

Virtual Battlespace Center for Systems Engineering

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Outline

- **Virtual Battlespace Center Concept**
- **Challenge of Acquiring Capabilities**
- **VBC Modeling and Simulation**
- **Security Considerations**
- **Organization Options**
- **Influence on Other M&S**
- **Role of SISO**
- **Conclusion**

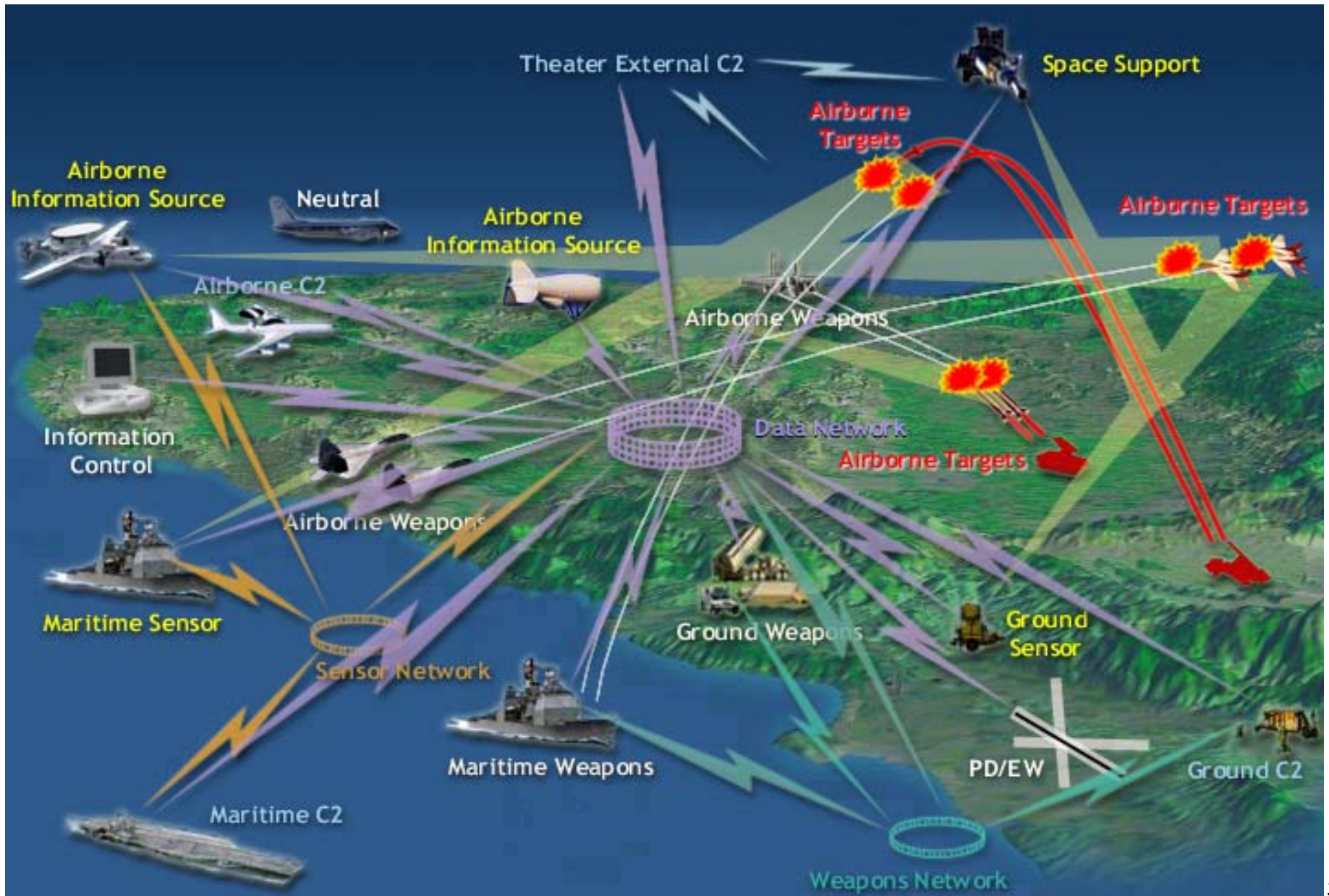
Virtual Battlespace Center Concept

- **“Virtual” = essence or effect of something, not the fact**
 - VBC will use models & all types of simulations (L,V,&C)
- **Primary mission: Support DoD corporate-level systems engineering responsibilities with advanced M&S**
 - A persistent environment in which all DoD-level system of systems (SoS) design and analysis is conducted
- **Secondary mission: Support analysis of DoD investment decisions and operational planning**
- **Most credible representations of every system, force, and activity in the battlespace**
- **Security for classified info and intellectual property (IP)**

Challenge of Acquiring Capabilities

- **DoD policy (CJCSI 3170.01, DoDD 5000.1, DODI 5000.2) calls for acquisition of functional capabilities**
 - Versus traditional orientation toward individual weapon systems (e.g., tanks, aircraft, ships)
 - Policy implementation has not yet been fully accomplished
- **Components of Functional Capability = DOTMLPF**
 - **Doctrine**
 - **Organization**
 - **Training**
 - **Materiel (usually systems of systems)**
 - **Leadership and education**
 - **Personnel**
 - **Facilities**

System of Systems Example



Challenge of Acquiring Capabilities

- **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 real equipment constrains lab integration & live tests
 - Range size, security needs, and safety also limit live testing

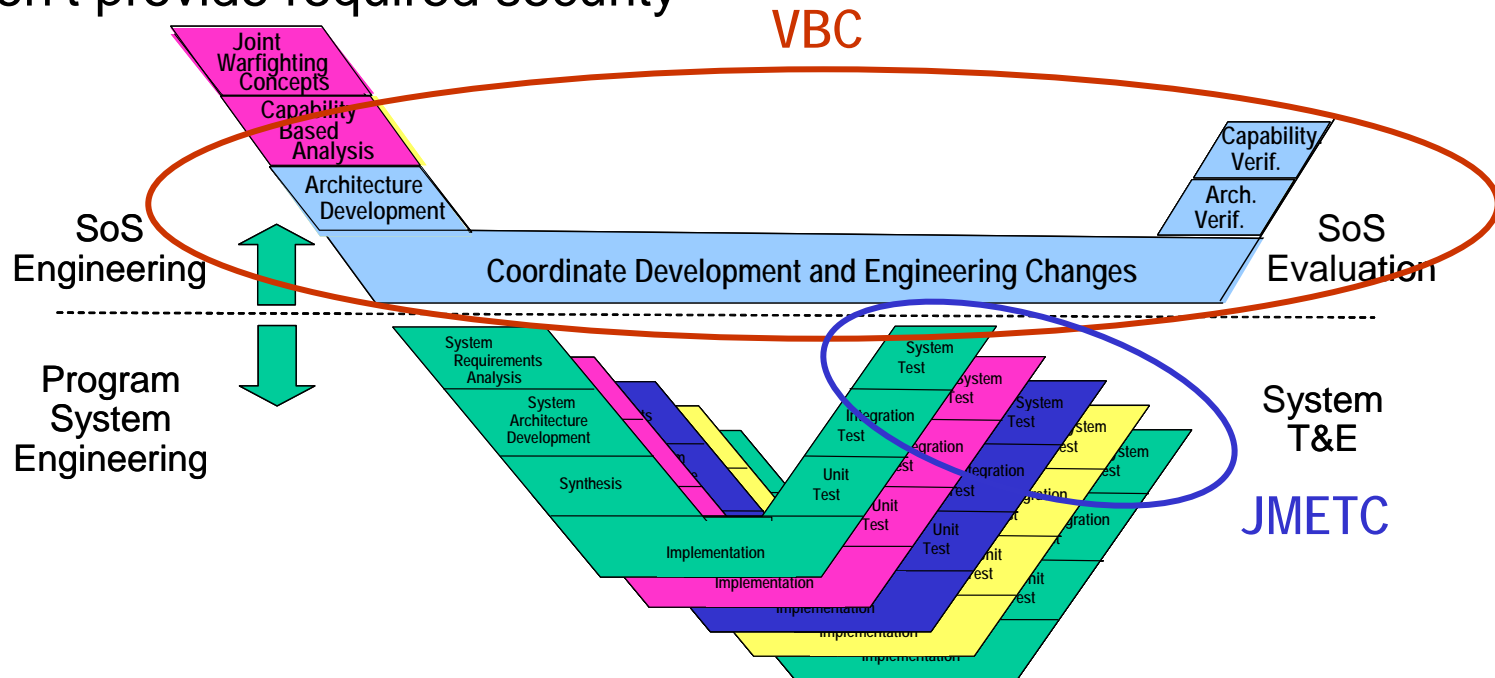
VBC Modeling and Simulation

- **M&S can improve design, integration, test, & assessment**
 - Accurately track complex relationships and micro-level interactions; present macro-level measures of merit to decision makers
 - Earlier, more accurate understanding of design, lowering risk
 - Defendable analytical underpinning for decisions
- **A wide range of M&S will be used in the VBC**
 - Architecture modeling
 - Design SoS topology, allocate functions, check efficiency, etc.
 - Concept assessment modeling
 - Comprehensive view of the entire trade-space to assess design decisions on key performance parameters (KPPs)
 - E.g., Georgia Tech's Collaborative Visualization Environment (CoVE)
 - Distributed simulation
 - Any mix of LVC; both real-time and other than real-time
 - Multiple standard federations will provide an 80% solution
 - Recursive levels of granularity for models, simulations, and federations
 - Hierarchically-integrated conceptual models
 - Common in engineering, but thus far quite uncommon in M&S

VBC Modeling and Simulation

Why Won't JMETC Suffice?

- **Joint Mission Environment Test Capability provides distributed simulation for operational testing of systems**
 - Managed by “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
 - TENA-based, so only supports real-time distributed simulation
 - Is focused on a single level of granularity
 - Won't provide required security



VBC Modeling and Simulation

Trustworthy Representations

- **The corporate-level systems engineering decisions arising from VBC analyses will determine:**
 - what individual systems are procured or modernized;
 - the functional capabilities 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 and algorithms must be traceable back to the most credible sources
- **Program offices & their contractors will be tasked to supply validated representations of their systems**

Security Considerations (1 of 2)

- **Classified national security information will be protected per standard DoD policies**
- **Business sensitive information (intellectual property, performance and programmatic info) is more troublesome**
- **Program offices and prime contractors regularly lament the difficulty of obtaining trustworthy data, models, and simulations to represent friendly (“blue”) systems**
 - **Owning contractors fear compromising their IP, undermining future business opportunities**
 - **Owning program offices are concerned their program or reputation will be harmed**
- **VBC must assure representation resource owners that misuse or compromise (further distribution) will not occur**

Security Considerations (2 of 2)

- **Is it often asserted that distributed simulation protects proprietary/intellectual property, because the data and algorithms which control system representation are encapsulated within the simulation application**
- **However, sensitive information may be compromised by repeated observation of a system's external behaviors**
 - For instance, multi-sensor integration logic can be inferred from responses to certain patterns of sensor inputs
 - Other characteristics (e.g., radar scanning logic, ECM effectiveness) can also be reverse engineered this way
- **To prevent such industrial espionage, the VBC will have to tightly control all federates in a distributed simulation**
 - Any suitable live, virtual, or constructive simulation can still be used provided (a) VBC personnel can be trained to operate them, or (b) a credible non-disclosure agreement is in place and data collection meticulously limited

Organization Options

- **Portfolio Management initiative is important step towards establishing enterprise-level Capability Management**
- **VBC would support corporate-level systems engineering under that management structure**
- **Candidate organizations to run the VBC include:**
 - Existing OUSD(AT&L) office (e.g., Systems & Software Engr.)
 - Existing or new defense agency or field activity
 - System command of a DoD Component
 - FFRDC or UARC
 - Contractor recused from any system development
 - Fire-walled division of a contractor
 - Some mix of the above (e.g., a “national team”)
- **Selection will require further study**

Impact on Other M&S (1 of 2)

- **Defense contractors and Services are building their own virtual battlespace instances**
 - to develop new warfighting capability concepts
 - to collaborate with government customers & industry partners
- **Different conceptual models of the joint battlespace**
- **Different distributed simulation architectures**
- **Representations of blue systems they don't own aren't authoritative**
- **So the benefits of these virtual battlespaces are limited**
 - Inaccuracies can lead to bad business decisions
 - Government customers often question their credibility
 - Collaboration with industry partners is hampered by incoherent representations

Impact on Other M&S (2 of 2)

- **System assessment in the VBC would be an “Olympic event”**
 - Its performance, interoperability, and contribution to a desired DoD functional capability would be evaluated and its fate decided
- **System owners will want their own virtual battlespace to be as close as possible to the VBC environment, so standards used there 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**
 - benefiting DoD’s mission, our warfighters, and the nation

Role of SISO

- **SISO's distributed simulation standards have already played a major role in making the VBC concept practical**

Potential further contributions:

- **Evolution of IEEE 1516 series standards and inputs to the DoD's LVCAR by the LVC Architecture Study Group**
- **Forum for defining VBC conceptual models and Reference FOMs?**
- **Developing an approach for establishing hierarchically integrated families of models, simulations, and federations?**
- **Best practice for assessing the relative validity of the virtual battlespace representations?**
 - More-abstract to higher-resolution representations within the VBC
 - Less-authoritative representations in industry virtual battlespaces to the “gold-standard” representations in the VBC

Conclusion

- **VBC can powerfully affect DoD's ability to acquire functional capabilities**
 - Fills a critical gap at the capability/SoS engineering level
- **Will positively impact M&S across defense acquisition**
- **Many challenges lie ahead**
 - Refining, and building ownership for, the VBC concept
 - Defining organizational roles
 - Establishing a program of record, allocating required funds
 - Accomplishing necessary R&D
 - Standing up and employing the VBC
- **Potential benefits argue this effort is warranted**

Discussion

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- **Virtual Battlespace Center Concept**
- **Challenge of Acquiring Capabilities**
- **VBC Modeling and Simulation**
- **New Capability, Organizational Implications**
- **Necessity of Trustworthy Representations**
- **Security Considerations**
- **Organization Options**
- **Why Not JMETC?**
- **Influence on Other M&S Activities**
- **Role of SISO**

