NDIA Conference: “Design Innovation to Improve DoD Acquisition”

User Executive Plenary Session: Ready To Design A Warship? Prove It!

Bob Keane, Ship Design USA, Inc.

15 November 2011

Opinions are those of the author and not those of any Government agency or program.
A “system of systems”: Operate in battle force with older and newer ships
- Very low quantities, high unit cost, long lives
- Extremely complex product: millions of pieces parts
- No prototypes, first ship(s) must be fully operational
- Government develops combat/weapons/communications systems
- Government ultimately assumes responsibility for meeting requirements
- Lack of commercial shipbuilding industrial base to build upon
- Intense Congressional oversight
Numerous antennas competing for limited space and coverage result in a complex electromagnetic environment (EME), presenting a challenge for effective topside integration and maintaining the topside baseline.
AV Integration Challenges

- Dynamic Interfaces between ship and aircraft
Examples of Effective Designs Using Physics-Based Modeling

- Improved “Seakeeping Performance” Hull Form for DDG 51 Class Ships
- Active Fin Roll Stabilization System for Increased Operational Envelopes of Helos on FFG 7 Class Ships
- Reduced Radar Cross-Section Signatures of Surface Combatants
- Reduced signature of ship/submarine propellers/propulsors
- Expanded Safe Operating Envelopes of submerged submarines
First amphibious ship designed to specific survivability and vulnerability requirements:

- greatly reduced signatures,
- hardened structure,
- improved separation/redundancy,
- significantly enhanced self defense systems, and
- cooperative engagement capability.

First surface ship designed for a 40-year service-life
GEOMETRY

CAD SYSTEMS → 3-D PRODUCT MODEL

BEHAVIOR

CAE CODES → PHYSICS-BASED MODELS → SMART PRODUCT MODEL

INTERACTION

VIRTUAL PROTOTYPE → REAL-TIME VISUALIZATION SYSTEMS

VIRTUAL ENVIRONMENT

SMART PRODUCT MODEL

OTHER CHARACTERISTICS

MANUFACTURING MODELS

FINANCIAL MODELS

LOGISTICS MODELS
LEAPS Universe

LEAPS Product Model

- Generic Class Structure
- Product Model Schema
  - NAVSEA Ship Focus Object Model
- Product Model Data

ASSET Ship
ASSET Sub
CAD
FORAN
TRIBON
FASTSHIP
HLA Federate(s)

Presentation Mgr
LEAPS/Editor
DOORS
Excel
STEP/IGES

In Development
Beta Code
Existing
Planned
Integrated Tools: “We Shape Our Tools And Our Tools Shape Us”

- Accelerate use of physics-based models by design engineers in early design
- Achieve an Integrated Design Environment (IDE) for early stage design
- Implement a design analysis product model - LEAPS (Leading Edge Architecture for Prototyping Systems)
- Integrate Design, Production and Support
- Capitalize on 3-D Product Model Technology

Structure IDE to Design-Build Process
Process Improvements: Set-Based Design

"Concurrent - Serial Process"

Design Space Study 1
Design Space Study 2
Design Space Study 3

Select Baseline(s)
Update Baseline(s)
Update Baseline

Planning
Requirements
Design

Costing
Performance
CONOPS

Explore Different Dimensions of Design Space in Succession.
Likely Faster Convergence to a near optimal design