Aligned with your needs.

Tool Development for the International Naval Market

NSRP
Product Design and Materials Technology Panel

11 February 2009

Mark C Oakes, PE
Chief Technical Officer
Engineering Integration and Solutions Sector

ALION
SCIENCE AND TECHNOLOGY

Outline

- What is the Alion Engineering Integration and Solutions Sector?
- Involvement in the international naval market
- Why the need to develop tools for this market?
- Types of tools developed
- Future

What is the Alion Engineering and Integration Solutions Sector?

EISS Was Created Out of the Acquisition and Integration of three World Class Organizations

JJMA

- World Class Naval Architecture and Marine Engineering Firm
- Full Spectrum Ship and Marine System Design Capability
- DoD, Commercial, and overseas Client Base
- 600 People, Employee Owned, Sold to Alion in April 2005

Micro Analysis & Design

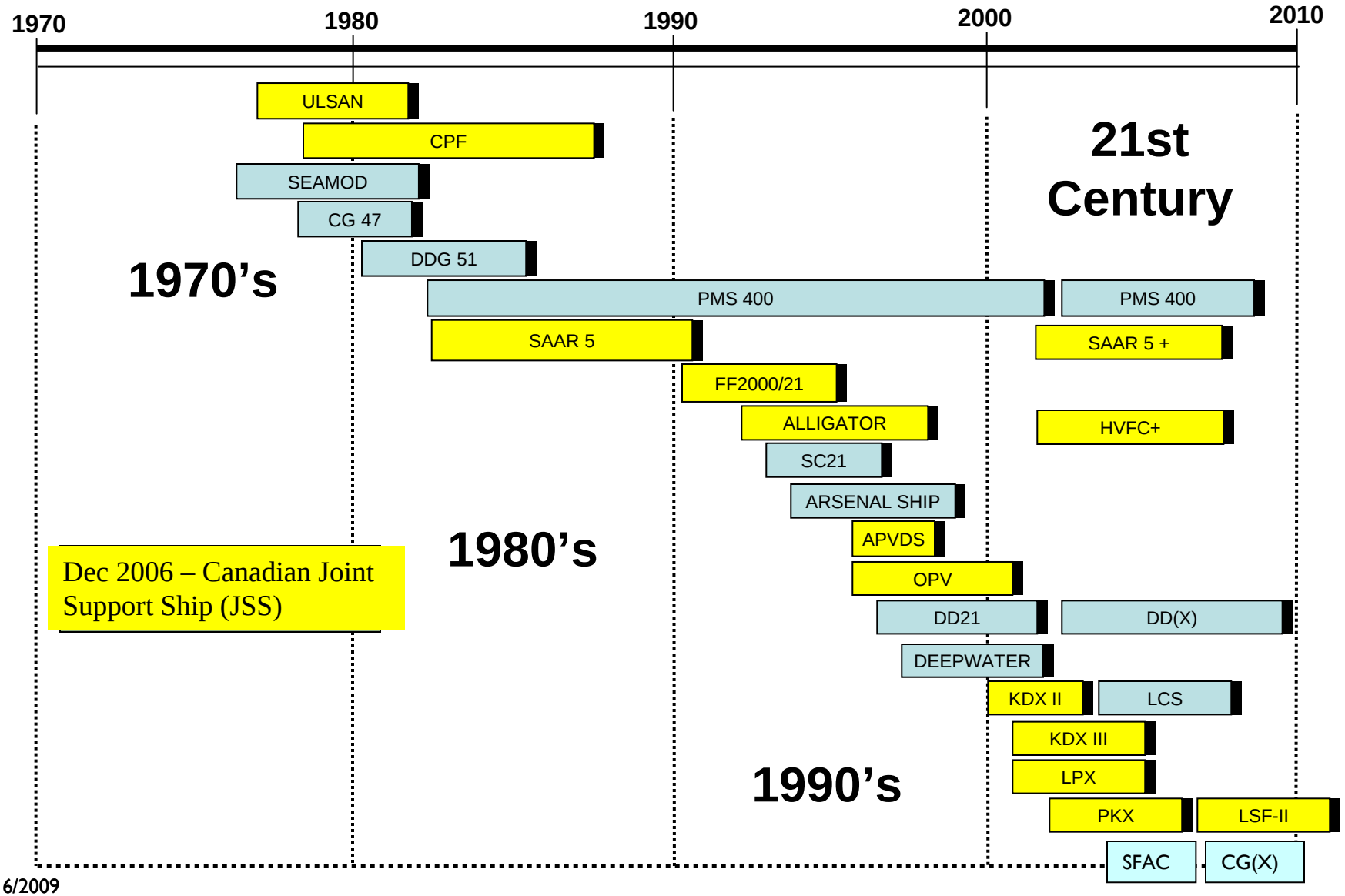
- Premier Human Performance Engineering and Analysis Capabilities
- Supports All Military Branches
- Extensive Application of Modeling and Simulation to model human performance
- 100 People, Privately Held, Sold to Alion May 2006

Anteon
Program Management And Engineering Services

- Predominant US Navy Acquisition and Life Cycle Support Services Firm
- Touch each and every ship and submarine class
- Included Proteus Engineering
- Wide Range of first principles analyses in acoustics, physics and electronics in support of US Navy Basic Research
- 700 people working Navy tasks
- Divested from Anteon/General Dynamics; sold to Alion July 2006

Integrated Into A Single Business Unit, These Elements Represent 1,400 Alion Employee Owners focused on the Maritime Markets

Combatant Designs



Why the Need to Develop Tools For this Market?

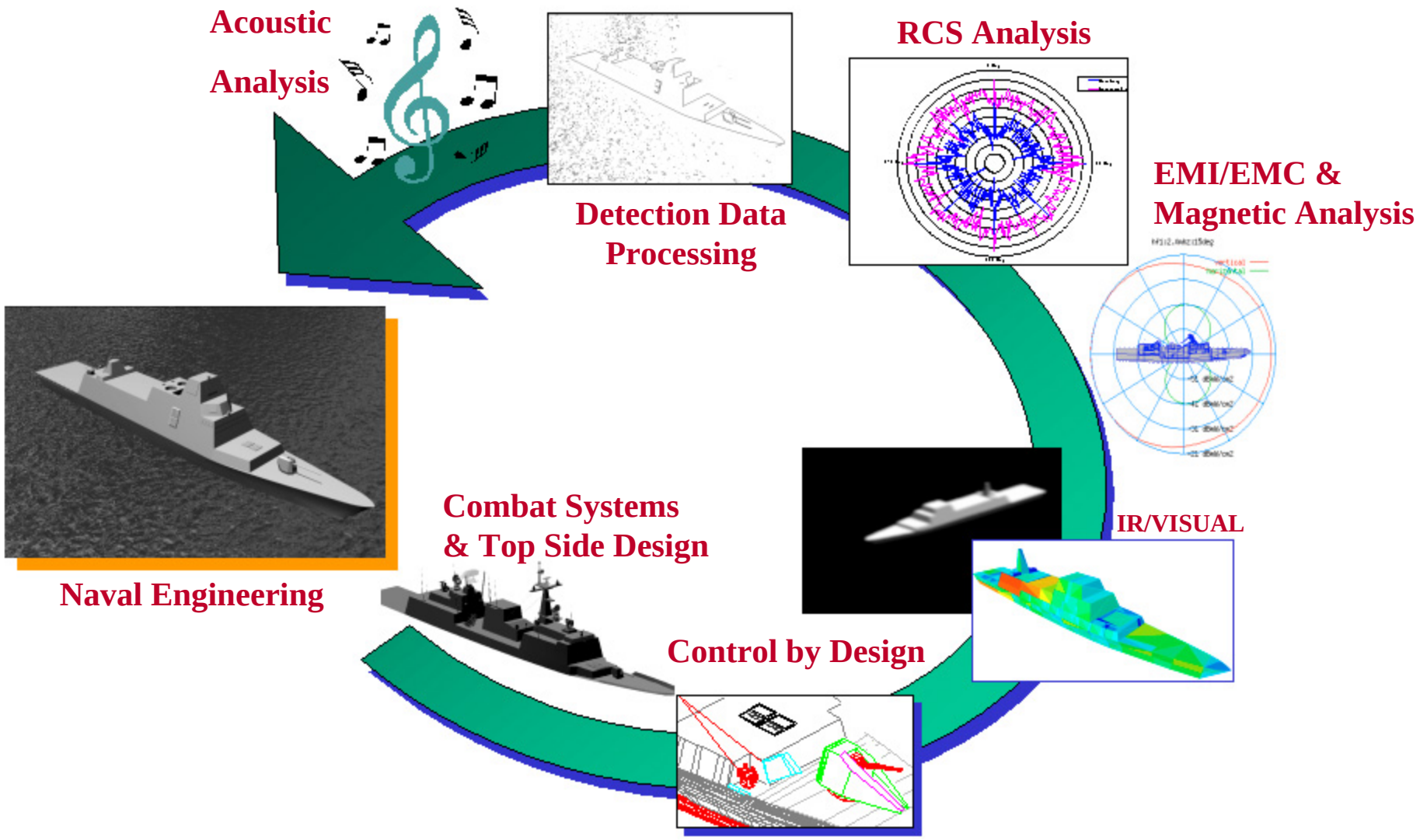
- In mid-80's international tenders began to include requirements for survivability, signatures and topside integration:
  - Blast/weapons effects/shock
  - RCS, IR, EO, Magnetic, Acoustic
  - EMC/EMI

- At that time off-the-shelf engineering analysis tools did not generally exist (Navy Labs/universities developing)
  - Since then, the Navy tools are "off-the-shelf", but not directly usable due to ITAR
  - Commercially available tools are now available
- HM&E engineering tools generally COTS based
  - Commercial tool development leveraged with time for international programs

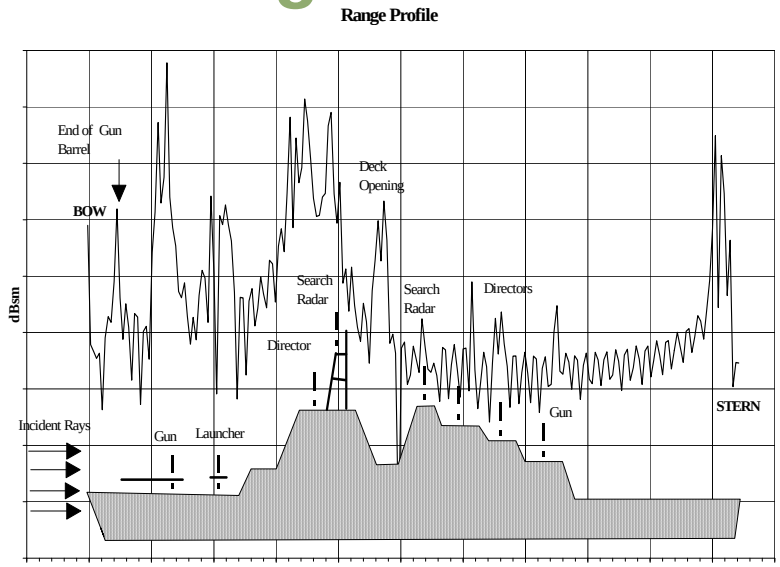
Types of Tools Developed by Alion

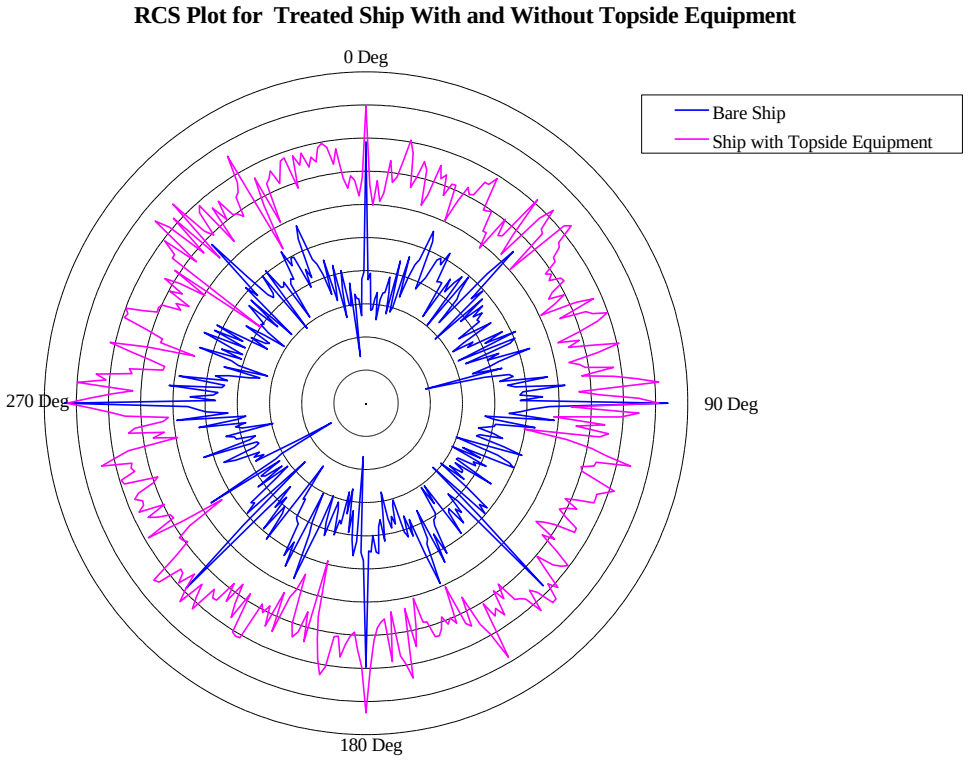
- MOTISS (Measure of Total Integrated System Survivability)
  - Piece parts developed in the 90's and integrated in the 2000's
  - Sold internationally
- RCS, IR and EO
  - Adapted government programs for application to naval ships
  - Created standard methods for hull/topside modeling so that only one model required for each program
  - RCS and IR results validated against full scale measurements
- EMI/EMC
  - Created first principals tools for naval ships and used common topside model
  - Tools validated against full scale measurements
- Magnetic Signature
  - Used commercial and in-house tools adapted to add dynamic component
- Acoustics
  - Developed commercial tool with NCE

Survivability/Combat Systems



RCS Signature

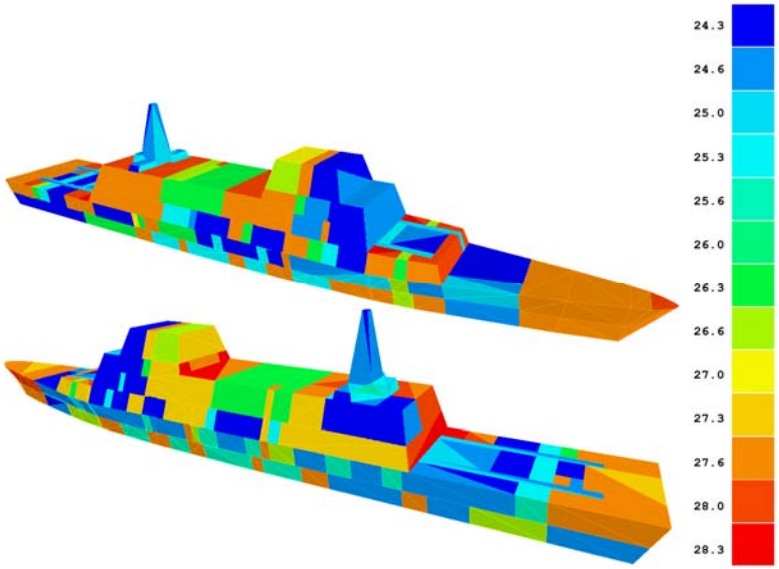


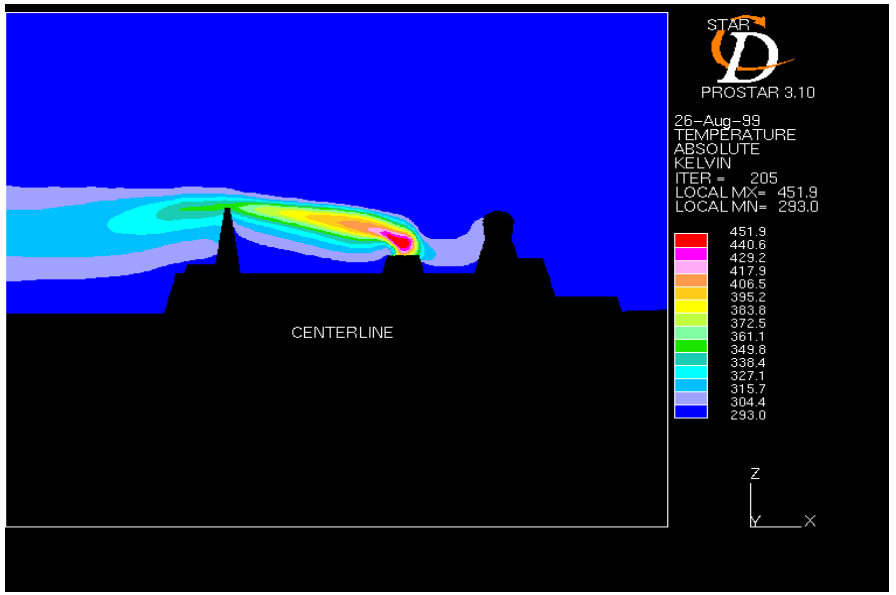


Projects

- 3000 ton Corvette Concept Design
- 2500 ton Corvette Preliminary Design
- 1800 ton Corvette Preliminary Design
- SAAR5+
- Multi-Purpose Sealift/UNREP Ship

Infrared Signature

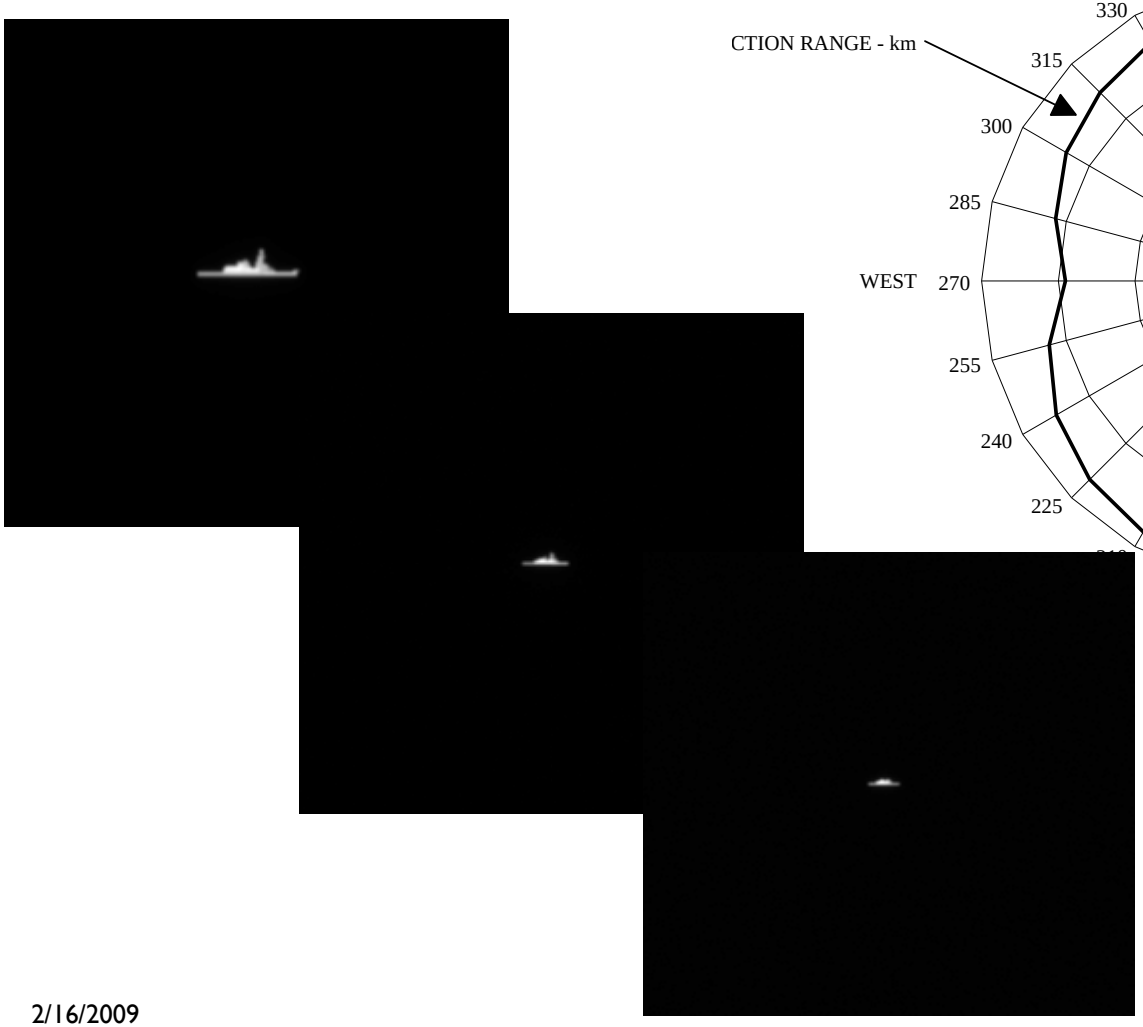


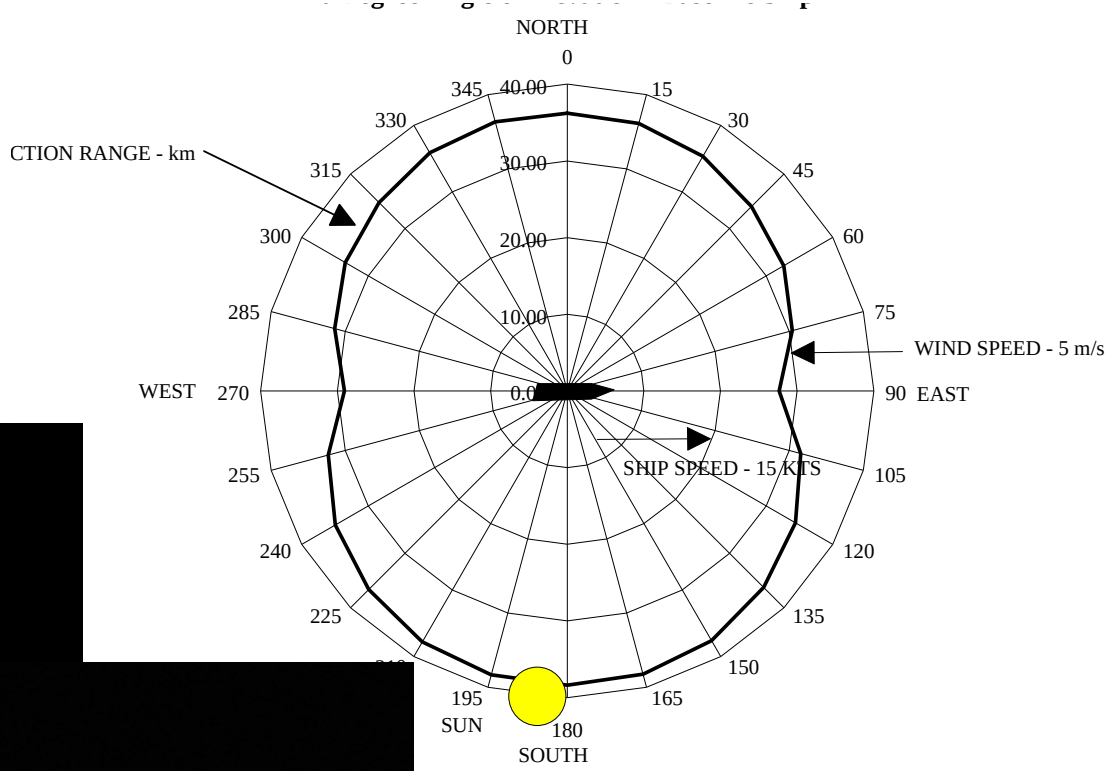


Projects

- 105 meter Patrol Vessel
- 40 foot High Speed Assault Craft
- 103 meter Corvette
- 96 meter Corvette
- SAAR5+
- Multi-Purpose Sealift/UNREP Ship

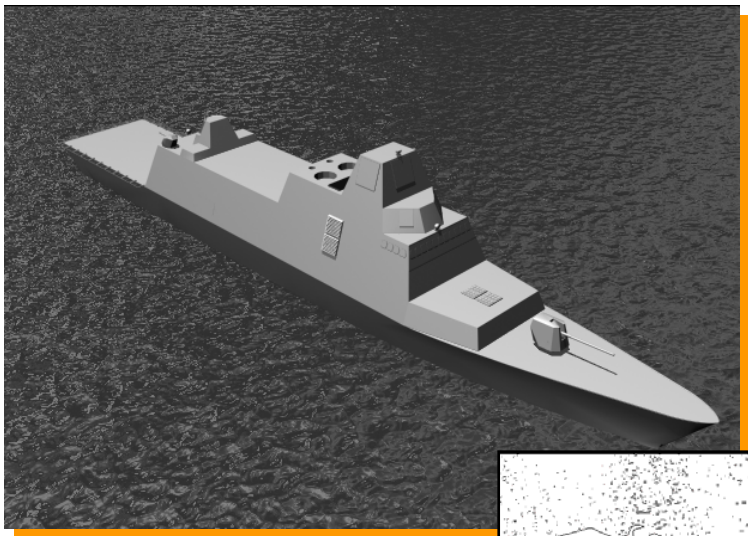
IR Detection Range



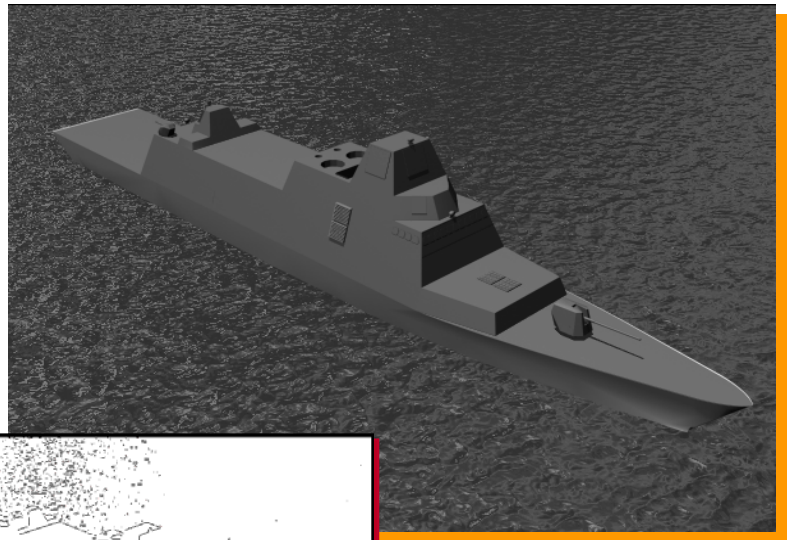


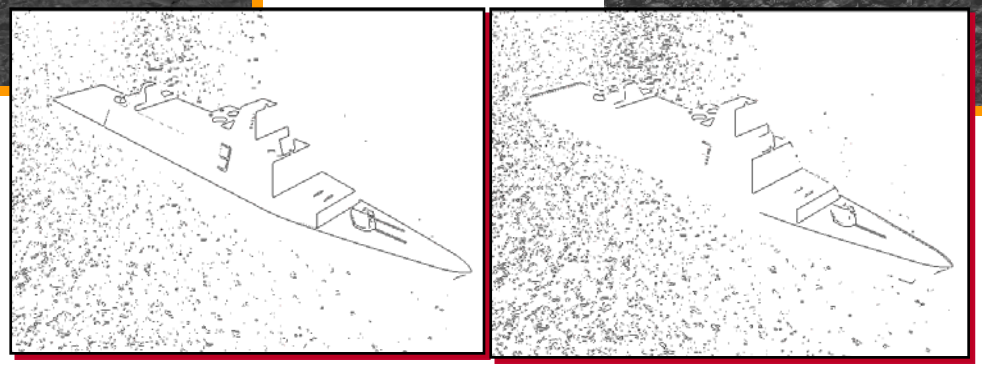
Visual Detection

Uniform Scheme



2-Tone Scheme





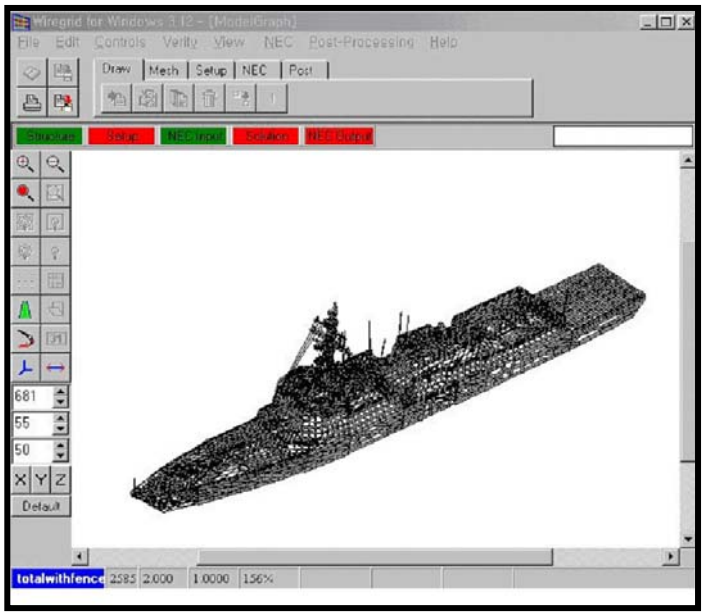
Projects

- 2500 ton Corvette PD

Software Tools

- Alion VIDE KAS

EMI/EMC/EMP Analysis



Platform Wire-frame Model

RADHAZ - HERP, HERO & HERF Analyses
CAM Cutout Analysis
Blockage Analysis

Projects

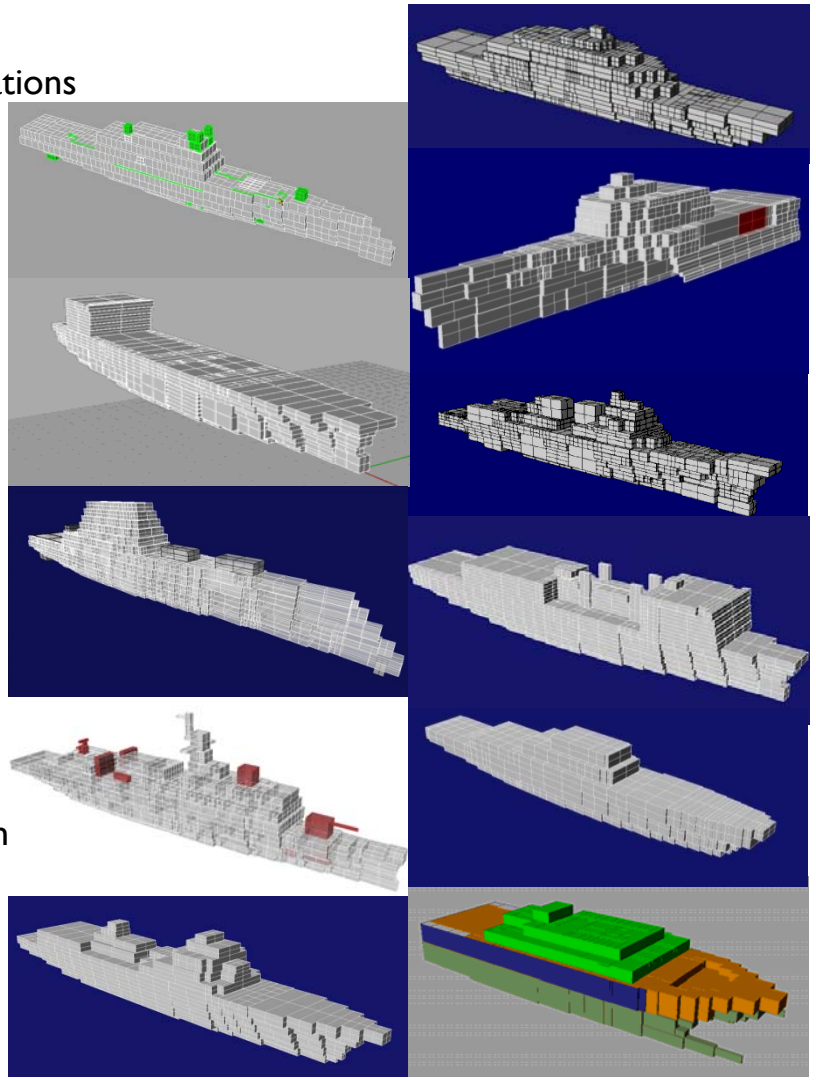
- LPX
- KDX II
- KDX III
- SAAR5+
- CVN 78
- Multi-Purpose Sealift/UNREP Ship

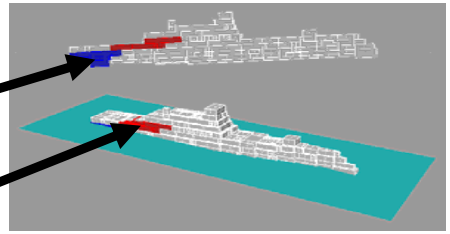
Alion Software/Tools

- EMENG
- TRIGO
- CULLING

The MOTISS Program…

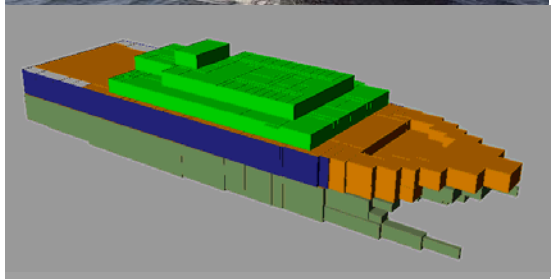
- MOTISS is a survivability analysis tool developed by Alion Science and Technology to provide…
  - … Concept, Basic and Detail Survivability Assessments
  - … Quantitative Design Improvements and Recommendations
  - … "Best Buy" Analyses (Saving Money)
  - … Quantitative Requirement Studies
  - … Internal Blast Assessments
  - … External Blast Assessments
  - … System Functionality Assessments
  - … Design Weakness Identification
  - … Structural Assessments
  - … Fragmentation Assessments
  - … Fire Spread and Suppression Assessments
  - … Ballistic Assessments
  - … Personnel Egress and Evacuation Assessments
  - … Damage Control Doctrine Assessments
  - … Shaped Charge Jetting Assessments
  - … System Failure Root Cause Determination Assessmen

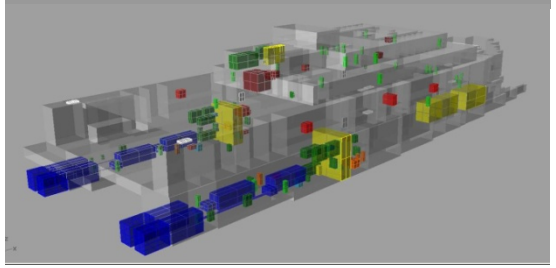


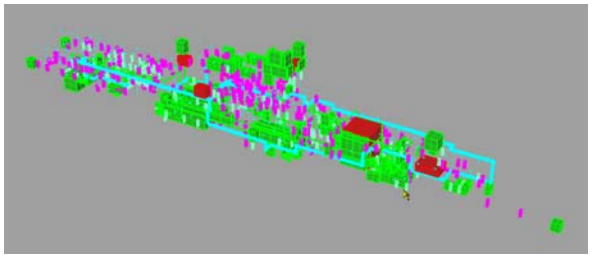


The MOTISS Program…

- Uses Combined Rule, Empirical & 1st Order Physics Methodologies
  - **Structural Modeling:**
    - Performed with *Rectilinear Mapping*
      - Allows more rapid processing over traditional M&S methods
      - Maintains simulation accuracy
  - **Component & System Modeling:**
    - Performed with *Axis-Aligned Bounding Box (AABB) space and weight formulation*
      - Allows rapid component modeling
      - Enables a total system simulation of the vessel performance
  - **Threat Modeling:**
    - Allows the creation of an *unlimited library of threats*
      - missiles, mines, small arms, torpedoes, shells, grenades
        Asymmetric encounters, fire scenarios, flooding scenarios, etc…
        - Allows any combined effect threat or defined accident event
          - Blast, Ballistics, fragmentation, shape charge jetting
            underwater explosions, collisions, thermal pulse
            fire ignition, hull rupture or tearing, etc…

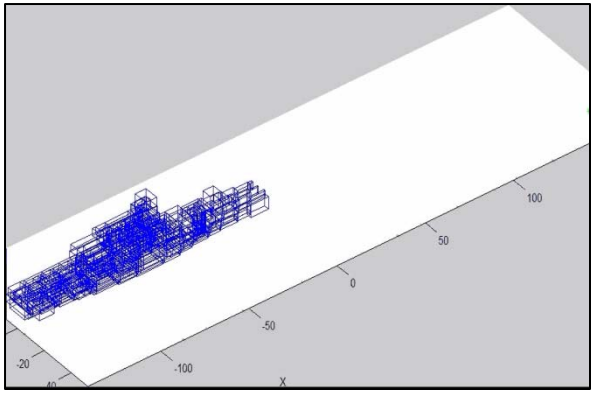


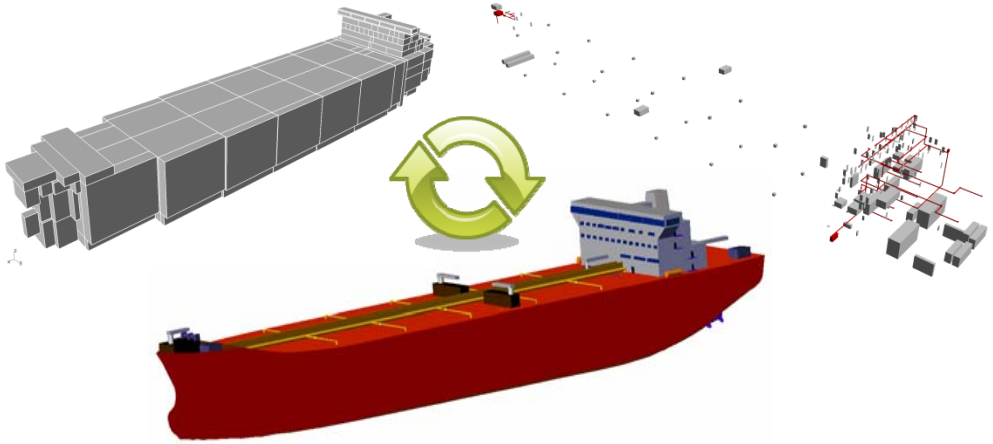




The MOTISS Program…

- Uses Combined Rule, Empirical & 1st Order Physics Methodologies
  - Loading and Structural and Component Response:
    - Methods of *Sachs And Aaron Scaling* for Blast
    - Methods of *NAVFAC P397 Manual* for internal overpressure
    - Methods of *Gurney, Mott and the Joint Technical Coordinating Group on Munitions* for Ballistic and Fragment Penetration
    - Methods of *Linear Jet Theory* for Shaped Charges
    - Methods of *Rigid-Plasticity and St. Venant Principles* for Hull Rupture and Holing
    - Applies *Rule Based Component Lethality*
      - Including Shock Impulse, Acceleration, Kinetic Impact, Temperature and Saturation failures
    - Methods of *Fault Tree Analysis and Network Decision Theory* for System Deactivation and Reactivation Evaluation
      - Includes option for flow requirements for functionality
    - Methods of *Nodal SMD* for dynamic structural and component responses including hull whipping
    - Methods of *Zonal Fire* Spread
      - Includes both Solid and Liquid Fuel loads and allows for Rule Based and Thermal Pulse Ignition
      - Includes options for sprinkling, water-mist, foam agent and gas agent fire suppression systems
    - Methods of Bernoulli Flooding
      - Includes Initial tank loading options and the inclusion of firewater release and eduction



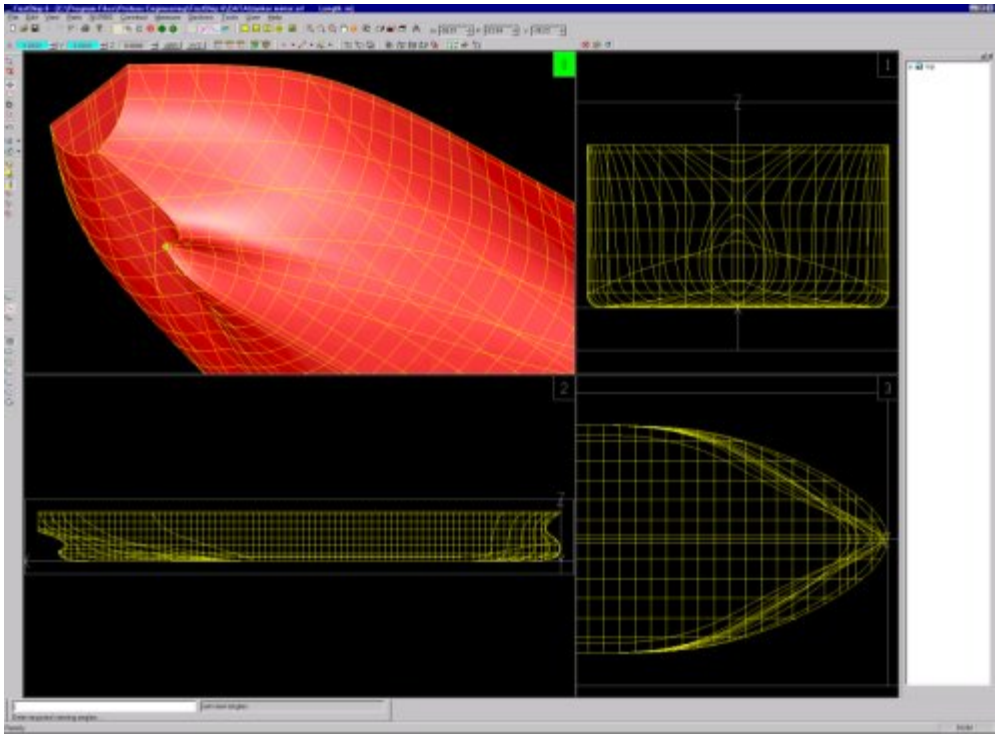


Other Tools Developed and Used in the International Market

- Driven by the need to have a complete integrated capability
  - Fast Ship
  - RhinoMarine
  - Cost Estimating
  - Crewing and Workload Analysis
- Other HM&E design and engineering tools generally COTS based

FastShip

- For hull design of ships and craft
- Hull wizards
- Parametric design
- Design from scratch
- Fitting existing offsets



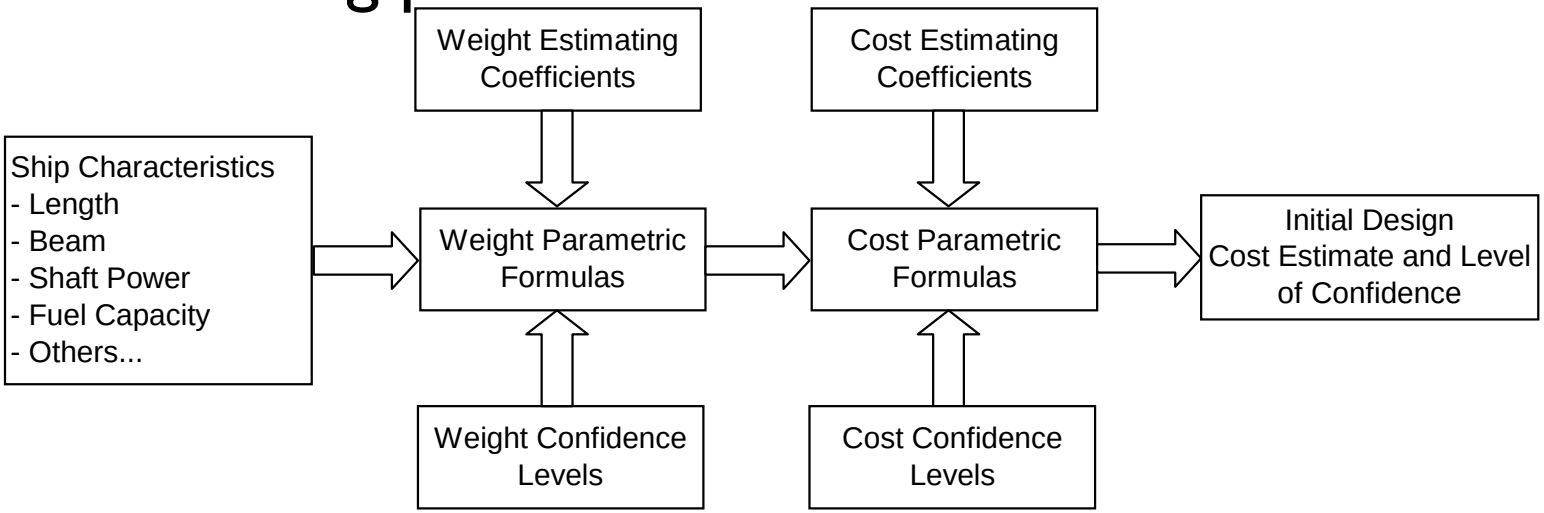
RhinoMarine

- RhinoMarine is a set of plug-ins to the Rhino modeling tool
- The user can:
  - Design and fair the hull
  - Compute hydrostatics, stability, and performance
  - Track and report the Weight and Cost of your model
  - Design the deck, superstructure, & interior
  - Create realistic renderings & animations
  - Produce 2-D dimensioned drawings

Modeled in Rhino and rendered in 3D Studio MAX by Juan Carreras, Advanced Digi-Design. 85 m Offshore Patrol Vessel. Designed by Kvaerner Masa Marine Naval Architects & Marine Consultants

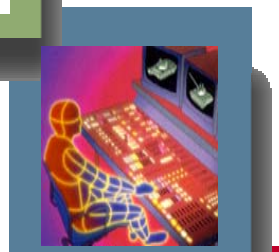
Initial Design Ship Cost Estimating Program

- Acquisition cost (labor & material)
- Simple to use
- Based on weight, power, dimensions, etc.
- Parametric approach
- Includes confidence levels to address risk in technical and cost estimating parameters

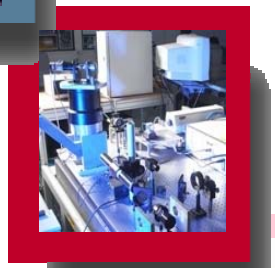


Crewing and Workload Analysis (MA&D)

- Human Systems Integration Solutions



- Modeling & Simulation Technologies

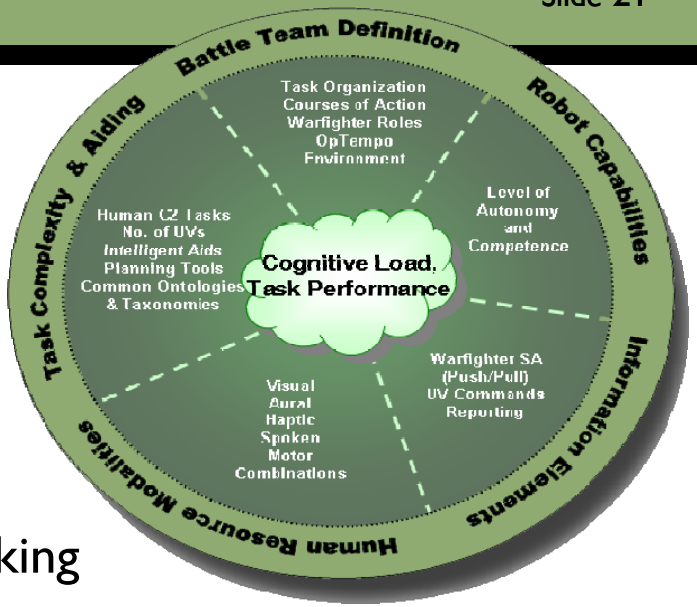


- Systems Design and Engineering

Micro Saint
S H A R P

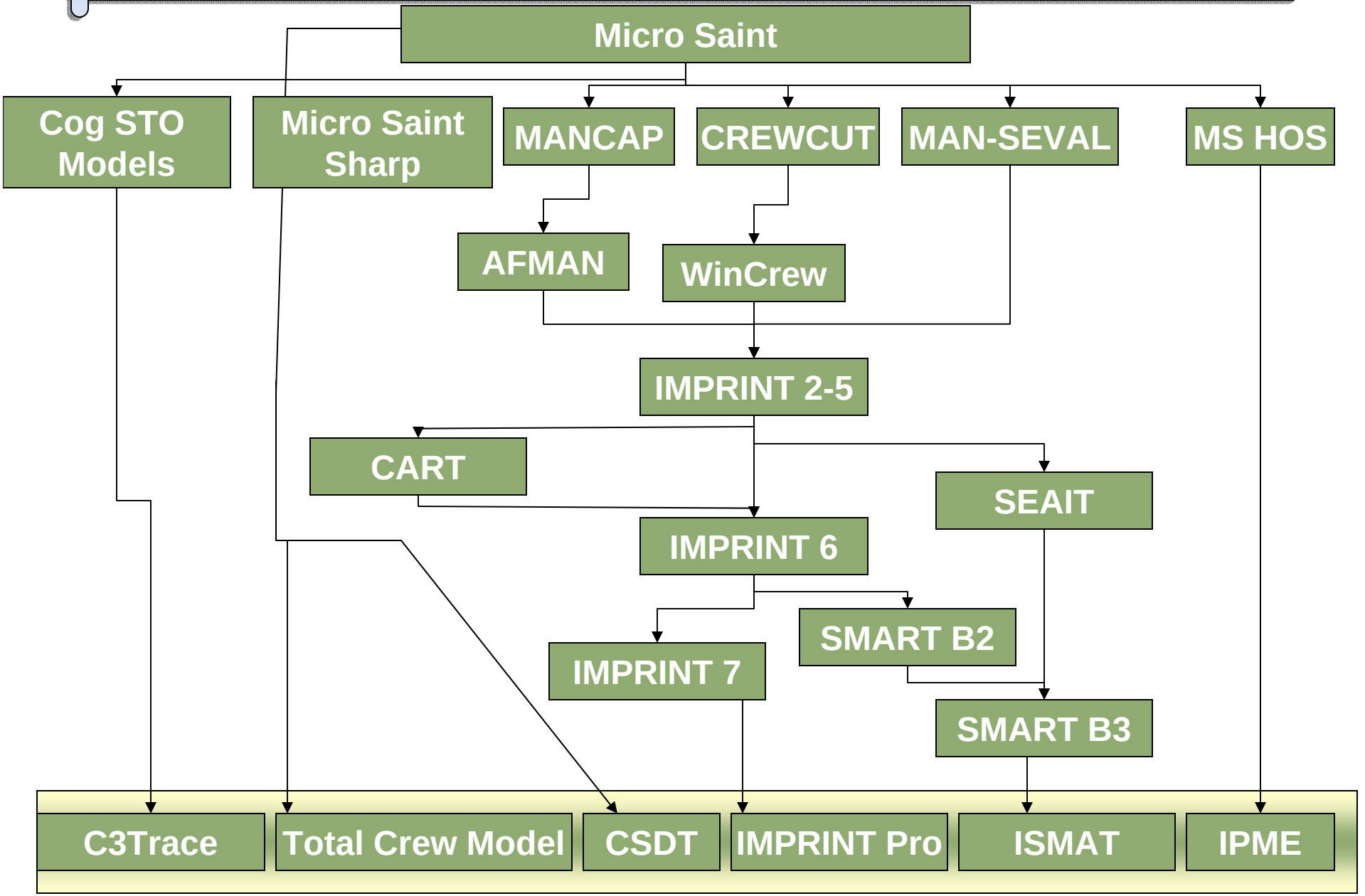
- Software Development

MSS and IMPRINT Application Domains

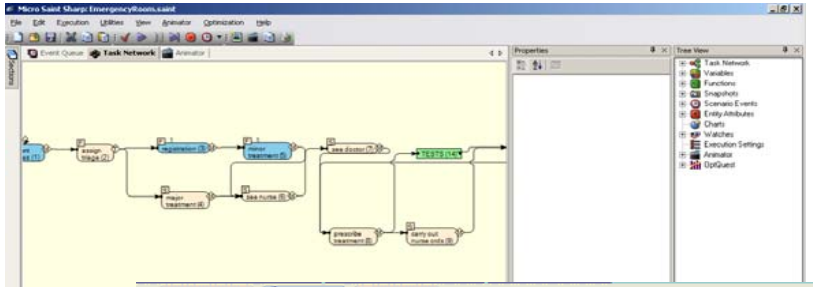


- Systems
  - Operations
  - Maintenance
- Command & control
  - Human performance
  - Asset performance
  - Network efficiency
- Process flow
  - BPR
  - Manufacturing
- Humans
  - Stress
  - Workload
  - Decision Making
- Units
  - Logistics support
  - Maintenance
- Training systems
  - DIS
  - SAFORS

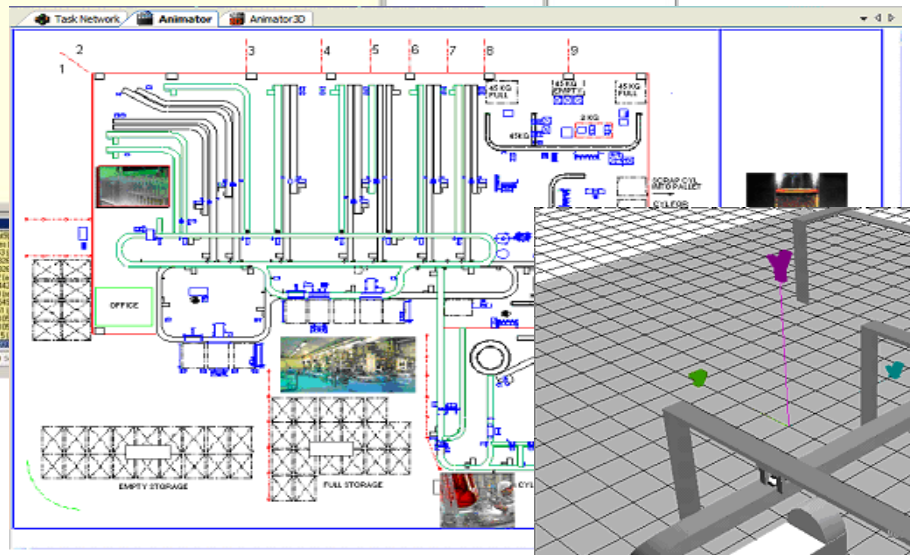
Micro Saint Family Tree



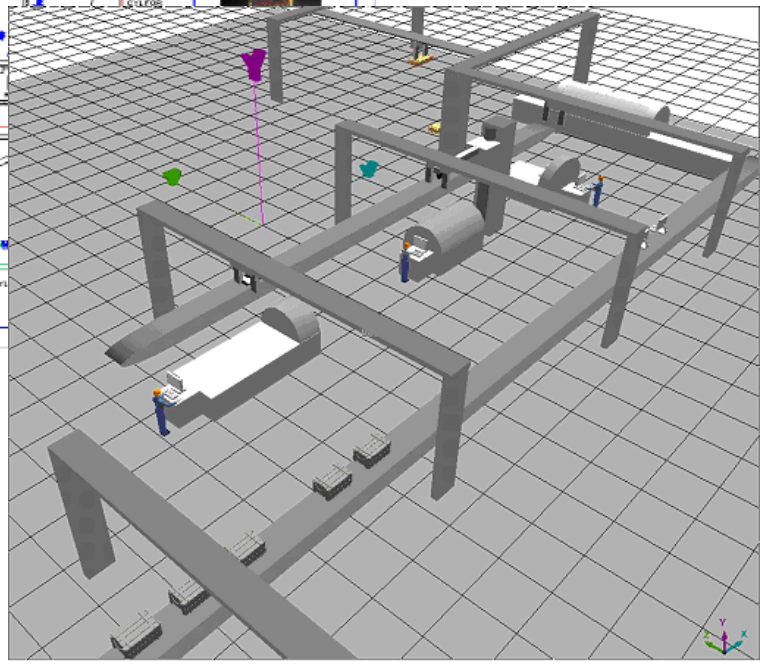
Visualization



Task Network



Animator



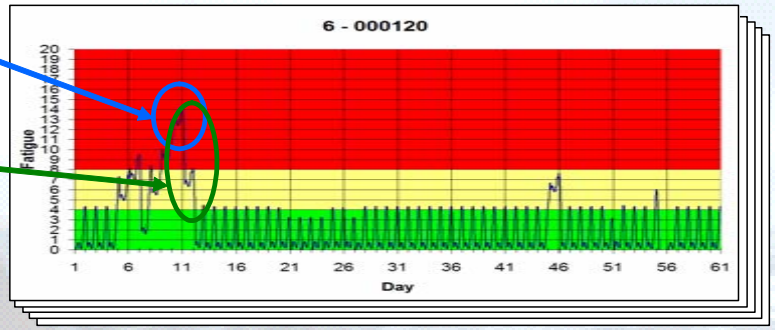
Animator3D

… and Human Performance Analyses

Total Crew Model Output Examples

Fatigue Analysis

- Excessively high fatigue
- Recovery rate following high fatigue



Sleep Statistics

Billet	# Days < 6 hours contiguous sleep	% Days < 6 hours contiguous sleep	Average sleep duration (hours)	Num Opt Sleeps taken
000020 - CDR	7	12%	6.4	19
000040 - LCDR	5	8%	6.6	19
000060 - LT	1	2%	6.0	10
000080 - LTJG	4	7%	5.9	13
000100 - LTJG	7	12%	5.5	14

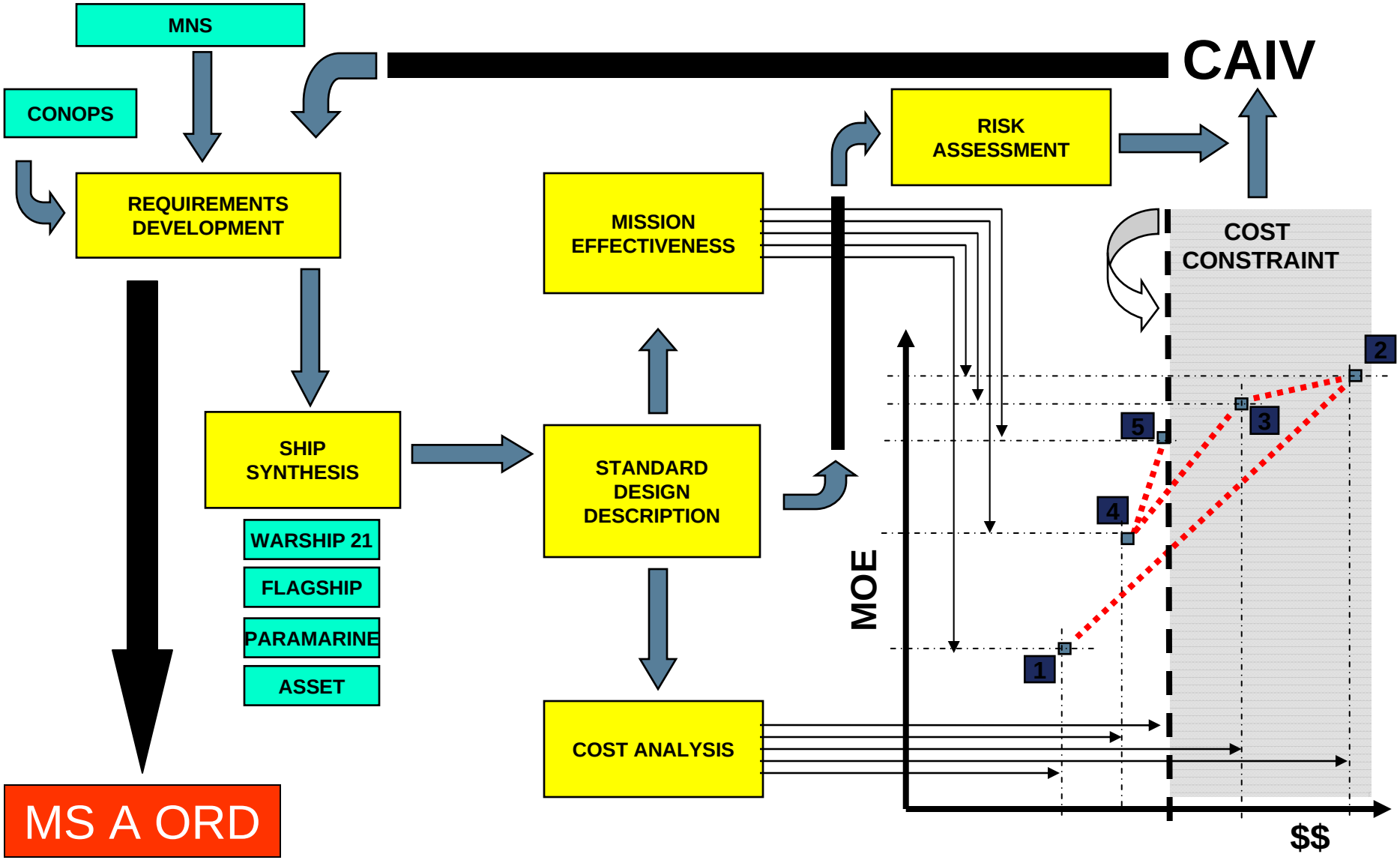
NSWW Analysis

	GOAL	MIN	MAX	AVERAGE DEVIATIOM
roductive Work	70	-17	18	-1.01
Training	7	-6	2.75	-3.78
Messing	14	-5.75	-1.75	-2.97
Sleep	56	-4.25	24.5	1.40
Personal Time	18	-6.5	18.5	7.50
Sunday (free time)	3	-3	0	-1.60

Future

- Integrate Design and Analysis tools inputs/outputs with Ship Synthesis Tool and with a Smart Product Model application to:
  - Support Early Stage Design Process
  - Support CAIV Process
  - Capture Design Data
- Use Alion IR&D program

Early Stage Design Process



Questions

Mark C. Oakes, PE
703-933-6687
moakes@alionscience.com