - **NAVSEA**
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- **Johns Hopkins University Applied Physics Laboratory**
  - **Institute for Defense Analyses**
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- **Product Data Services**
  - **Consultant - ShipDesign USA, Inc.**
  - **Grey Ghost LLC**
  - **ATI**
  - **Gibbs & Cox, Inc.**
  - **BMT Designers & Planners**
  - **ITE**

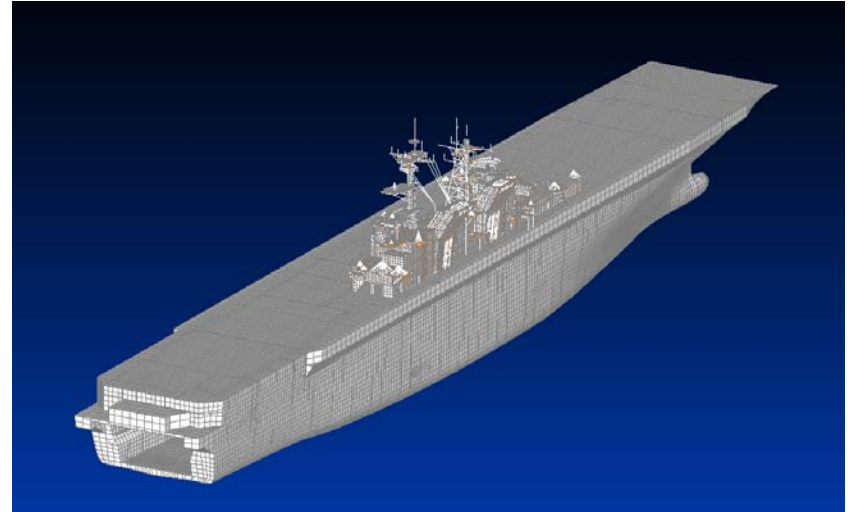
- **Electric Boat**
  - **Northrop Grumman Shipbuilding – Gulf Coast**
  - **Northrop Grumman Shipbuilding – Newport News**
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- **Alion Science and Technology Corporation**
  - **Altair Engineering**
  - **ANSYS, Inc**
  - **Atlantec**
  - **DRS Defense Solutions Advanced Technology Center**
  - **SAIC**
  - **Simulia**
  - **TechnoSoft**
  - **NEiNastran**
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- **MIT**
  - **University of Delaware**

# Improvements Demonstrated

Prior Method



New Method

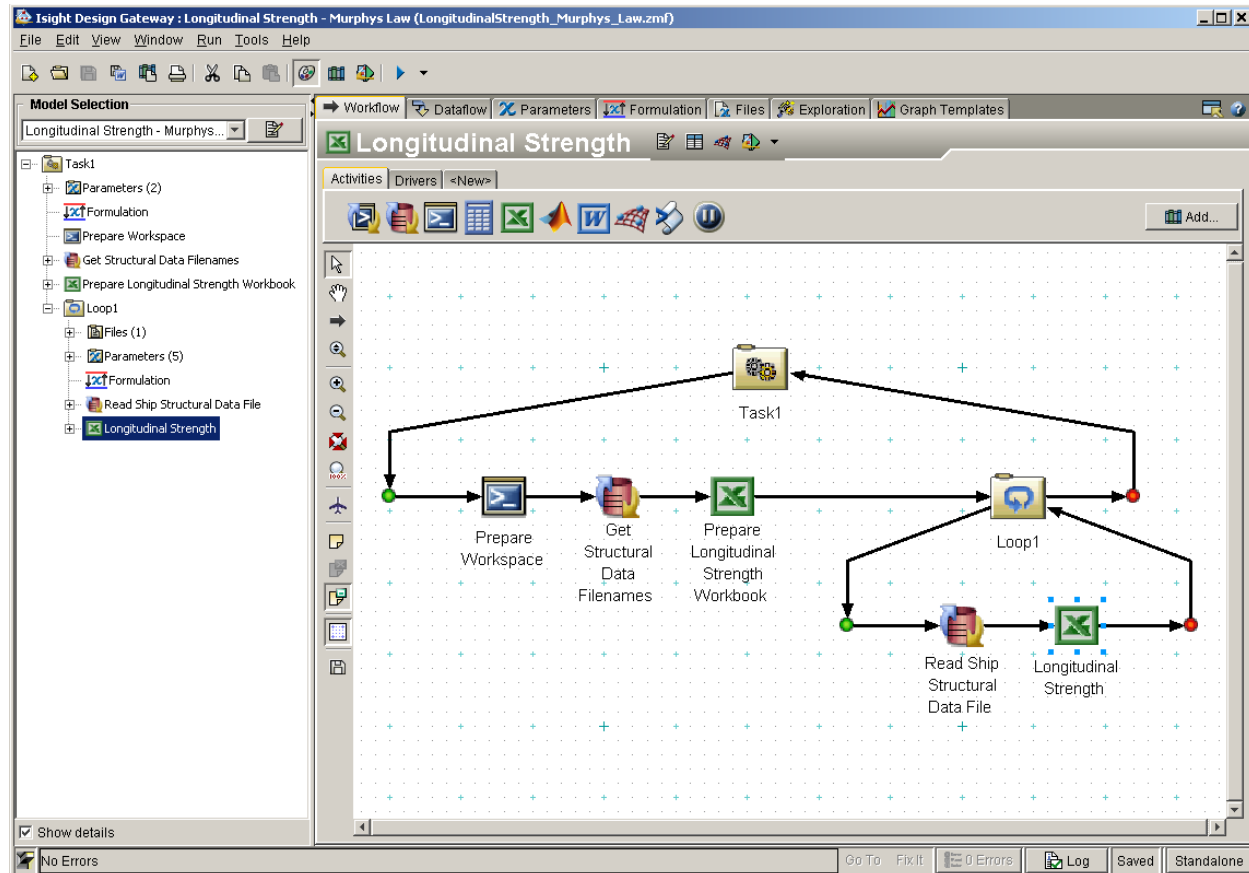


	Original Analysis (mhr)	AMWaves Analysis (mhr)
Obtaining assembly drawings, general arrangement drawings, weight data, and engineering change notices	671	80
Modeling of structure	1248	818
Modeling of weight	132	10
Performing vibration analysis	82	21
<i>Total</i>	<i>2133</i>	<i>919</i>

# Improvements Demonstrated (Continued)

Measured productivity improvements using two new tools for full-ship analysis

- Use of TechnoSoft AMWaves achieved a 57% reduction in the man-hours required to create an LHD 8 full-ship analysis model
- Use of Simulia Isight simulation flow automation tool delivered a step decrease in execution times (Weeks to days, days to hours, etc.)



# Improvements Demonstrated (Continued)

- Shipbuilders are contractually required to perform analyses
  - Ship Specification Section 072 (Shock Requirements)
    - Full Ship Shock Analysis\*
    - Large Sectional Ship Shock Analysis (Masts, Superstructure, Engine rooms, Weapon systems, etc.)\*
    - Foundation Analysis on all equipment
    - Shock analysis for all systems and their components
  - Ship Specification Section 073 (Noise and Vibration)
    - Full Ship Vibration Analysis\*
    - Superstructure forced vibration analysis\*
    - Large sectional ship vibration analysis (Masts, Hangar, Weapon Systems, full propulsion system)\*
    - Vibration analysis for all systems and their components

\* Approach/Technology from M&S 2 project can be used to satisfy these requirements

# Imp'd Methods for Gen. of Full-Ship Sim/Analysis Models 2 (M&S-2)

Ship Program	2009	2010	2011	2012	2013	2014	2015
DDG 51 Class							
LPD 17 Class							
LHD 8							
NSC Class							
LHA 6							
DDG 1000 Class							

- Analysis efforts for the DDG 51 Class, LPD 17 Class, and LHD 8 are nearing completion
- Analysis efforts for NSC are mid-way
- Analysis efforts for LHA 6 and DDG 1000 Classes are in the early stages

## **M&S 2 Wrap-Up and Take-Aways**

**We have:**

- **Showcased several newer capabilities which are applicable to both surface ships and submarines.**
- **Integrated legacy tools into more efficient M&S process flows.**
- **Automated several key steps in the full ship modeling process.**
- **Illustrated more automated mesh generation, which can be merged with analysis and post-processing**

**We still need to:**

- **Continually evaluate the improved efficiency of these methods.**
- **Continue to gather qualitative metrics and quantitative metrics to document M&S process improvements.**
- **Work synergistically with emerging programs (DoD CREATE, DoE NICE, and other NSRP programs)**

# Way Forward - Continue funding next phase

- The use of open architectures will be fostered, and employment of shipbuilding (and other) ISO STEP standards will be investigated and employed wherever appropriate.
- New or updated automated full-ship meshing approaches will be assessed and prototyped.
- Improved simulation data handling and work flow methodology will be explored for dealing with these very large ship simulation models and their analysis results in both first and second-tier shipyards
- Work with FSST-IPT and CREATE
- Participate in next Design Tools Workshop (December?)
- Bring NSWCCD into team

Benefits: further integration of data inputs allowing faster analysis in other areas: i.e. large sectional ship shock and vibration analysis

Project Team will submit request for continuation of project

Phase 2 originally priced at \$1.382 M NSRP  
Phase 3 originally priced at \$1.592 M NSRP

# M&S 2 Phase 2

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- Kick-Off Meeting: April 13<sup>th</sup>, Groton CT
- Possible Phase 2 Project Areas
  - GUI Interface with CATIA V5/NX
  - GUI Interface with ShipConstructor
  - Solid Modeling de-featuring and mid-planning
  - Integration of CAD to CAE capability
  - Increase capability of statistical analysis and sensitivity studies
  - Expand Isight use into other areas of analysis
  - Increase capability of NEi/NASTRAN connection (Use of the NEi Editor)
  - Foundation Analysis