



NAVAL AVIATION TECHNOLOGIES



# How to Incorporate Modeling and Simulation into the System Acquisition Lifecycle

James N. Elele PhD



**BATTLESPACE**  
modeling and simulation

# How to Incorporate Modeling and Simulation into the System Acquisition Lifecycle

Presented By

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**(For Dr. James N. Elele)**

NAVAIR

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# SUMMARY

- **DoD & Navy Regulations Mandating the Use Of M&S In Acquisition (DoD 5000.2-R)**
- **M&S Support in the System Lifecycle and Systems Engineering Technical Review Process**
- **M&S Support to Phases of System Lifecycle**
- **M&S Support to the System Lifecycle**
  - *Pre-system acquisition: Concept Refinement*
  - *Pre-system acquisition: Technology Development*
  - *System acquisition: Development/Demonstration*
  - *System acquisition: Production and Deployment*

# DoD & NAVY REGULATIONS REQUIRING MODELING & SIMULATION USE FOR SYSTEM LIFECYCLE SUPPORT

## Department of Defense

- DoD Directive 5000.1, "The Defense Acquisition System"
- DoD Instruction 5000.2, "Operation of the Defense Acquisition System"
- DoD Directive 5000.59
- DoD Acquisition Model and Simulation Master Plan
- DoD Guide to System of Systems (SoS) Engineering
- Army's Simulation Based Acquisition

## Department of the Navy

- SECNAVINST 5000.2C – DON Acquisition Policy
- SECNAVINST 5200.38A – DoN M&S Management
- OPNAVINST 5200.34 – Navy M&S Management
- M&S VV&A Implementation Handbook, Volume I VV&A Framework
- M&S VV&A Implementation Handbook, Volume II VV&A: Adopt, Adapt & Improve (Draft)

## NAVAIR

- NAVAIRINST 4355.19C - NAVAIR System Engineering Technical Review Requirements
- PEO Aircraft Carriers Instruction 5200.5
- NAVAIR M&S VV&A Guidelines (2009 Draft)

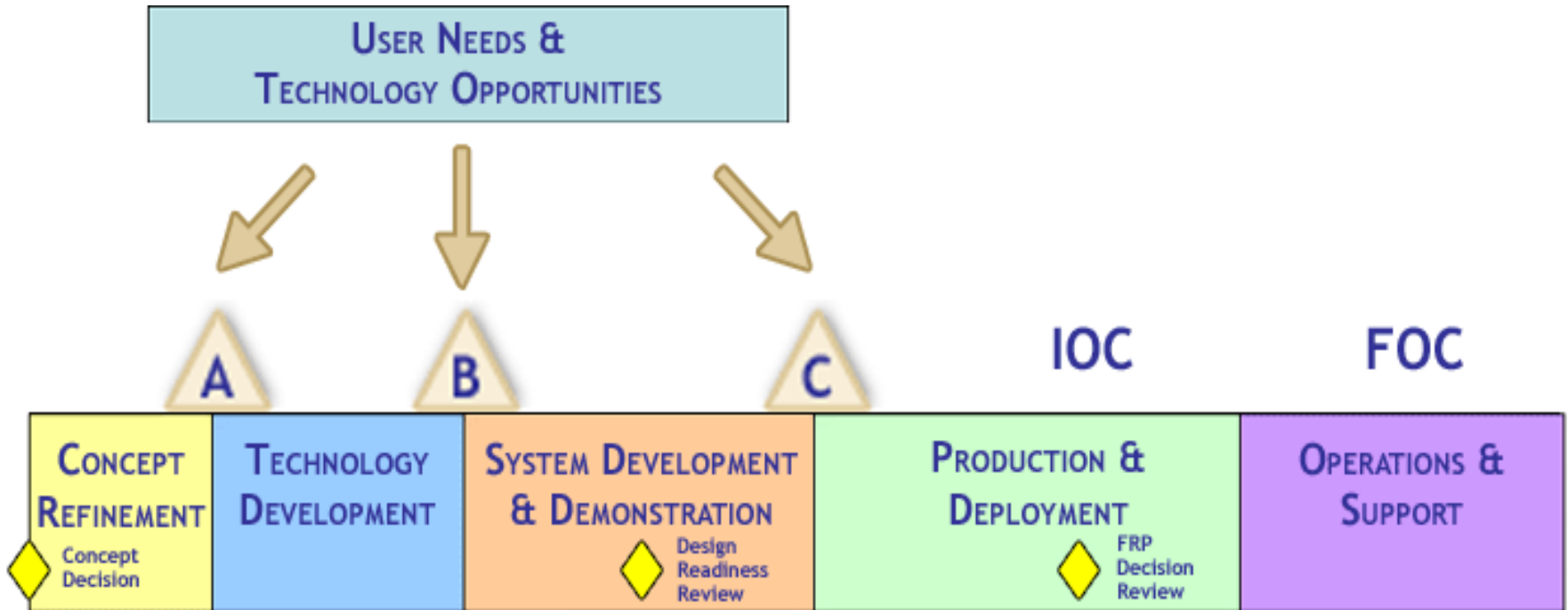
**DoD &  
Department of  
the Navy  
Simulation  
Support  
Documents**

# DoD REGULATION 5000.2-R

- Paragraph 3.4.4:
  - *Accredited* Models and Simulations (M&S) shall be applied, as appropriate, throughout the system lifecycle in support of various acquisition activities.
  - Note that:
    - M&S shall be applied
    - as appropriate,
    - throughout the system lifecycle

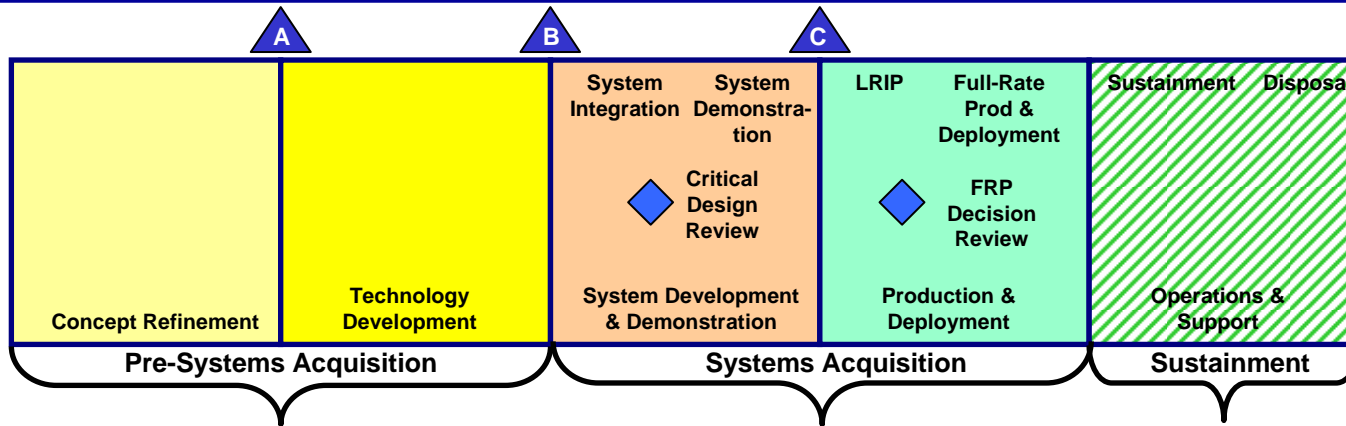
# SYSTEM LIFECYCLE FRAMEWORK OVERVIEW

**GOAL: To indicate how M&S may be used at each phase**



# M&S in the System Lifecycle and Systems Engineering

## M&S Support In The Technical Review Process



### Acquisition Processes and M&S

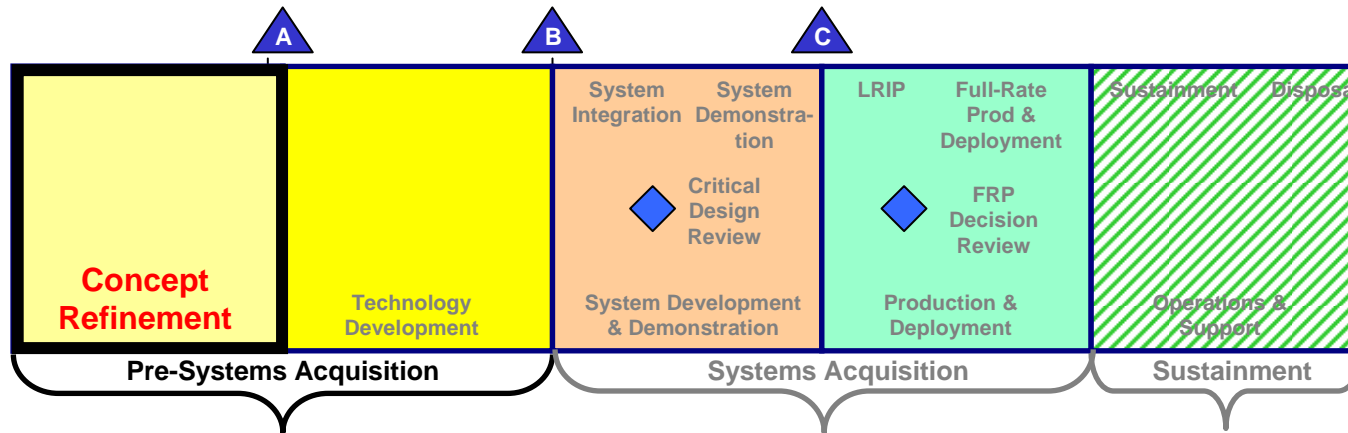
- DoD 5000.2-R, Mandatory Procedures for Major Defense, Acquisition Programs (MDAPS) and Major Automated Information System (MAIS)
  - *C3.9. MODELING AND SIMULATION (M&S)*: “The PM shall identify and fund required M&S resources early in the acquisition lifecycle, so that M&S may be integrated with the T&E program.”
  - *Paragraph 3.4.4*: “PMs shall integrate the use of modeling and simulation within program planning activities, plan for life-cycle application, support, capitalizing on reuse of models and simulations, and integrate modeling and simulation across the functional areas.”
- Provides a logical start to the program
- Maximizes re-use of existing M&S providing economical testing methodology
- Presents technology opportunity

### How to Incorporate M&S into System Lifecycle

- **Identify applicable existing M&S**
- **Maximize re-use of available M&S**
- **Provide product growth for M&S to meet intended uses**
- **When possible, initiate creation of collaborative M&S environment of applicable M&S**

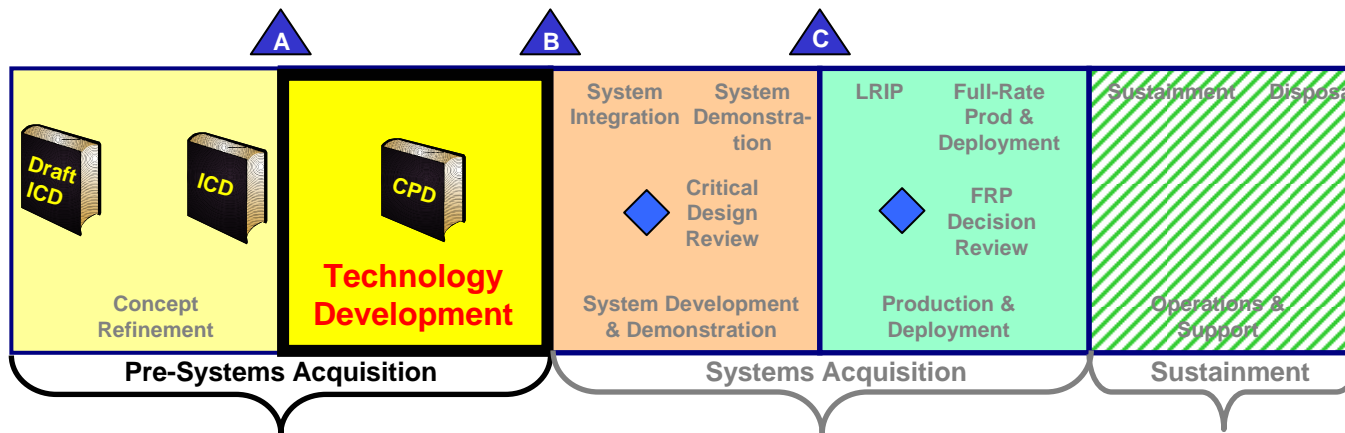
### What is the Collaborative M&S Environment?

- Interactive environment populated with applicable M&S to the specific program
- Environment provides different levels of fidelity to match different phases of the acquisition process
- Ranges from desktop engineering models to HWIL training simulators
- Provides ready availability to M&S and/or applicable data and information to system designers, developers, testers, operators



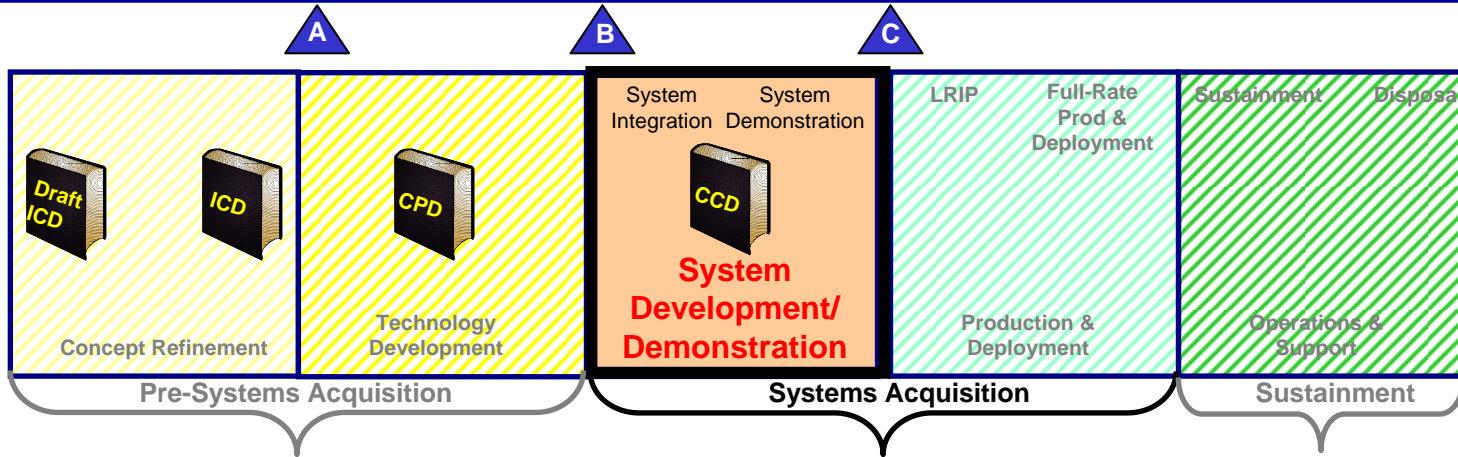
<p>Lifecycle Phase</p> <p><b>Pre-system Acquisition:</b></p> <p><b>Concept Refinement</b></p> <ul style="list-style-type: none"> <li>• Technical framework definition</li> <li>• Analysis of alternatives</li> <li>• Capabilities definition</li> <li>• Rapid virtual prototyping</li> <li>• Concept exploration</li> <li>• Augmentation of the T&amp;E process</li> </ul>	<p>M&amp;S Application Categories</p>	<ul style="list-style-type: none"> <li>• Architecture Definition</li> <li>• Effectiveness Models</li> <li>• Engineering Models</li> <li>• Manufacturing Simulations</li> <li>• Assembly Simulations</li> <li>• Campaign Level Simulations</li> <li>• Engagement Level Simulations</li> </ul>
<p>SETR Phase Venues</p> <ul style="list-style-type: none"> <li>• Initial Technical Review</li> <li>• Alternative System Review</li> </ul>	<p><b>M&amp;S Used For</b></p>	<ul style="list-style-type: none"> <li>• M&amp;S modification requirements</li> <li>• Concept testing</li> <li>• Gap analysis</li> <li>• Planned capability assessments</li> <li>• Concept development input</li> <li>• Technology identification</li> </ul>
	<p>Example M&amp;S Products</p>	<ul style="list-style-type: none"> <li>• Draft Initial Capabilities Document</li> <li>• Initial Capabilities Document</li> <li>• Plan for Analysis of Alternatives</li> <li>• Planned phased funding requirements</li> </ul>





<p>Lifecycle Phase <b>Pre-system Acquisition: Technology Development</b></p> <ul style="list-style-type: none"> <li>• Technological risk reduction</li> <li>• Technology integration into system</li> <li>• Technology analysis</li> <li>• Capability assessment</li> <li>• Lifecycle cost projection</li> <li>• Operational test integration planning</li> <li>• Virtual prototyping</li> </ul>	<p>M&amp;S Application Categories</p> <ul style="list-style-type: none"> <li>• Architecture Definition</li> <li>• Effectiveness Models</li> <li>• Design and Specialty Engineering Models</li> </ul>	<ul style="list-style-type: none"> <li>• Manufacturing Simulations</li> <li>• Assembly Simulations</li> <li>• Supportability Models</li> </ul>
<p>SETR Phase Venues</p> <ul style="list-style-type: none"> <li>• Systems Readiness Review</li> <li>• Integrated Baseline Review</li> </ul>	<p><b>M&amp;S Used For</b></p>	<ul style="list-style-type: none"> <li>• Risk reduction assessment</li> <li>• Technology selection</li> <li>• System integration analysis</li> <li>• Interoperability analysis</li> </ul>
<p>Example M&amp;S Products</p>	<ul style="list-style-type: none"> <li>• Capabilities Development Document</li> <li>• Technology Development Strategy</li> </ul>	<ul style="list-style-type: none"> <li>• Inputs for System Readiness Review</li> </ul>

**SYSTEMS ACQUISITION: SYSTEM DEVELOPMENT/DEMONSTRATION**



Lifecycle Phase  
System Acquisition  
**Development/Demonstration**

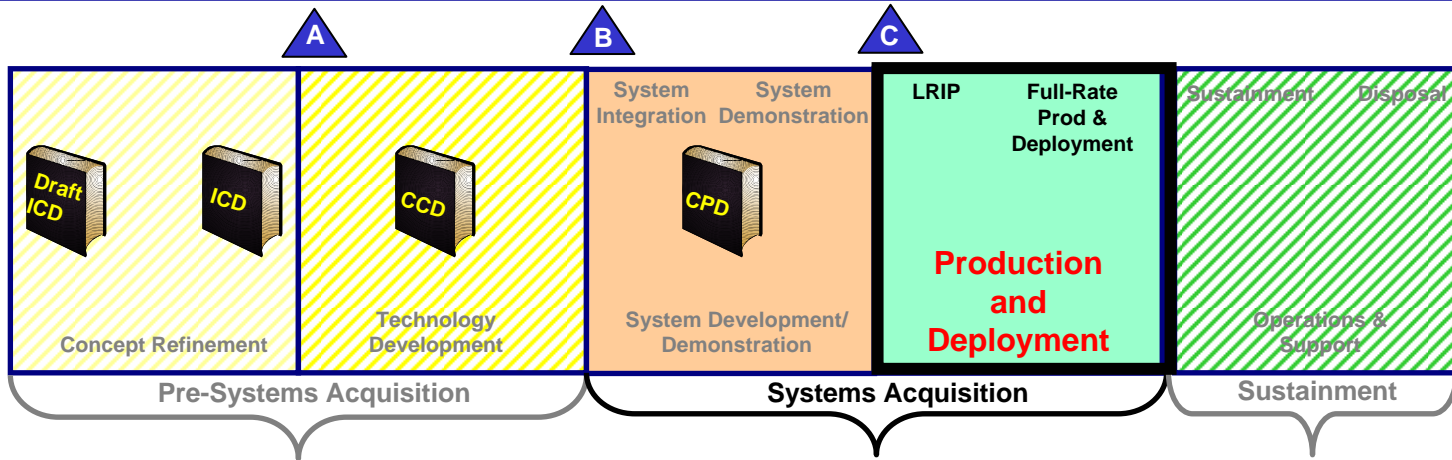
- Interface requirements definition
- Test and evaluation of technology under development
- Hardware prototype T&E process refinement
- Assessment of system in varying scenarios, mission space, and performance envelope

- Flight Readiness Review
- Operational Test Readiness Review
- System Verification Review/Production Readiness Review

M&S Application Categories	<ul style="list-style-type: none"> <li>• System Demonstration Models</li> <li>• Effectiveness Models</li> </ul>	<ul style="list-style-type: none"> <li>• Supportability Models</li> <li>• HWIL/SWIL/MIL T&amp;E</li> </ul>
<b>M&amp;S Used For</b>	<ul style="list-style-type: none"> <li>• System integration of subsystems and components</li> <li>• Interoperability analysis</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis for refining HW and SW</li> <li>• System integration risk reduction</li> </ul>
Example Products	<ul style="list-style-type: none"> <li>• Prototypes</li> <li>• Risk Mitigation Reports</li> </ul>	<ul style="list-style-type: none"> <li>• Capability Production Document</li> </ul>

SETR Phase Venues

- Systems Functional Review
- Preliminary Design Review
- Critical Design Review
- Test Readiness Review



Lifecycle Phase  
System Acquisition:  
**Production and Deployment**

- Detailed system design development
- System production and support process definition
- Manufacturing facility design
- Production flow definition
- Production bottleneck analysis and elimination
- Virtual training

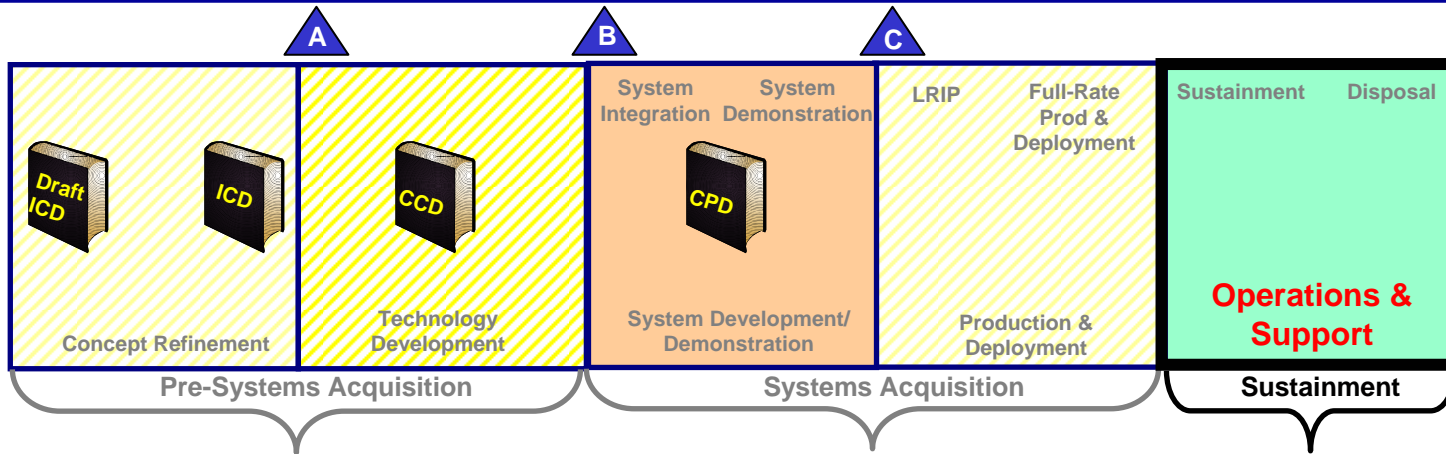
SETR Phase Venues

- Physical Configuration Audit

M&S Application Categories	<ul style="list-style-type: none"> <li>• Manufacturing Simulations</li> <li>• Assembly Simulations</li> </ul>	<ul style="list-style-type: none"> <li>• Supportability Models</li> <li>• Training Simulations</li> </ul>
<b>M&amp;S Used For</b>	<ul style="list-style-type: none"> <li>• Full manufacturing capability analysis</li> <li>• Production representative statistics</li> </ul>	<ul style="list-style-type: none"> <li>• Initial production recommendations</li> <li>• Support analysis</li> </ul>
Example M&S Products	<ul style="list-style-type: none"> <li>• Full-rate production estimates</li> <li>• Process Improvement Report</li> </ul>	<ul style="list-style-type: none"> <li>• System deployment plans</li> <li>• Operational capability</li> <li>• Quality Control</li> </ul>

# M&S SUPPORT TO THE SYSTEM LIFECYCLE

## *SUSTAINMENT: OPERATIONS AND SUPPORT*

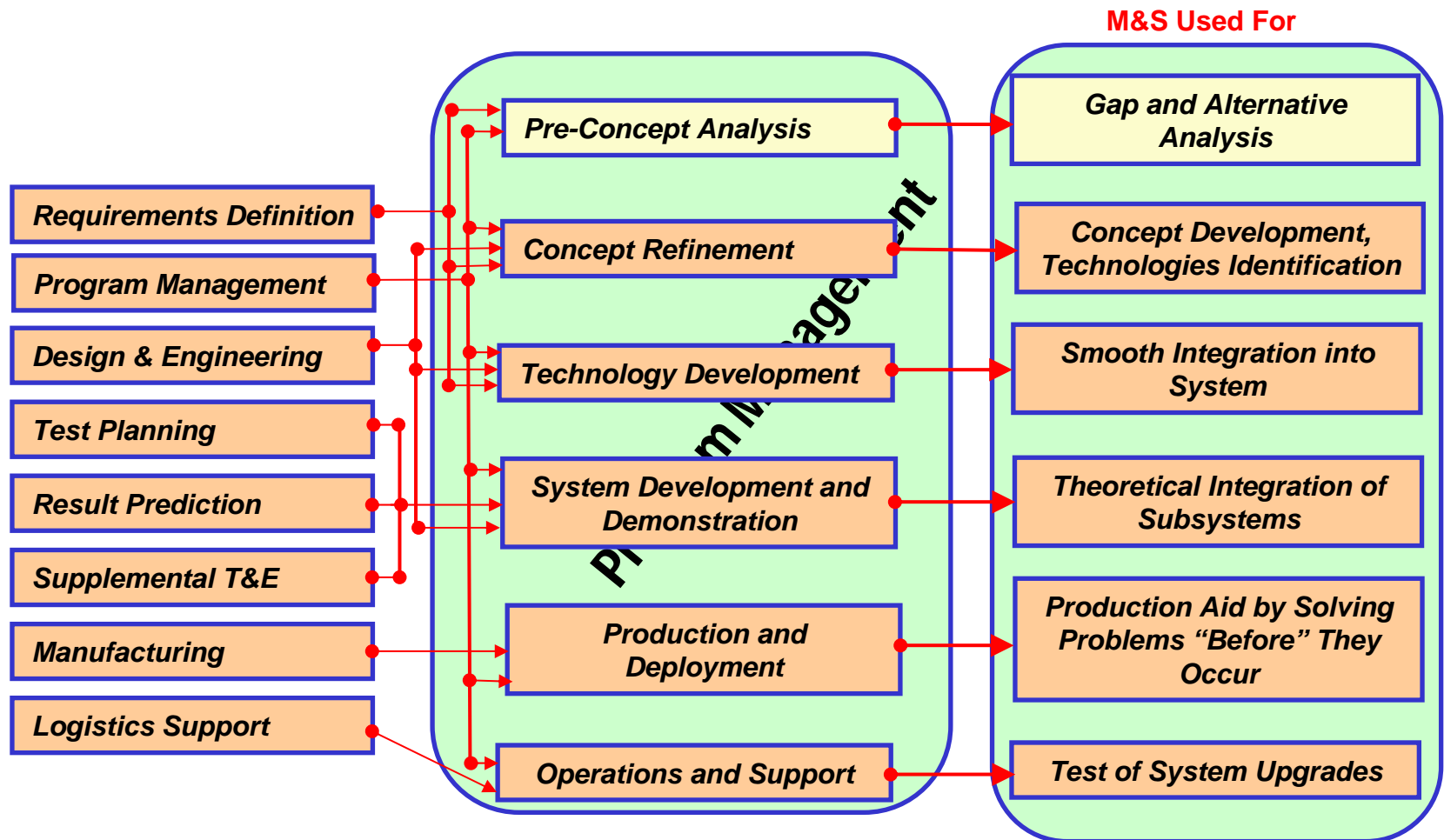


<p>Lifecycle Phase <b><u>Sustainment:</u></b> <b><u>Operation and Support</u></b></p> <ul style="list-style-type: none"> <li>• Detailed system operational improvement</li> <li>• Future system improvement and support and process definition</li> <li>• Operational bottleneck analysis and elimination</li> <li>• Virtual training</li> <li>• Future requirements definition</li> </ul>
<p>SETR Phase Venues</p> <ul style="list-style-type: none"> <li>• Physical Configuration Audit</li> </ul>

M&S Application Categories	<ul style="list-style-type: none"> <li>• Simulations</li> <li>• Assembly Simulations</li> </ul>	<ul style="list-style-type: none"> <li>• Supportability Models</li> <li>• Training Simulations</li> </ul>
<b><u>M&amp;S Used For</u></b>	<ul style="list-style-type: none"> <li>• Full manufacturing capability analysis</li> <li>• Production representative statistics</li> </ul>	<ul style="list-style-type: none"> <li>• Initial production recommendations</li> <li>• Support analysis</li> </ul>
Example Products	<ul style="list-style-type: none"> <li>• Full-rate production estimates</li> </ul>	<ul style="list-style-type: none"> <li>• System deployment plans</li> <li>• Operational capability</li> </ul>

# REVIEW

- Acquisition activities span all phases of the system lifecycle
- M&S heavily supports all aspects of the system lifecycle
- M&S provides valuable input into the System Engineering Technical Review Process



# ACKNOWLEDGMENT

- The material for this brief was derived from various sources:
  - DoD Publications
  - DAU course materials
  - DMSO documents
  - NMSO Lectures
  - NAVAIR Publications

# Questions

