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Industry & Government Modeling & Simulation Crosstalk Conference

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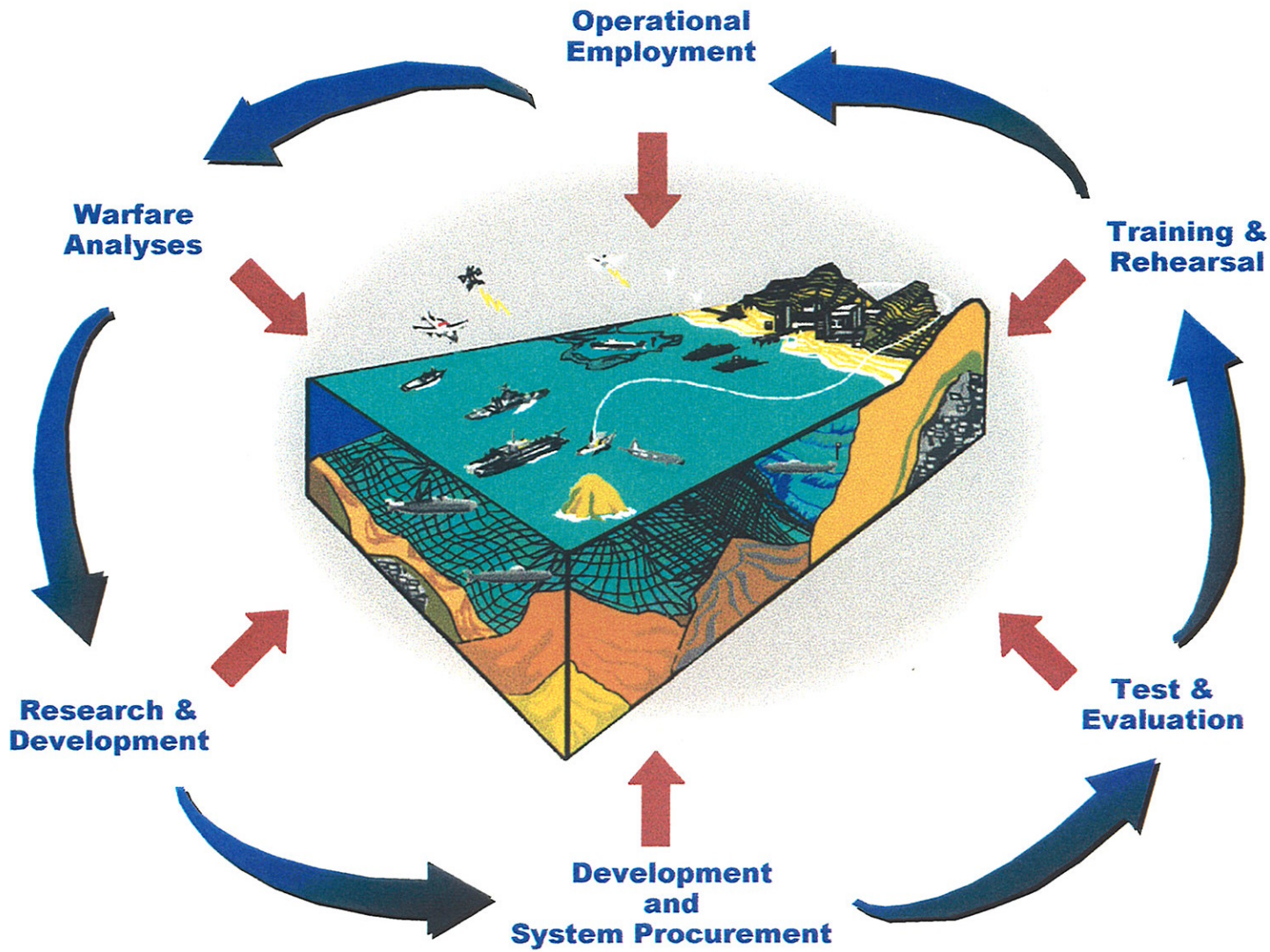
THE CHALLENGE

Live Test vs. M&S—Finding the Right Balance

- **The driver**
  - Shrinking target missile inventories, threat realism, rising cost, and complexity of test
- **The road to the solution**
  - Identified areas where M&S can augment live fire T&E
    - Combat system capability assessment
    - Tactical doctrine development and training
  - Commissioned live fire test reduction study
    - Assessment agent Naval Warfare Analysis Division
    - Establish methodology and process for determining appropriate utilization of M&S
  - Use live test events to validate simulations
- **Expand process across PEO(TAD/SC)**

TAD/SC is striving toward optimal balance between live test and M&S

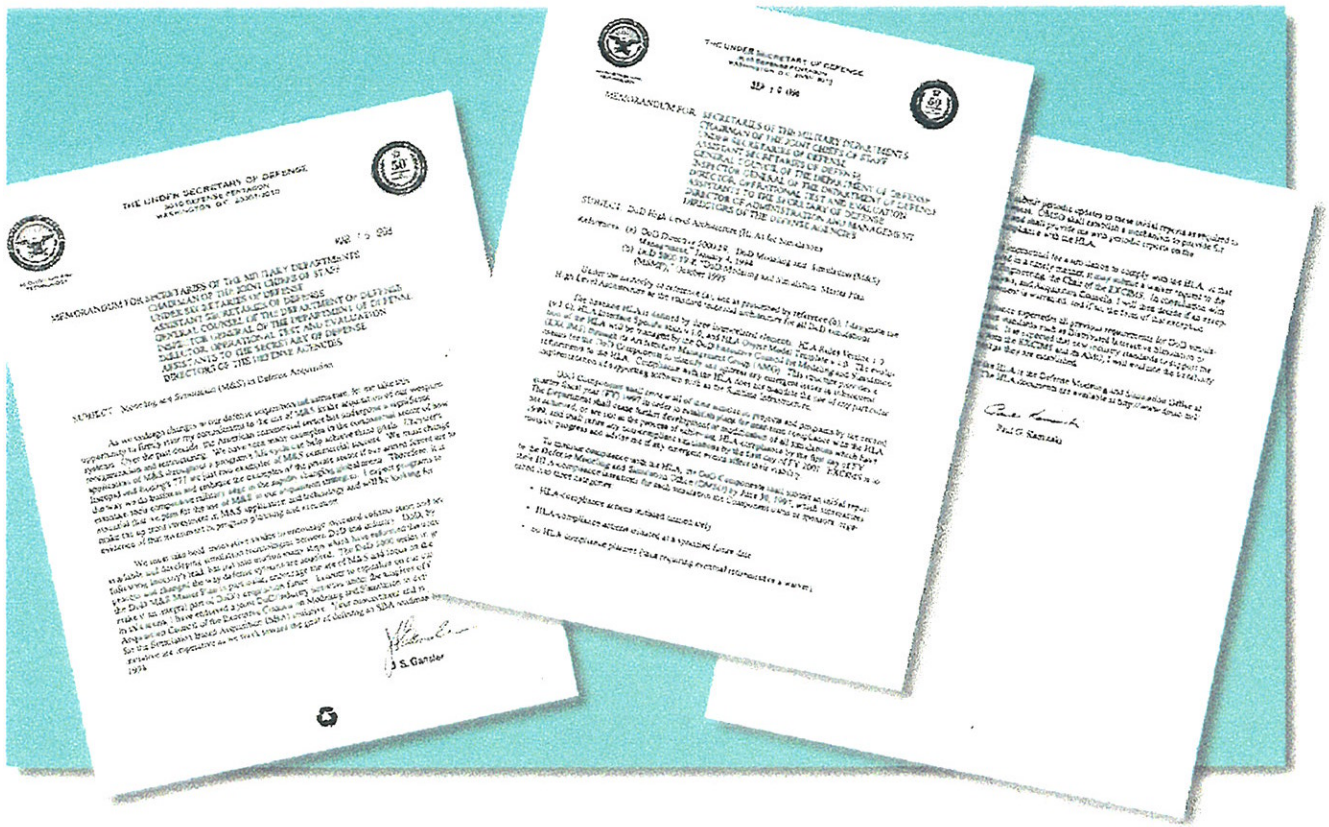
THE BIG PICTURE



CURRENT M&S ISSUES

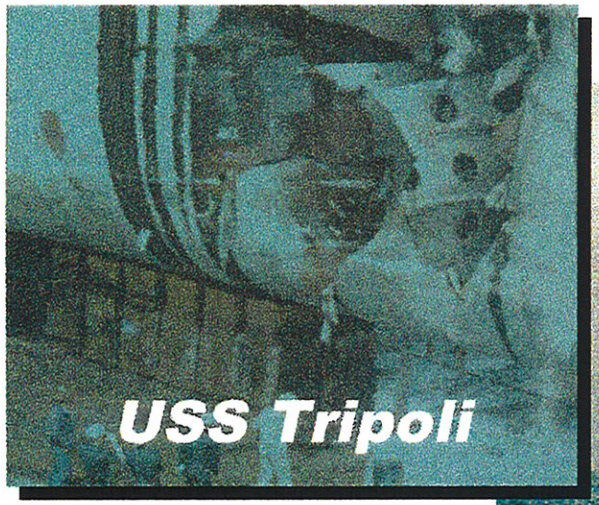
- **Standardization**
  - High Level Architecture (HLA)
  - Environment
  - Scenarios
  - Threat representation
  - Data standards
- **Communication infrastructure**
  - Mature Run Time Infrastructure (RTI)
  - Networks
  - Federation/functional area linking
  - System-to-System interaction
- **End-to-end simulation**
  - Engineering federation
  - Near real-time
  - Common environment
  - Common threat
- **Accuracy and fidelity**
  - Appropriate level for application
  - Hi-fidelity models for acquisition
  - Validation of campaign level simulations

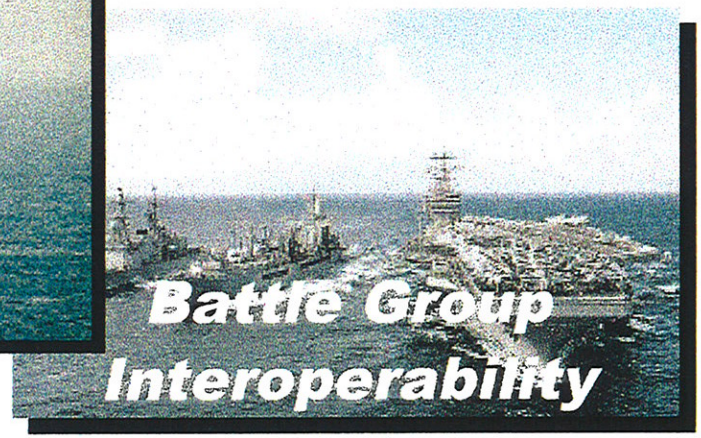
REQUIREMENT



- "…firmly state my commitment to the use of M&S in the acquisition of our weapon systems."

THE "REAL" REQUIREMENT

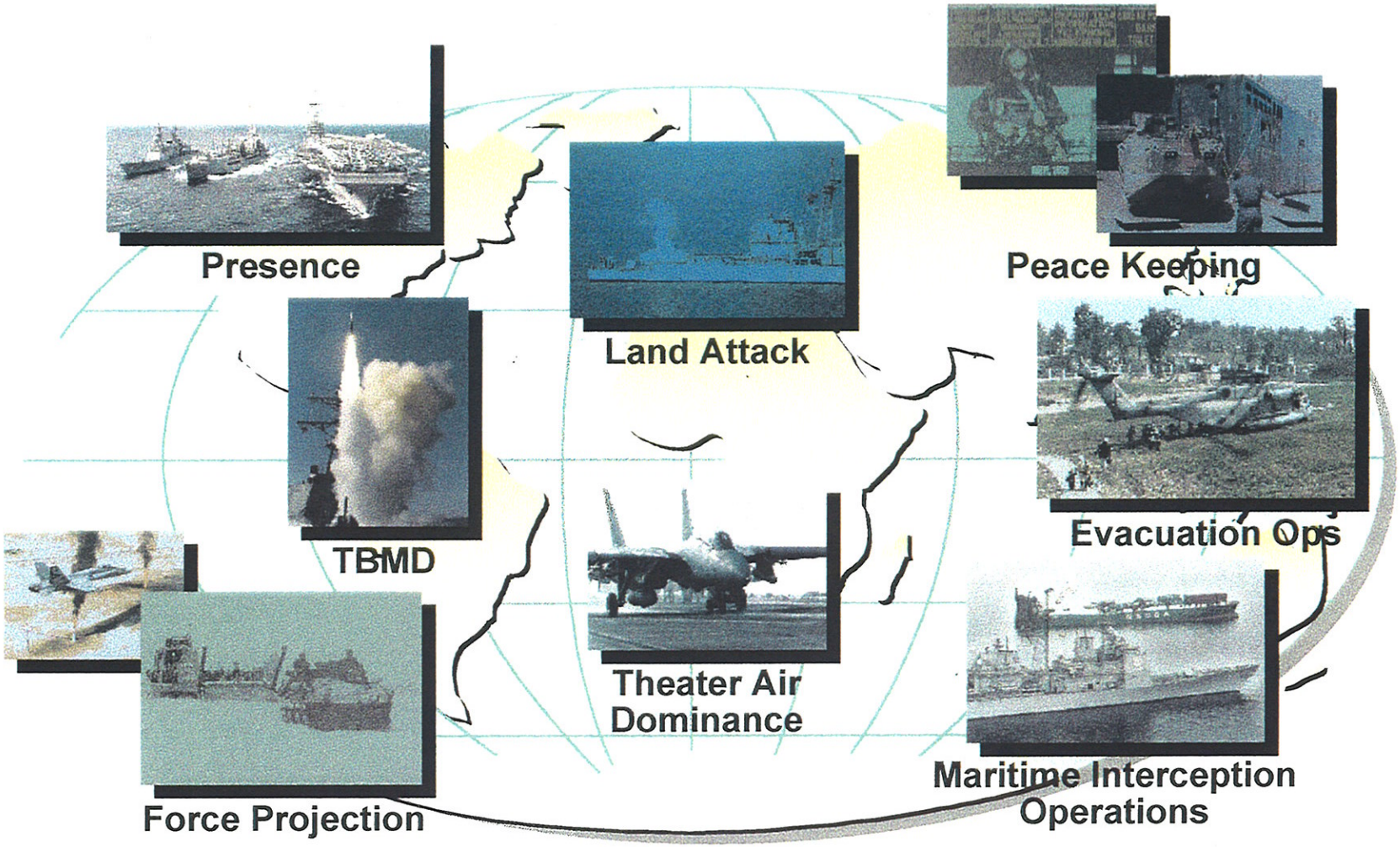




- Deployed forces are at risk
- Threat weapons have become very sophisticated
- No way to measure battle group effectiveness prior to deployment
- Live testing resources have been reduced

M&S can help provide a better product to the warfighter

BROAD BASE OF ACTIVITIES



M&S will optimize our resources

PILOT PROGRAM GOALS

TECHNICAL

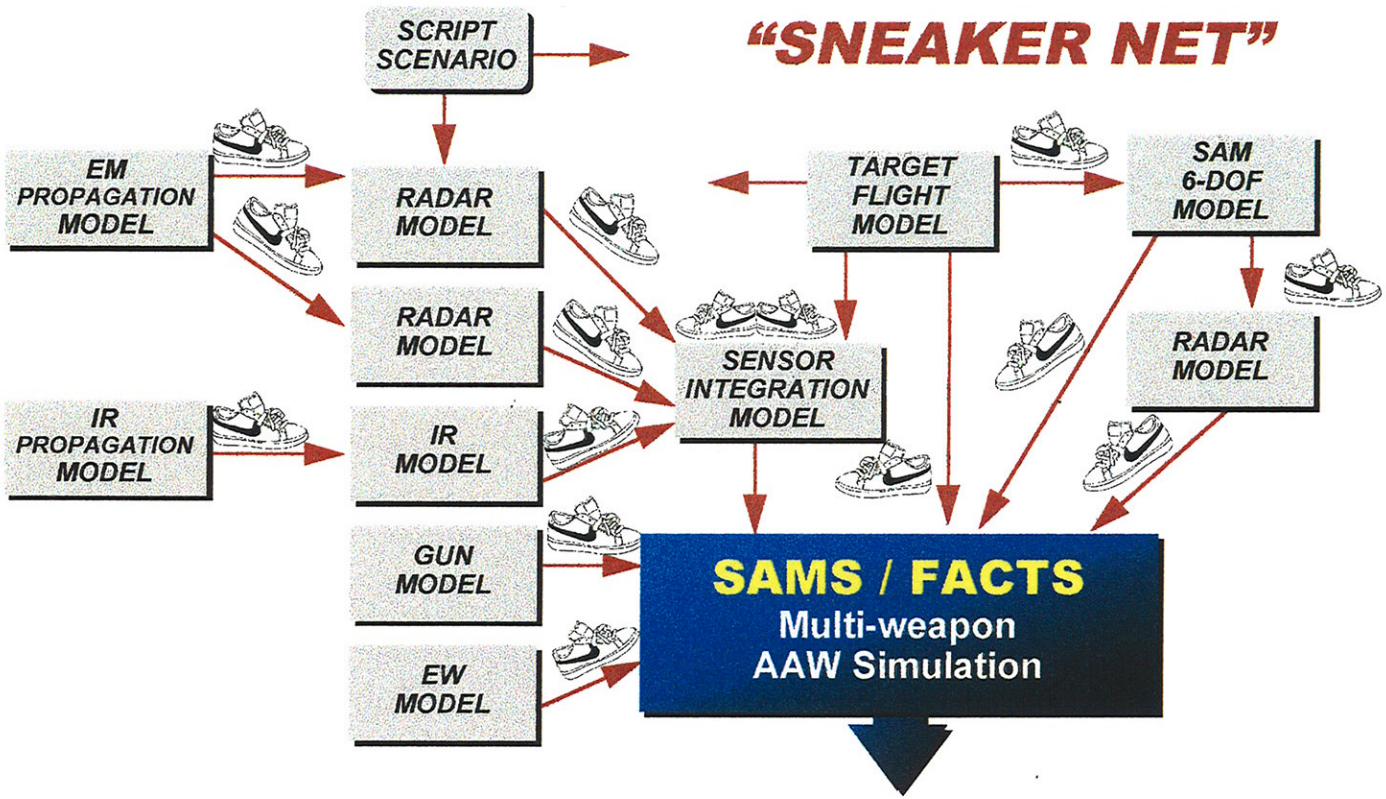
- **Develop an HLA based Federation using authoritative system representations for requirements and analysis and T&E, engineering & development**
  - Common threat and environment
  - Interactive, interoperable Federates
  - End-to-end combat system simulation
  - Accredited Federation using live test data

PROGRAMMATIC

- **Determine viability of HLA, resources required, and value added**
  - Return on investment
  - Educate acquisition community
  - Corporate level and PM commitment

Example: Integrated Ship Defense

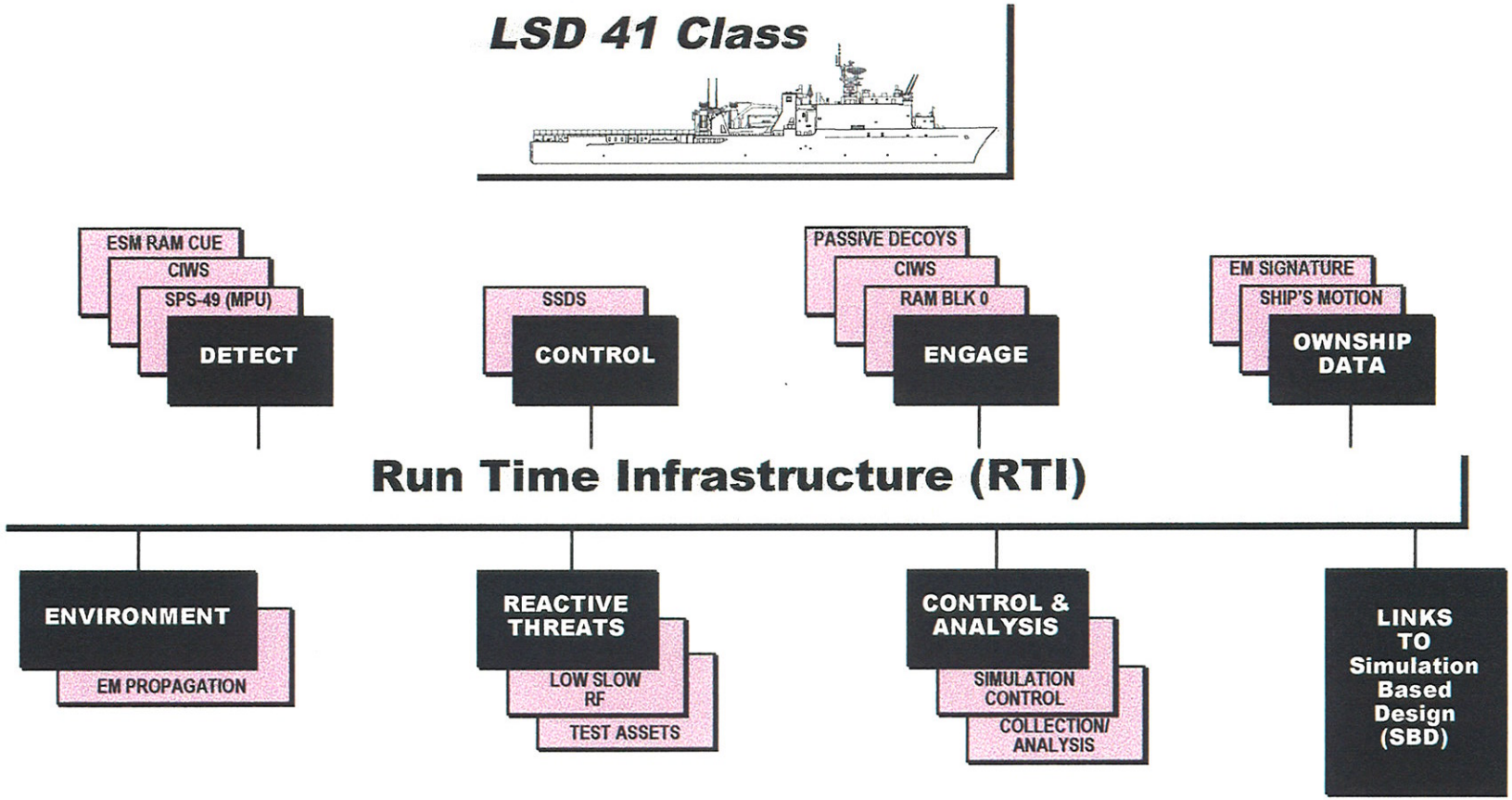
REQUIREMENTS AND ANALYSIS PROCESS



LIMITATIONS:

- *Labor intensive*
- *No Hard Kill/Electronic Warfare (HK/EW) interaction*
- *No way test combat system interoperability*
- *No joint or multi-warfare connectivity*

PHASE I ARCHITECTURE
(CY 97/98)



- Initial Federation locally distributed
- Demonstrate federation of high fidelity models
- Benchmark capability for follow-on applications

DEVELOPMENT APPROACH

The Ship Defense engineering-level federation created in Phase I will be evaluated by applying the practice of Model–Test–Model described in the Navy Test Evaluation Modeling Simulation plan

MODEL

- Create a detailed, engineering-level representation of a significant portion of the LSD 48 SSDS QRCC
- Assess the value of using an engineering-level physics-based interactive simulation Federation to plan and review a test scenario contained in the LSD 48 TEMP

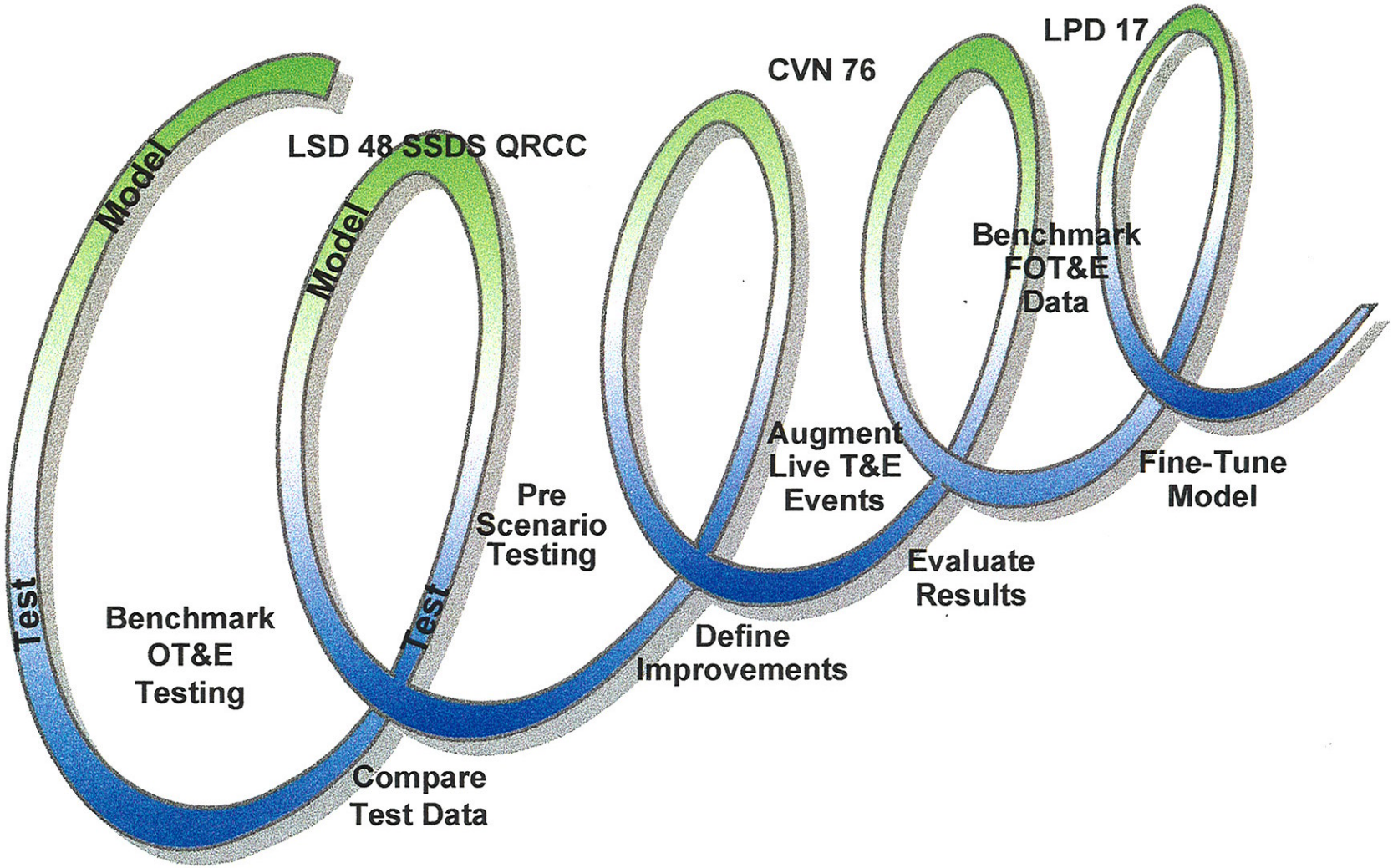
TEST

- Compare simulation results against actual results of LSD 44/48 and Self DefenseTest Ship (SDTS) Ship Self Defense System (SSDS) OT&E testing to support federation validation
- Identify, catalog, summarize and analyze differences between simulation results and live testing results as part of the federation

MODEL

- Define improvements required to align the simulation to better represent live test results
- Evaluate the Pilot Program federation's current and future value to:
  - Combat system engineering analysis, definition, design and optimization
  - Supplementing or supplanting live T&E
  - Extending test results to present and future tactical scenarios

M-T-M ITERATIVE GOALS



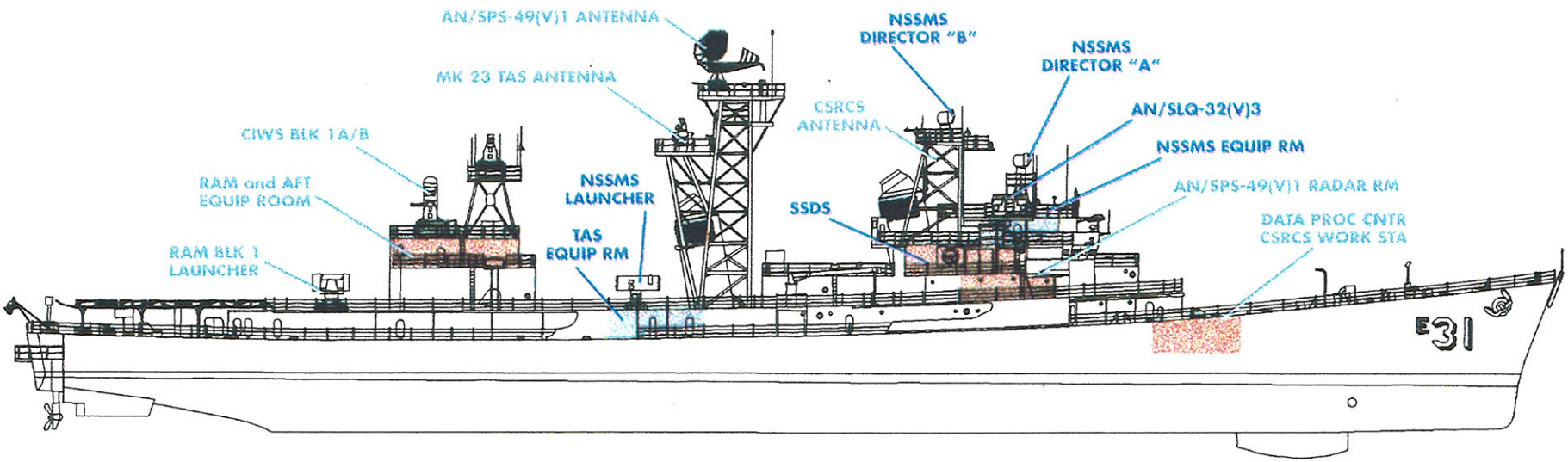
PILOT PROGRAM
Live Testing

- **Initial validation using operational test data from FY 97 SSDS Mk I OT**
- **Refine Federation using live test data from SSDS MK1 DT/OT and FOT&E 4Q FY 98**
- **Phase I VV&A of Pilot Program accomplished upon completion of SSDS/RAM Blk 1 testing**
  - Pilot Program will be available in time for Evolved Sea Sparrow Missile (ESSM) testing on SDTS in 3Q FY 99 and SSDS FOT&E

SHIP DEFENSE FEDERATION DEMONSTRATION

EX USS Decatur (EX DDG 31)

SELF DEFENSE TEST SHIP



1 May 1998

TEST ASSETS

Anticipated to be provided by PMA 208 this calendar year.

- **BQM-34 / 74**
- **VANDAL ER**
- **VANDAL EER**

Reactive threat provides greater performance assessment

VERIFICATION AND VALIDATION EFFORTS

VV&A Team

Accreditation Authority
PEO(TAD/SC) or COTF

- Makes accreditation decision
- Responsible for use of M&S results
- Responsible for overall application
- Owns the system

Accreditation Review Panel
NSWC DD, SMEs, Developers (COTF)

- Responsible for acceptability criteria and recommendation
- Manages overall effort

IV&V Agent
As Designated

- Develops and assembles V&V report
- Assists in verification
- Provides risk assessment

M&S Proponents
Federate Developers APL, NRL, NSWC DD, etc.

- Develops, executes and maintains M&S
- Performs verification
- Assists in validation

Maritime Virtual Environment Data Specification (MARVEDS)
Consistent Environment Representation

"A virtual prototype is...

...a model/simulation of a system *placed in a synthetic environment;* used to investigate/evaluate requirements, concepts, system design, testing, production, and life cycle sustainment."

DMSO M&S Master Plan

- **MARVEDS provides the synthetic environment for the ISD Pilot Federation**
  - Terrain, ocean/atmosphere/electromagnetic models
  - Other environment data essential to support virtual prototyping
  - MARVEDS addresses issues of multiple fidelity, consistency, scalability for engineering-level HLA Federations
- **MARVEDS participation benefits ISD and Navy/Joint community**
  - MARVEDS helps ISD implement consistent, scalable environment representation for Federation
  - ISD EM and IR data/models incorporated into community standards
  - MARVEDS Working Group composed of Navy/Joint programs who are environment consumers and producers

IN SUMMARY WE WILL PROVIDE:

- Increased testing availability (live plus synthetic)
- Target characteristics (altitude, speed, reaction and radar cross section) will completely emulate the current (and projected) threat
- Observation of performance in a wide spectrum of operational and meteorological environments
- Operational realism by allowing targets to close to terminal distances
- Affordably augmented live test sample sizes
- Synergy between testers and modelers

Evolutionary M&S efforts required to meet program needs