SBA Yesterday & Today:
Current View of SBA in Advanced Systems Engineering and System-of-Systems Environment

Dr. Judith Dahmann
• SBA concepts have been a topic of interest for several years
  – Where are we in implementing these concepts in today’s systems acquisitions?

• Growing emphasis on Network Centric Warfare, Coalition Operation and Systems of Systems
  – How do SBA concepts support tomorrow’s acquisition environments?
“A concept which envisions greater and more integrated use of modeling and simulation in the acquisition process. DoD and industry would be enabled by robust, collaborative use of simulation technology that is integrated across acquisition programs and phases.”

November 1998
Origins
Need for More Cost Effective Acquisition Process

• Declining defense budgets and changing force structure
  – Modernization/Transformation versus Recapitalization
  – 1995 Vice President’s National Performance Review (NPR) -- 25% reduction in delivery time for new systems
  – Department of Defense (DoD) stretch of NPR goal to 50% reduction, plus reduction in Total Ownership Costs

• Cost-performance consideration allow routine use of advanced IT, modeling and simulation tools
  – Defense Systems Affordability Council recognizes M&S potential
SBA Benefits Risk Reduction

- Continuous evaluation of system development
- Rapid evaluation of concept design
- Reduce and delay need for physical prototype
- Facilitate continuous user participation in development process
- Efficient development/evaluation of manufacturing plans
- Reuse of system software and hardware in training simulators

M&S Use in the Army Acquisition Process, Dr Herbert K. Fallin, Jr; 1997
Original Goals

• Substantially **reduce the time, resources and risk** associated with the entire acquisition process

• **Increase the quality, military worth and supportability** of fielded systems, while **reducing** their **total ownership costs throughout the total life cycle**

• Enable Integrated Product and Process Development (IPPD) **across the entire acquisition life cycle**.
1998 SBA Roadmap

- Joint SBA task force, including government and industry, identified cultural, process, and technical elements.
- Identified actions needed to implement new approach to systems acquisition efficiently, expeditiously, and non-intrusively.
Key Ideas

• **Shared system or product description**
  – a shared, definitive source of data describing the system which evolves as the system matures and serves as a common reference for multiple disciplines through system development life cycle

• **Multiple concurrent views and assessments of the system**
  – based on shared system descriptive data allowing for consideration of more options, and their implications, at each stage of the development and acquisition process

• **Early and continuous use of simulation**
  – in lieu of hardware prototyping and live test; by representing as many aspects of a systems in simulation for as long as possible, reducing costs of development

• **Common tools**
  – employed at different stages of the acquisition process and reuse of tools (including simulations) which have been used by others, reducing cost and time and increasing credibility since each user doesn't have to do all the tool development for themselves
Joint Strike Fighter
DDXX

- Geometric Data
- Non-geometric Data
- Analysis Results
- Behavioral Data

- Wargame models (e.g., MARS)
- Hardware in the loop
- Other models

- Engineering analysis models (e.g., ASAP, RTS)
- Embedded SW
- MARVEDS

- Physical models & tests
Army Future Combat System

FCS Advanced Collaborative Environment

Government Led Future Combat Collaborative Environment (FCCE)
- Test, Evaluation, Analysis, Experimentation, Demonstration
- Develop/refine/illuminate concepts, doctrine, TTP
- View operational & force effectiveness parameters
- Training

LSI Led Design/Engineering/Manufacturing Collaborative Environment (DEMCE)
- Computer Aided Systems Engineering
- Computer Aided Design
- Computer Aided Manufacturing
- Virtual System Assessment
- Visualization
- Design/Engineering Review

FCS Distributed Product Description (DPD)

FCS Army/Industry Resource Repository (FAIRR)
- Blue System Data/Models
- Red System Data/Models
- Scenario Databases
- Environment Databases
- Archived M&S

Management and Collaborative Tools

Other Users (Army, Navy, Air Force, Joint, etc.)
Technology Adoption Life Cycle

Where are we today?

Innovators
Early Adopters
Early Majority
Late Majority
Laggards

Boeing 777? DDXX? JSF? FCS?
SBA Roadmap?

...probably further to the left than we would like to think.....
Progress has been made
• **Programs/Services** are creating the systems engineering environments for their specific applications
• **Industry** investing for their own competitive advantage

However….
• Limited attention to system-wide issues
• Ongoing developments will not ‘work together’ across systems throughout the lifecycle to create the needed leverage
• Many needed components are available from ongoing efforts, but these are not designed to be reused, there is duplication of efforts and there are missing elements
‘System of Systems’ Pose New Challenges

• Systems of systems pose new challenges
  – For operations
  – …. and for development
• To address these challenges, common environments which can be used across systems are needed
• In each of the Services, and at the DOD level, new initiatives are being created to address the SOS development issues
• These new initiatives provide broader and more extensible advanced systems engineering environments to support future system development
Air Force Joint Synthetic Battlespace

**Today:**
Unable to Fully Understand Operational Impacts in a Heavily Vegetated Environment

---Camouflage, Hyper-spectral, ...

**Future:**
Able to Understand Operational Impacts in all Environments

**Today:**
Unable to Fully Understand System of Systems and Environmental Impacts

**Future:**
Simulations Readily Available to Assess System Complexities

**A Common Architecture That:**
- Represents the Natural Environment Realistically
- Physics Based Sensor Models
- Allows Integration of Legacy Simulations
Army Joint Virtual Battlespace

SMART
(Simulation & Modeling for Acquisition, Requirements and Training)...
...Tool To Support The Objective Force and Future Combat System

JVB Design Includes:
- Joint Forces
- Legacy Forces
- Objective Force
- Future Combat Systems
  - C3
  - ISR
  - Robots
  - New Weapons
- Dynamic Weather
- Dynamic Terrain
- High Fidelity Terrain
- Certified Data
Joint Distributed Engineering Plant

- JDEP will build interoperable forces by providing a tool for
  - Developers to engineer interoperability into their systems
  - Testers to test and evaluate interoperability among systems
  - War fighters to assess operational capabilities of forces

- Single Integrated Air Picture (SIAP) Systems Engineer
  - Pilot development of systems of systems engineering environment for the DOD
Interoperable Systems of Systems Require Interoperable Development Environments

As with interoperable war fighting capabilities, Service and Joint development capabilities must work together to create the needed system of systems development and engineering environment.
Challenges

• Challenges of advanced systems of systems engineering environments **parallel** those of interoperable operational systems of systems

• **Cooperation** among Services and DOD communities to create need components

• Need ways to continue to identify and address **technical and policy** areas
  – Key interfaces and common standards
  – Opportunities for shared developments
  – Building components for reuse and sharing
  – Routine application of shared engineering capabilities throughout the system of systems life cycle
Simulation-supported system of system engineering environments will develop hand-in-hand with mission area capabilities.
Summary

- Concepts of **simulation support to acquisition and development** are key to advanced engineering environments
- Early emphasis on individual systems and improved efficiency
- Future direction toward enabling **systems of systems** development, test and war fighter assessment
- Interoperable systems of systems to support joint war fighting requires shared **system of system engineering environments**