



FUTURE COMBAT SYSTEMS



One Team-The Army/Defense/Industry

M&S In a Networked Battlespace Requirements for FCS: Maturing Models and Simulations

Paul Lowe

MS&I Chief Simulation System Engineer

12 DEC 2006

(version 1.0.4)

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 12 DEC 2006		2. REPORT TYPE		3. DATES COVERED 00-00-2006 to 00-00-2006	
4. TITLE AND SUBTITLE M&S In a Networked Battlespace Requirements for FCS: Maturing Models and Simulations				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Future Combat Systems, Washington, DC, 20301				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES 12th Annual ITEA Modeling and Simulation Conference, Dec 2006, Las Cruces, NM					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 19	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

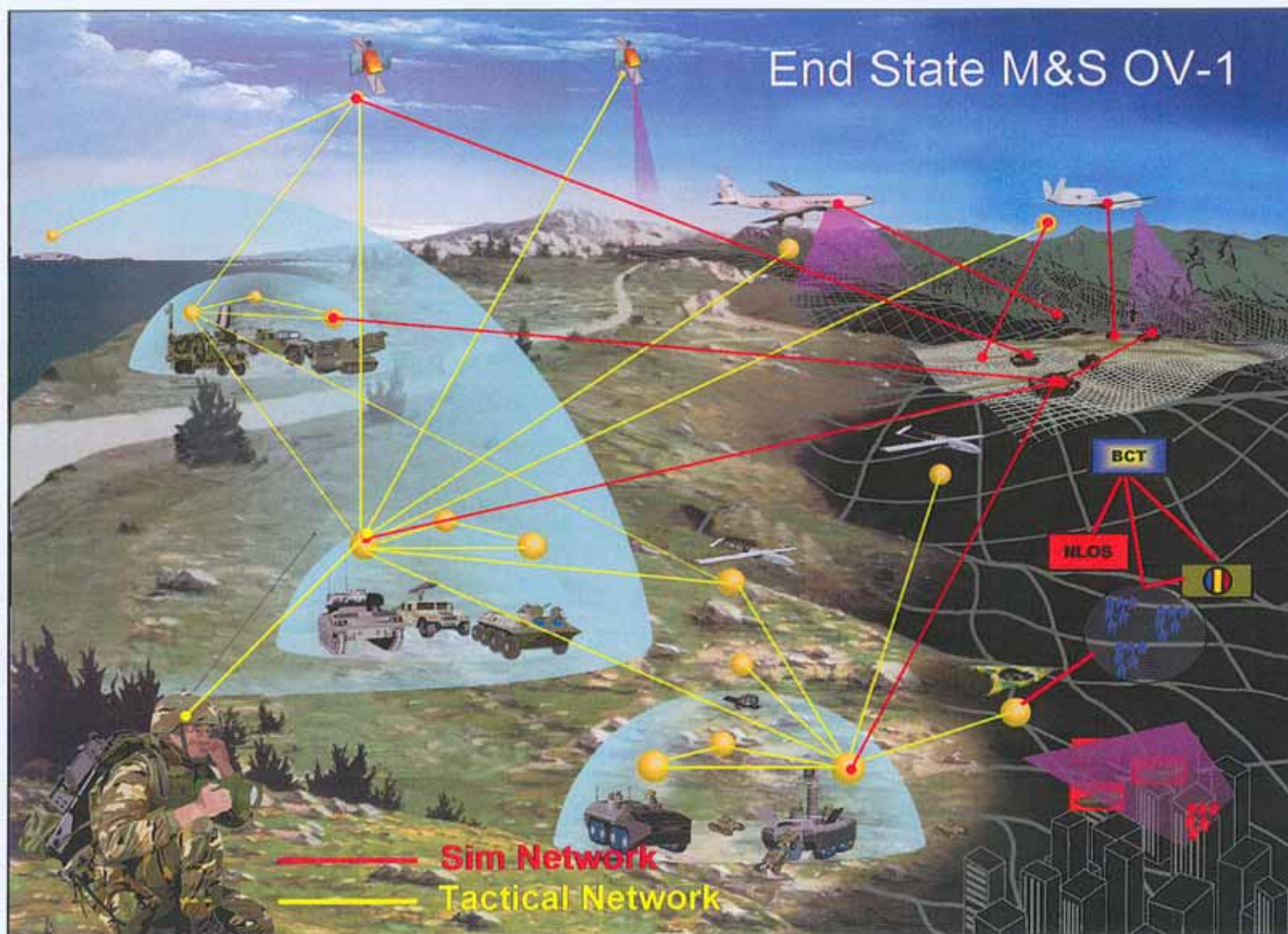
Overview

- **BLUF: Bottom Line Up Front**
- **FCS BCT Context for SoS Simulation**
- **Integration Phase (IP) Based Maturity Concept**
- **Strategy for Maturing M&S**
 - FCS and SMART
 - Maturing Models and Simulations
 - M&S Requirements Development
 - Phased Objectives / Requirements
 - Model-Test-Model Paradigm
- **Integrated Mission Test (IMT) 0**
- **Simulation Evolving End State Vision**
 - Maturing Simulations and Verification, Validation and Accreditation (VV&A)
- **Summary**

Bottom Line Up Front

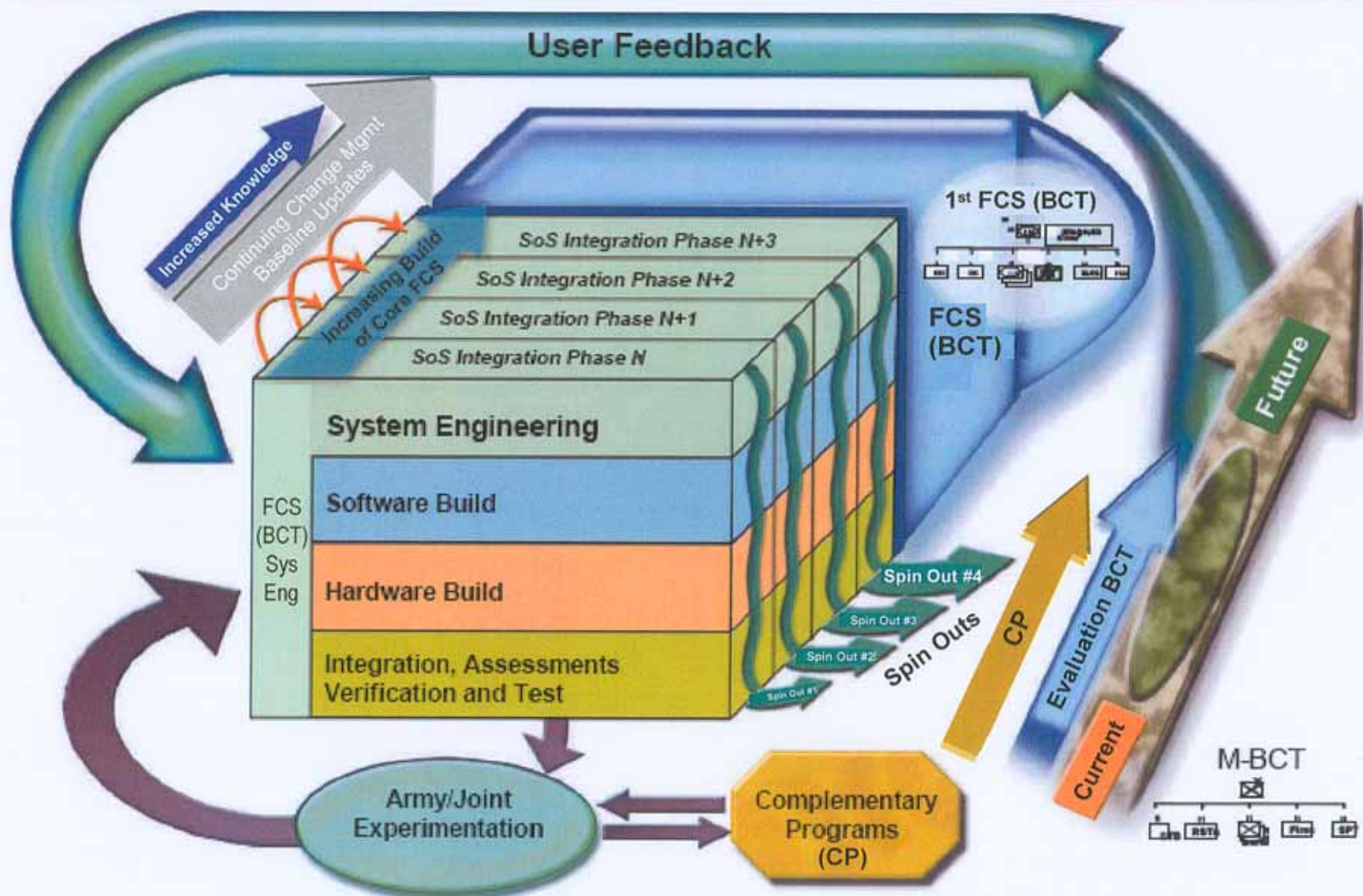
- **Developmental and operational testing data, analysis results, and system/Soldier behaviors development all contribute to the maturing and accrediting of the M&S and associated data that will be used to support the Program Milestone C decision and subsequent operational testing**
- **Maturing of the Future Combat Systems (FCS) constructive and virtual M&S is being realized over a series of Integration Phases (IPs) with phased functional requirements that support capabilities needed for Events within each IP**
- **The Integration/Test Lab infrastructure provides an environment for (1) integration of aggregations of M&S and (2) execution of simulation-based Experiments and Tests that generate data for post-test analysis, leading to increased confidence in the maturing functionality and fidelity of the FCS M&S**

FCS BCT Context for SoS Simulation



Approved for Public Release, Distribution Unlimited, TACOM 21 November 2006, case 06-273.

FCS SoS Iterative Maturation



FCS and SMART

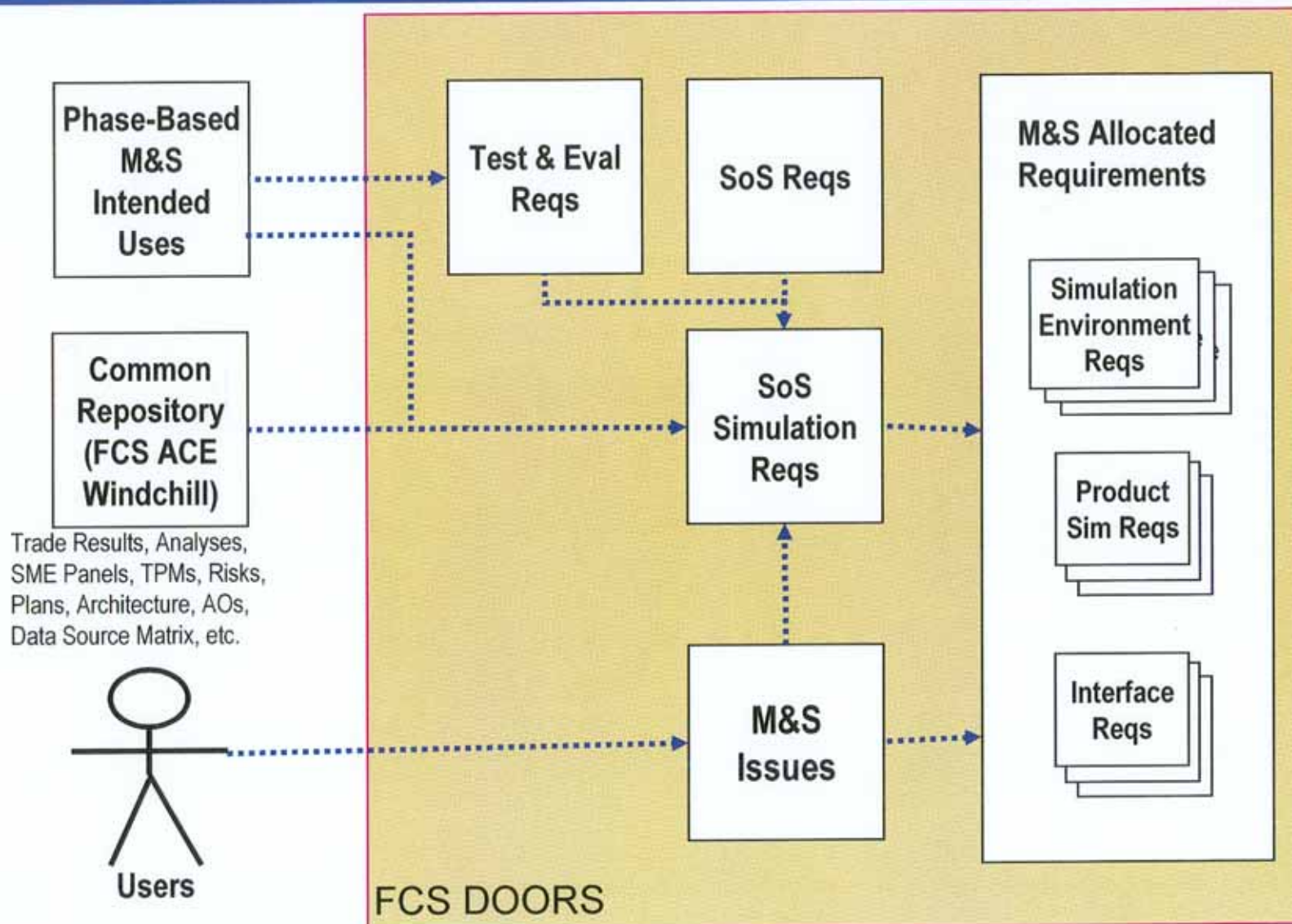
The FCS implements the Simulation and Modeling for Acquisition, Requirements, and Training (SMART) vision by executing a lifecycle product line approach and by following these fundamental concepts:

- Development of comprehensive, mature M&S execution strategies, action plans, and resource priorities
- Creation and enforcement of policies, procedures, and standards that facilitate development, sharing, and efficient use or reuse of consistent, mature FCS (BCT) representations, databases, and M&S applications
- Technical M&S support for design, development, and reuse of the FCS M&S common, composable S2F product line architectures, federations, and domain specific products for use in domains such as Test, Evaluation, Analysis, and Experimentation
- Utilization of a shared repository for storing event artifacts as “boxed sets” that can be reused in new events or for repeating previous events

Strategy for Maturing M&S

- The FCS SMART strategy for maturing models and simulations emphasizes collaboration, concurrency, and authoritative sources of data and information intended to accelerate decision processes by enabling innovative ideas and activities, as well as ensuring that false starts or low-value paths are avoided or quickly rejected
- The emphasis on maturing models and simulations saves time and resources by providing the means to execute analyses, logistics, training, and test in an iterative concurrent manner without requiring actual system HW and SW to support all simultaneous activities
- The FCS (BCT) Program employs newly developed M&S as well as proven applications and tools

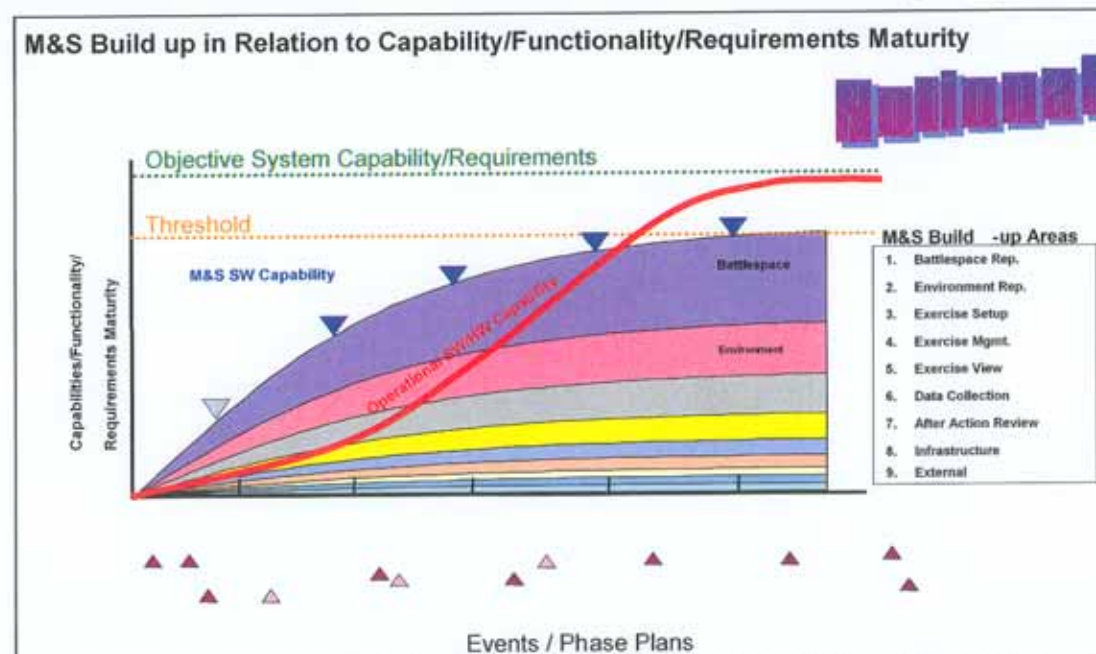
M&S Requirement Development



Phased M&S Objectives / Requirements

The M&S objectives of each phase represent an aggregation of the objectives for each event within that phase

The collections of M&S requirements for a phase build upon the M&S requirements from the previous phases and as such represent an incremental step towards the final set of M&S requirements that define the overall project



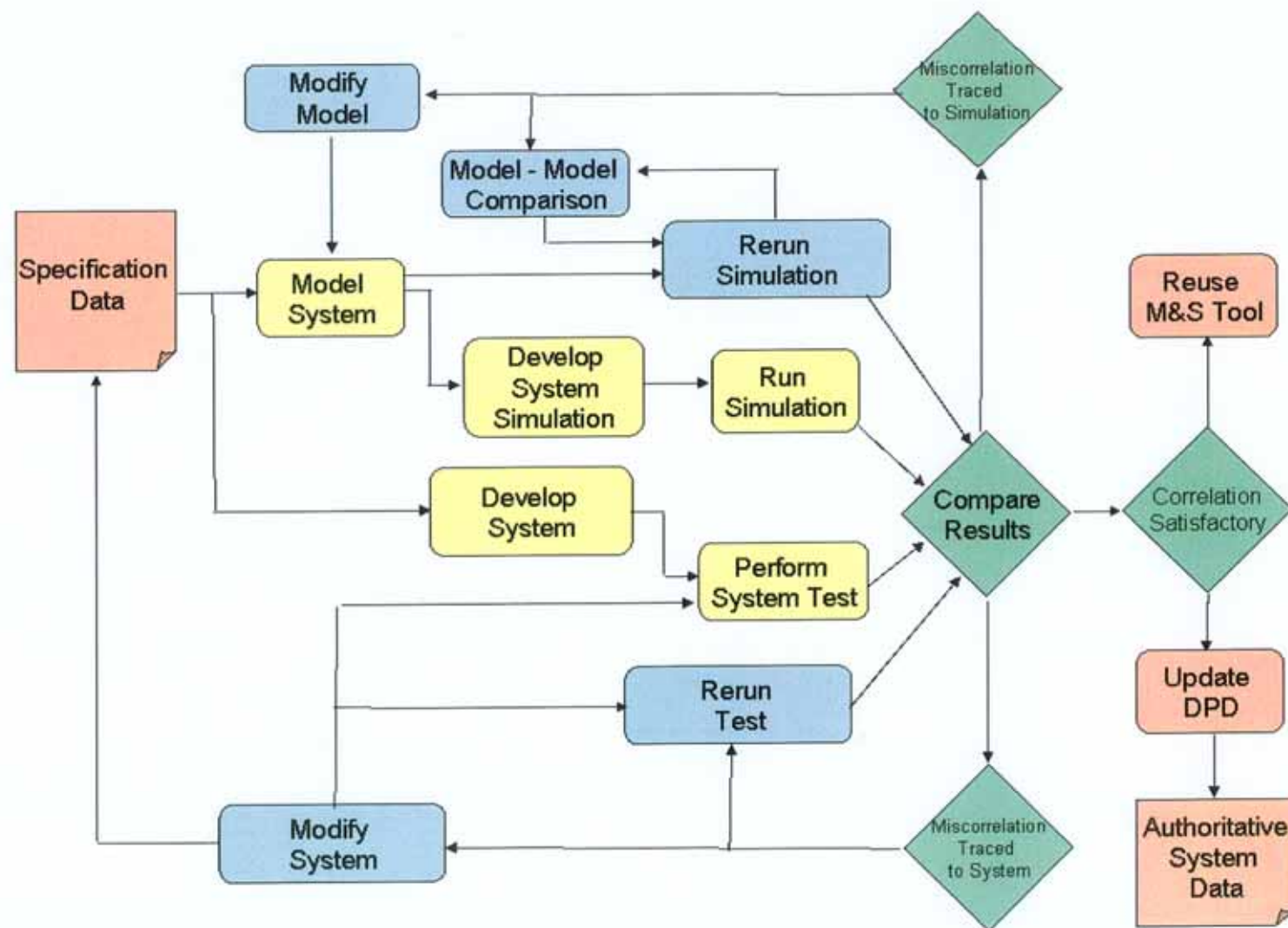
Approved for Public Release, Distribution Unlimited, TACOM 21 November 2006, case 06-273.

Model-Test-Model: Paradigm for Maturing M&S



- **Model-Test-Model as a Paradigm for Maturing M&S is an integrated approach to using models and simulations in support of pre-test analysis and planning; conducting the actual test and collecting data; and post-test analysis of test results along with further validation of the models using the test data**

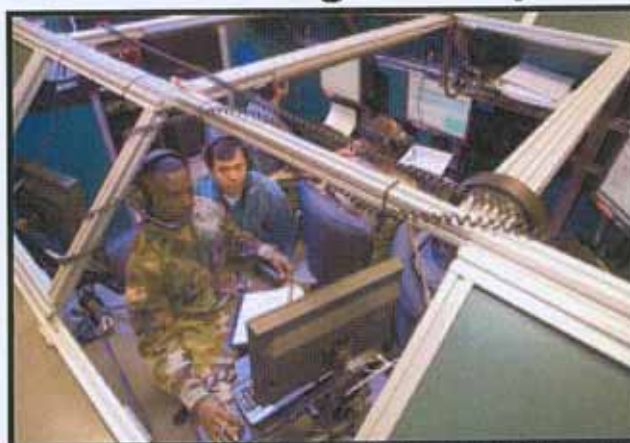
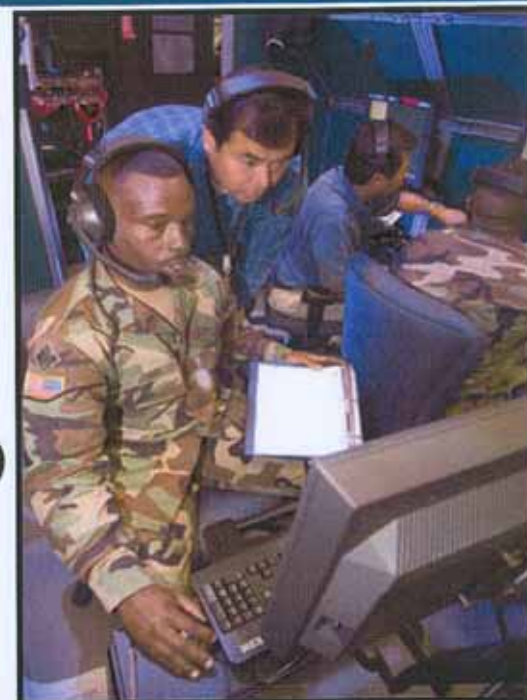
Model-Test-Model



Integrated Mission Test 0, Completed

Objectives:

- Stand up People, Parts, Paper, and Processes
- Integrate across One Team test articles
- Demonstrate
 - Leveraging of Constructive / Virtual Simulations
 - Performance of Software Build 0 (~ 6M lines of code)
 - Ability to incorporate Complementary Systems
 - Analysis to Test Coordination
- Establish foundation for next integration phases



Simulation Evolving End State Vision

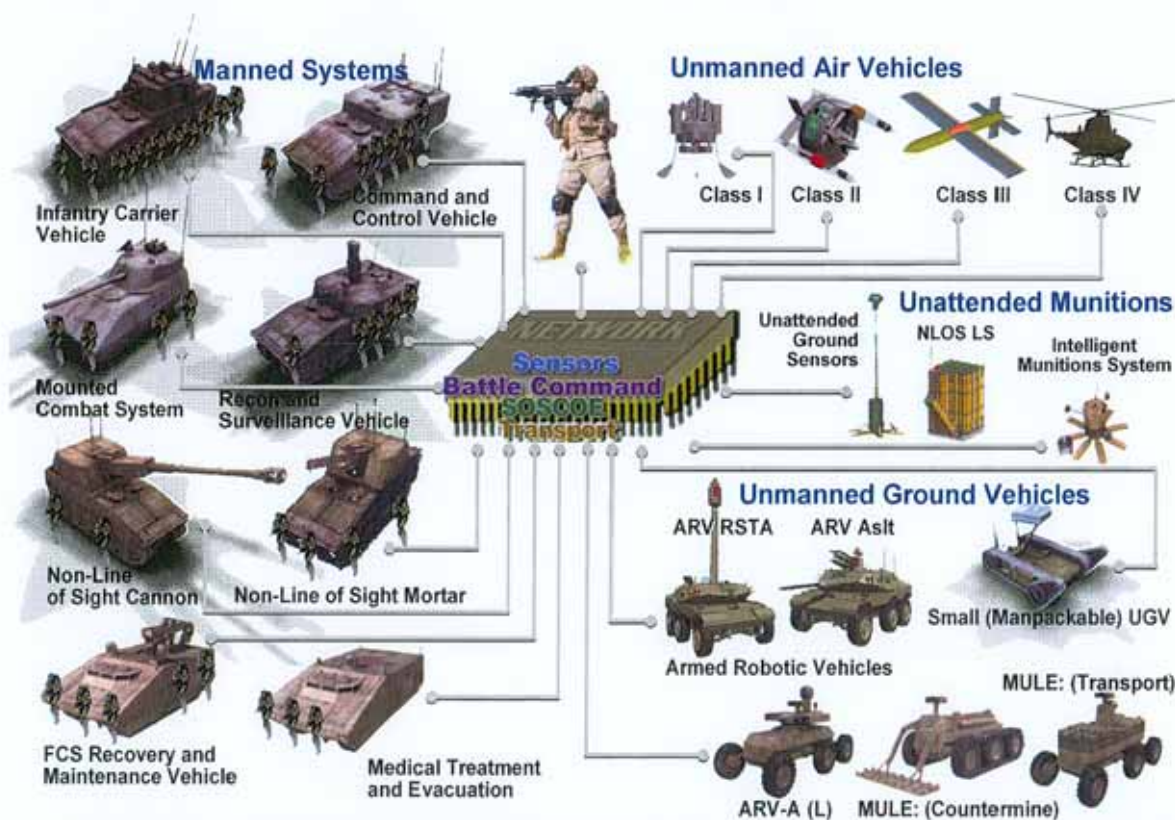
- **The vision of the FCS (BCT) Modeling, Simulation and Integration (MS&I) is to**
 - Support the Program Milestone C
 - Support the Program IOT&E
 - Produce a creditable integrated, mature requirements-based M&S execution environment
- **The maturing M&S environment, over the Program lifecycle, enables the execution of events as well as examination of issues, concerns, and activities across a broad set of domains that include, but are not limited to:**
 - Concept Development
 - Analysis
 - Testing
 - Evaluation
 - Experimentation
 - Engineering
 - Design
 - Virtual Prototyping
 - Manufacturing Development
 - Doctrine
 - TTPs
 - Logistics Development
 - Training
 - Military Operations
 - FCS Life Cycle Cost

Maturing Simulations and VV&A

- **For newly developed M&S, the V&V process begins as an integral part of the M&S software development process for maturing simulation products over the Program lifecycle**
 - It is imperative that the V&V process begins with the M&S development so as to capture the documentation of the maturing M&S, its capabilities, limitations, and its data over the Program lifecycle
- **In the case of legacy M&S, a V&V activity would be initiated for V&V of a modification and/or a specific intended use**
 - A set of core artifacts would be collected with the continued maturation of the legacy M&S and used to perform a V&V assessment and/or an accreditation decision
- **In both the newly developed M&S and legacy M&S cases, where insufficient artifacts are available, the V&V assessment will leverage expert opinion and identify any risk associated with use of the M&S, at its varying levels of maturity, for a specific intended use, along with its maturing capabilities and limitations**

Summary

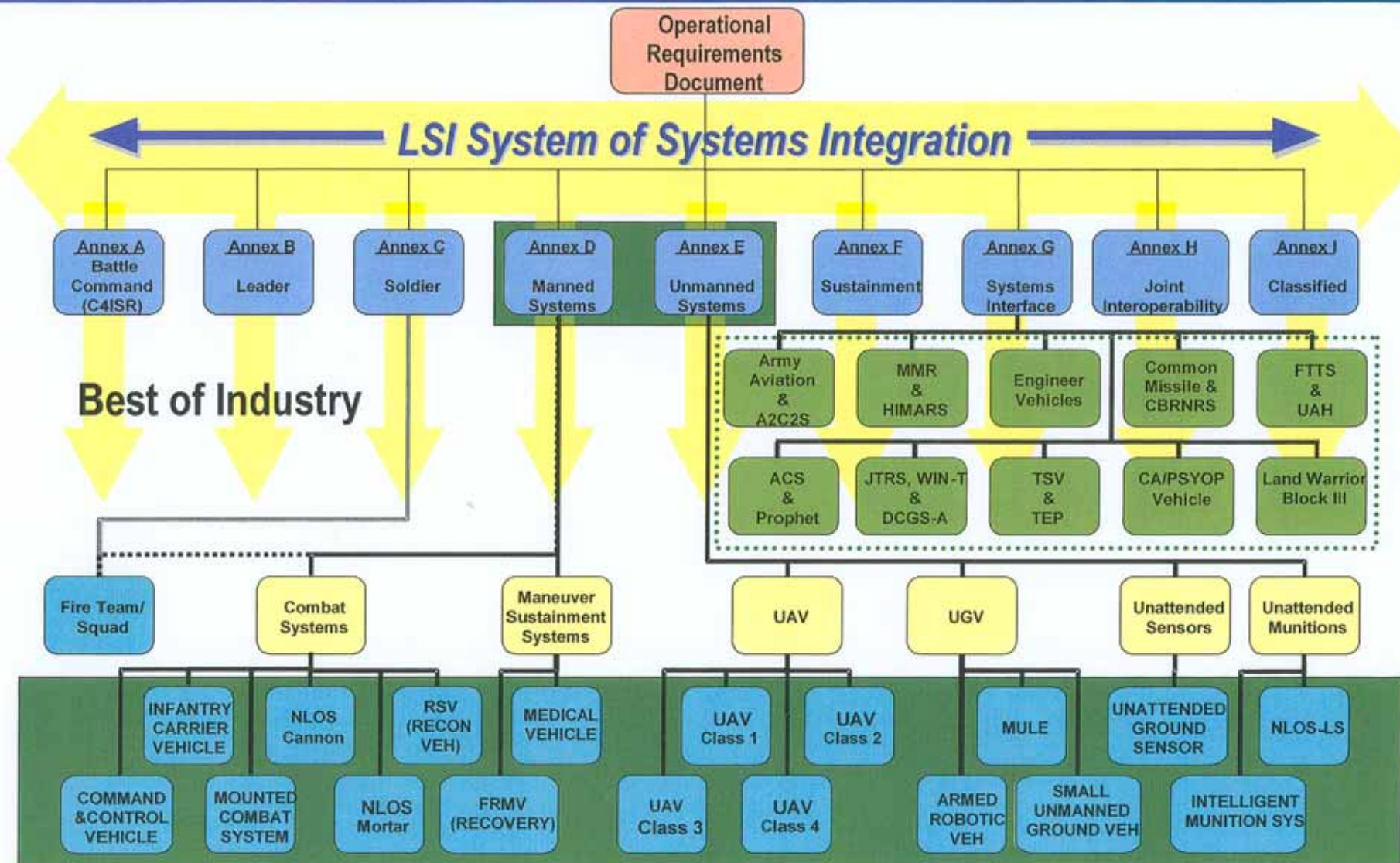
- The detailed FCS models & simulations will evolve over time as they are matured through four IPs of iterative (incremental, spiral) system development, demonstration, risk management, and User feedback



Approved for Public Release, Distribution Unlimited, TACOM 21 November 2006, case 06-273.

Q&A

FCS BCT SoS Approach



Integrated Mission Test 0 Environment



Approved for Public Release, Distribution Unlimited, TACOM 21 November 2006, case 06-273.

Acronyms

AO	Analysis Objective
BLUF	Bottom Line Up Front
BCT	Brigade Combat Team
FCS	Future Combat Systems
FEDEP	Federation Development & Execution Plan
IMT	Integrated Mission Test
IP	Integration Phase
LSI	Lead System Integrator
MS&I	Models, Simulations and Integration
M&S	Models & Simulations
S2F	System of Systems Simulation Framework
SBA	Simulation Based Acquisition
SMART	Simulation and Modeling for Acquisition, Requirements and Training
TTP	Tactics, Techniques, and Procedures
VV&A	Verification, Validation and Accreditation