Virtual Battlespace Center

Advanced M&S to Inform
OSD Acquisition Decisions

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- **Modeling and Simulation in the VBC**

- **Protecting Business-Sensitive Information**

- **Organization Options**

- **Influence on Other M&S**

- **DSB Task Force Study**

Observations

1. Acquiring capabilities is a huge challenge

- **Expanded trade space = dramatic increase in complexity**
  - Many more entities, variables, interactions, etc.
  - Development enterprises become vast, distributed
  - Many more stakeholders, with much at stake

- **Need systems engineering above individual system level**
  - Complexity precludes intuitive design and analysis
  - Program to program negotiations impractical

- **Need to assess capabilities, not just individual systems**
  - Many more forces & systems, bigger battlespace, more events
  - Scarcity of equipment constrains lab integration & live tests
  - Range size, security needs, and safety also limit live testing
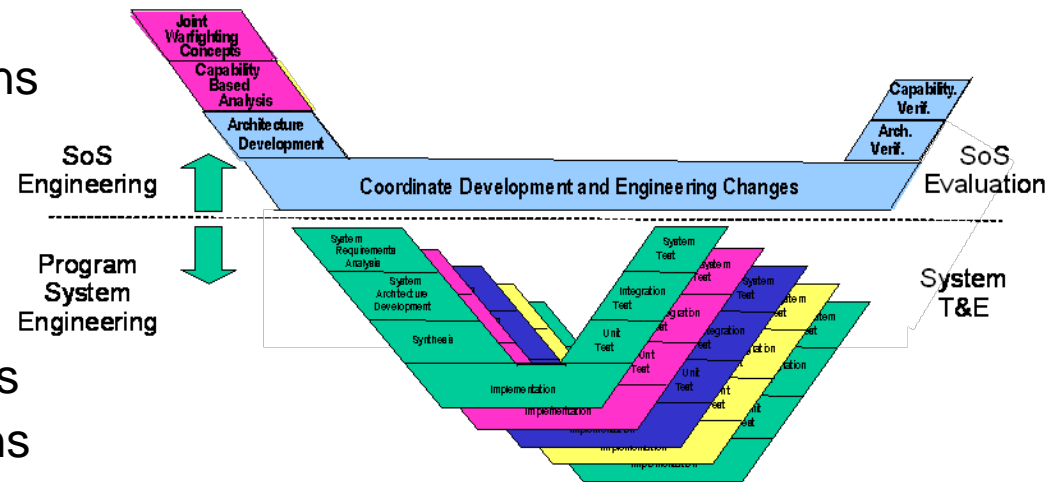
2. **M&S can improve the design, integration, test, and assessment of capabilities and systems of systems**

- **Earlier, more accurate designs and assessments of designs, lowering risk**
- **Accurately track complex relationships and micro-level interactions; present macro-level measures of merit to decision makers**
- **Defendable analytical underpinning for decisions**
- **Several SoS efforts (e.g., JSSEO, FCS) provide glimpses of M&S benefits**

3. **DoD prime contractors have built joint battlespace simulations to help develop new warfighting capability/system concepts and to collaborate with their government customers & industry partners**

- **But these virtual battlespaces are neither authoritative nor coherent**
  - Representations of blue systems they don't build aren't authoritative
  - They have different conceptual models of the battlespace and standards
- **Thus many of their intended benefits are negated**
  - Inaccuracies can lead to bad business decisions
  - Government customers question their credibility
  - Collaboration with partners is hampered by incoherent representations

Observations

4. **The Services also have various SoS simulation efforts to support their system development activities, such as:**

- **Army's Cross-Command Collaboration Effort (3CE) and Modeling Architecture for Technology, Research and Experimentation (MATREX) Distributed Virtual Laboratory (DVL)**

- **Air Force Integrated Collaborative Environment (AF-ICE)**

5. **OSD has no equivalent virtual battlespace…**

- **to provide independent assessments of system concepts and designs**

- **to plan and evaluate how individual systems function in a SoS**

- **to assess capabilities as proposed and as evolutionary changes to a SoS occur**

6. **Hence corporate decisions are not as informed as they could be**

Virtual Battlespace Center Concept

- **Primary mission: <u>Support OSD's corporate-level acquisition responsibilities with advanced M&S</u>**
  - A persistent environment in which all DoD-level capability/ system of systems (SoS) design and analysis is conducted
  - A means to refine concepts and define requirements for both capabilities and individual systems
  - An objective view of how systems interoperate and perform

- **Secondary mission: Support analysis of DoD investment decisions and operational plans**

- **VBC will have the most credible representations of every system, force, and activity in the battlespace**

- **To do so, VBC must provide security for business-sensitive information**

VBC Modeling and Simulation

- **A wide range of M&S will be used in the VBC**
  - **Architecture modeling**
    - Design SoS topology, allocate functions, check completeness & efficiency
    - Using SE tools like System Architect, Core, Cradle
  - **Concept assessment modeling**
    - Comprehensive view of the entire trade-space to assess design decision impacts on key performance parameters (KPPs)
    - E.g., Georgia Tech's Collaborative Visualization Environment (CoVE)
  - **Distributed simulation**
    - Any mix of live, virtual, and constructive (LVC) simulation; much constructive simulation will be other than real-time
    - Multiple standard federations will provide an 80% solution
  - **Recursive levels of granularity for models, simulations, and federations**
    - Based on hierarchically-integrated conceptual models (common in engineering, but thus far quite uncommon in M&S)
  - **Other M&S TBD**

Why Won't JMETC Suffice?

- **Joint Mission Environment Test Capability provides distributed simulation for operational testing of systems**
  - Managed by the Testing in a Joint Environment Senior Steering Group
- **Provides a sub-set of M&S capabilities needed by VBC**
  - Doesn't include architecture modeling or concept assessment modeling
  - Distributed simulation is limited to real-time (TENA-based)
  - Is focused on a single level of granularity (platform level)
  - Won't adequately protect business-sensitive information
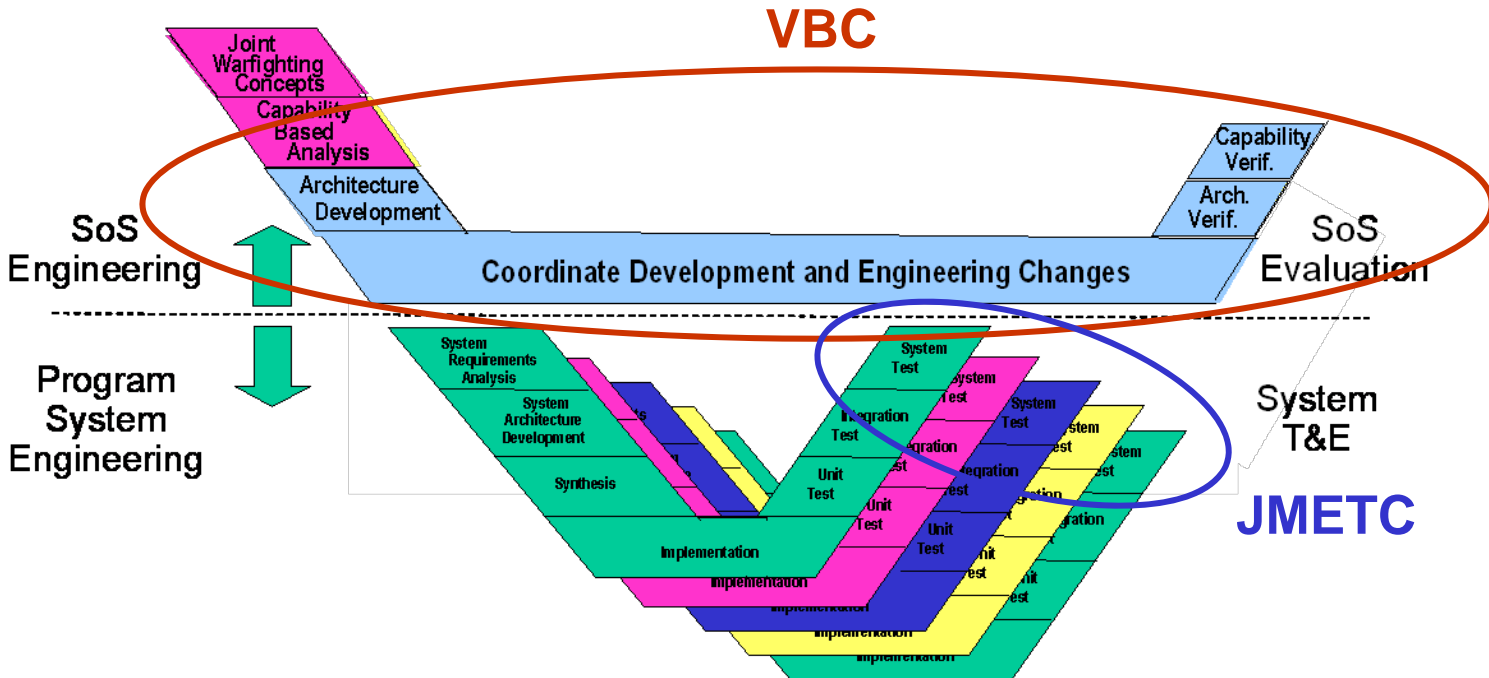
Need for Trustworthy Representations

- **Corporate-level decisions arising from VBC analyses will determine:**
  - **what individual systems are procured or modernized;**
  - **the functional capabilities & interfaces each system must have;**
  - **the standards to which those systems must conform;**
  - **the schedule on which they must be developed or evolved; and**
  - **indirectly, the funding allocated to each**

- **The risk of an erroneous representation leading to an incorrect decision must be minimized**
  - **Decisions will be challenged unless the VBC representations and associated analyses are above reproach**

- **VBC must have credible, trustworthy representations**
  - **System data & algorithms must be traceable back to the most credible sources**

- **Program offices & their contractors should be tasked to supply validated representations of their systems**
  - **Requirements for these must first be carefully and unambiguously defined by the VBC**

Protecting Business-Sensitive Information

- **To get trustworthy representations, business sensitive information (e.g., intellectual property, programmatic info) must be protected**
  - **Contractors fear compromising IP, undermining business opportunities**
  - **Program offices are concerned their program or reputation will be harmed**
  - **VBC must assure representation resource owners that misuse or compromise will not occur**

- **Distributed simulation technology provides some protection of sensitive information via encapsulation, but it can still be compromised by repeated observation of a system's behaviors**
  - **For instance, multi-sensor integration logic can be inferred from responses to various patterns of sensor inputs**

- **To prevent industrial espionage, VBC will have to tightly control access to its M&S representations**
  - **VBC personnel will operate the models and simulations, or**
  - **Other simulation owners participating in a distributed simulation will do so under non-disclosure agreements, with tightly limited data collection**

Organization Options

- **Capability/SoS management may be instituted under an evolved portfolio management concept or other organizational structure**
  - **VBC would support whatever organization emerges**

- **Candidate organizations to run the VBC include:**
  - **Existing OUSD(AT&L) office**
  - **Defense agency or field activity, either existing or new**
  - **System command of a DoD Component (objectivity concerns)**
  - **FFRDC or UARC**
  - **Contractor recused from any other system acquisition work**
  - **Fire-walled division of a contractor (objectivity concerns)**

- **Selection will require further study**

Impact on Other M&S

- **System assessment in the VBC would be a capstone event**
  - The system's performance and contribution to a desired DoD functional capability will be evaluated and its fate decided

- **System owners will want their own virtual battlespace to be as close as possible to the VBC's, so standards used in the VBC will foster alignment by the rest of acquisition M&S**
  - Architectures, battlespace conceptual models, & FOMs can be matched
  - Government-owned, non-IP data used in VBC (e.g., scenarios, threats, natural environment) can be shared under CRADAS
  - "One-off versions" of owner-provided representations could be shared using abstraction means (e.g., neural nets, response surface equations)
  - VV&A practices to ensure the trustworthiness of VBC representations will foster more diligent VV&A in other virtual battlespaces

- **Interoperability, reuse, and rapid, cost-effective composition of distributed simulation federations will all be enhanced**
  - As a side benefit, we'll achieve effective DoD M&S governance
  - Benefiting DoD's mission, our warfighters, and the nation

Next Step: DSB Task Force Study

- **A Defense Science Board Task Force is about to be convened to…**
    - **examine and refine the Virtual Battlespace Center concept**
    - **consider capability management approaches**
    - **develop a VBC concept of operations**
    - **identify and prioritize candidate M&S capabilities**
    - **recommend an organization to manage the VBC**
    - **verify or refute the VBC benefits asserted here**

- **Dr. Anita Jones and Dr. Ron Sega, both former DDR&E's, will co-chair**

- **If the DSB TF makes a positive recommendation, this will set the stage for a VBC initiative under the next administration**