I/ITSEC 2000 Panel on Economics of Modeling & Simulation

“M&S Business and SBA at Boeing”

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M&S Business Case Today at Boeing

• M&S is integral part of Engineering & Manufacturing Process

• M&S is used as competitive discriminant and is a core competency

• Focused to make it broad based, standardized, efficient, and cost effective

• Already doing much of SBA Enablers
Core Competencies;
Boeing Vision 2016

• **Detailed Customer Knowledge & Focus**
  • _______________________________________
  • _______________________________________
  • _______________________________________

• **Large Scale System Integration**
  • _______________________________________
  • _______________________________________
  • _______________________________________
  • _______________________________________

• **Lean Efficient Design and Production System**
  • _______________________________________
  • _______________________________________

• **Modeling & Simulation/Simulation Based Acquisition**
  • _______________________________________
ISG’s SBA Enablers

• Policy, process and organizational changes
• Models, simulations and other tools
• Standards and means for information exchange
• Ensuring authoritative representation
  • Managing collaboration and multi-domain optimization
• Means to identify, obtain and yet protect reusable resources
• Education and motivation
• Business case
  ✓ SBA M&S economic issues
Policy, Process and Organizational Changes

- Integrated many disparate tools activities into common Phantom Works Thrust
  - Lean & Efficient Design Tools & Processes
  - Charter for common tools & process for product concept development, design, & manufacturing
  - Spending 25% of PW investment dollars
  - Focal for NASA ISE Initiative
- Established a M&S Thrust
- Organizing contracted programs with strong and elevated Modeling & Simulation IPT’s that look across the program, e.g., UCAV, FCS, JSF
- Writing M&S and SBA plans for the new programs, e.g., JSF, NMD, FCS
- Modeling & Simulation organization in PW
• Extensive and wide spread use of models and simulations in all disciplines, i.e., several hundreds of models

• Extensive investment in tools and tool infrastructure for automation of design and manufacturing, i.e., CAD CAM
  • CATIA
  • ENOVIA
Standards and Means for Information Exchange

- Broad use of singular COTS products
- Heavy participation in STEP protocol development (data exchange for CAD CAM data)
- Heavy use of DIS, now HLA, for simulation data exchange
- Singling up on common home grown models across the company
  - Sharing with customers
- Transferring ownership to government
Ensuring Authoritative Representation

- Adopting and applying DMSO V,V,&A Recommended Best Practices Guide
- Documentation of V,V,&A database
- Goal to get M&S development organizations up the SEI CMM levels
- Reducing size of model repository to best in class
  - 50% reduction in number of tools/models
- Wider spread of model use
- Strong integration of test, manufactured prototypes, etc. back into models on new programs, e.g., JSF
Managing Collaboration and Multi-Domain Optimization

• Use of JSF Full-Mission Simulation (Pilot-in-the-Loop) for requirements, engineering & training

✓ • Investing in distributed real-time and constructive simulation
  • Theater Sim project

✓ • Investing in Systems of Systems evaluation facility, Boeing Integration Center
  • Modeling & Simulation
  • Information & Communication Systems
  • Product Development and Testing
  • Systems Integration
  • Focus on C2 and Battle Management for Systems of Systems
Theater Simulation Concept

PHANTOM WORKS

Engagement, Theater & Force Structure Models

- Value of C4ISR, Battle Mgm
- Benefits of New Systems - UCAV, etc.

Virtual Simulation and HWIL Facilities

- Detailed System Performance
- CONOPS, Joint Ops

HLA
Theater Simulation

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Objective

• Design, develop and implement an enduring enterprise-wide theater simulation capability

• Focus on developing an affordable, available, and responsive capability; leveraging existing Boeing assets; and aligning with future government efforts in virtual, constructive, and distributed simulation

• Utilize common processes and interface standards

• Support both a simulation development environment and evaluation/analysis of new systems with variable fidelity representations, superior visualization/data presentation, and operator-in-the-loop/hardware-in-the-loop capability

Technical Approach

• Leverage existing assets, distributed across the enterprise, grow to include HWIL

• Build network of virtual simulations using standardized interfaces/protocols - focus on CMD

• Build federation of constructive models selected from best available - focus on space control issues

• Align with government model selection

Deliverables

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<th>Development Plan</th>
<th>Virtual Network</th>
<th>Constructive Federation</th>
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Schedule
Boeing Integration Center

- 11,000 square foot facility located in Anaheim, CA
  - Configured as multiple secure facilities, within a secure perimeter
  - State-of-the-art 3 screen theater
- World-wide Connectivity and Bandwidth on Demand
  - 1Gb internal fiber-optic Ethernet
  - All major communications protocols supported (ATM, Ethernet, Internet, VOIP)
  - 8 dedicated point-to-point T1 connection ports
- Tools for
  - Stimulation
  - Plug-n-Play Integration/Interfacing
  - Visualization
The BIC Network Harnesses SoS Capabilities

- Anaheim (BIC)
- Battle Mgmt/H-I-L C2
- Info Architectures
- Comm’l Networks
- Seattle ITDL (JSF, F-22, AWACS, etc.)
- St. Louis VWC (UCAV F-15, F-18, etc.)
- Seal Beach SAL-W
- Launch Systems
- Satellite Systems
- Huntsville SIL
- NMD / TAMD
- DoD Battle Labs
- Customers / Users
- International Partners
- Suppliers & Vendors
Systems of Systems Proving Ground
Ready
Means to Identify, Obtain, and Protect Reusable Resources

- Extensive use of government models in concept phase of life cycle
- Strong support for Services to single up on mission environment models
  - JIMM for SWEG/SUPPRESSOR
  - JIMM integrated with DIADS
- Strong support for expansion into HLA Federations
- Make available to government and industry Boeing developed models
  - MIL-AASPEM
  - AMASIM
- Strong emphasis on re-use of models and simulations through entire life cycle
  - NMD Test, Training, & Evaluation Capability (TTEC)
Business Case

• Use of modeling & simulation is going to increase on DoD & NASA programs independent of any SBA initiative
  • Cheaper than prototypes
  • Complexity of products
  • Systems of systems interactions/dependencies/netcentric warfare
  • Computing capability cheaper and more capable

• Boeing looked on as a industry leader in modeling and simulation, i.e., 777, JSF, NMD
  • Trying to exploit modeling & simulation as a discriminant
  ✓ Heavily funding streamlined, computer based, product life cycle process and tools

The Business Case for SBA today is the Business Case for expanding use of models, simulations, and tools inside.
Summary M&S Economic Issues in SBA Paradigm

• SBA has possibility to drive towards more of a commercial investment business model for DoD
  • How much M&S investment will be required to market users?
  • How to incentivize industry to invest more to reduce product recurring cost so as to sell more units?
• SBA calls for open sharing and re-use of models, tools, etc. across industries and DoD programs
  • What can be the economic mechanisms to encourage this behavior?
  • Who provides reusable models to established DoD programs?
  • Who maintains models, etc.?
• How to accomplish across all DoD programs when we have independent Service procurement authority today?
Summary

• Boeing making significant M&S investments across the entire life cycle
• Models and data essentially capture majority of corporate product knowledge
• Boeing want to leverage those investments to increase business in our product lines
• Major current issues
  • How to invest wisely and efficiently in M&S with limited investment dollars and large sunk costs in 3 different companies
  • How to best organize and utilize M&S professionals
One Last Thought on Economics of M&S

• Read “Serious Play - How the World’s Best Companies Simulate to Innovate” by Michael Schrage

• His 10 Rules of Good Use of M&S
  1. Figure out who stands to benefit from model results
  2. Decide metrics output of model and measure rigorously
  3. Fail early and often using cheap models in the design process
  4. Manage diverse modeling approaches/ mediums
  5. Have a migration path of the models to the product
  6. Use models as a means for innovation & creativity by bosses, clients, and supplier
  7. Create markets around the models to help subsidize the process of innovation
  8. Encourage role playing using the model/simulation
  9. Determine the points of diminishing returns
  10. Record and review the process relentlessly and vigorously