ARMY SCIENCE BOARD
TRADOC ISSUES GROUP

AN EVALUATION OF TRADOC'S DEVELOPMENT OF THE C4I OPERATIONAL ARCHITECTURE

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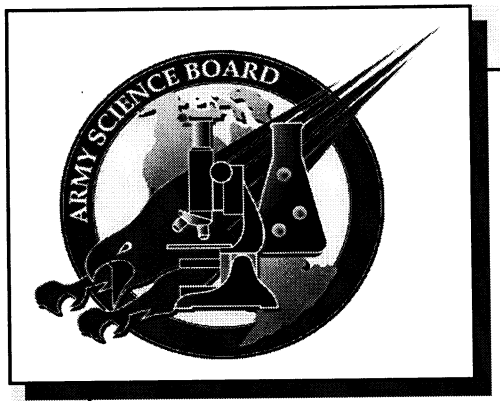
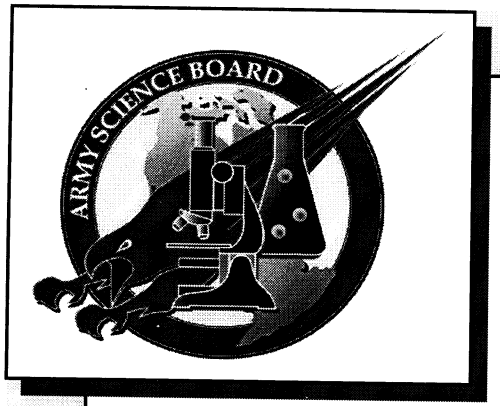


Topics to Be Covered

- Background
  - Terms of Reference
  - Rationale for Study and History
  - Membership and Other Participants
  - Agencies Visited or Individuals Interviewed
- Observations
- Findings
- Recommendations

Terms of Reference

- Review and assess the current OA and the ongoing TRADOC programs to define and develop specific OAs.
- In coordination with the Army Technical and Systems Architects, define the elements of the OA necessary to support Force XXI.
- Based on 1 and 2 above, *provide feedback on process to produce OAs and recommendation on what approach(es) to use.*
- *Identify value and uses of OA. Assess use of OA as an evaluation instrument for future Warfighting Experiments.*



Rationale and History

- The ASB Battle Labs Issue Group was first formed in 1994
- In the Fall of 1995, Dr. Dickinson as Chair recommended to CG TRADOC that title be changed to "TRADOC" Issue Group to represent giving it a broader scope
- General Hartzog concurred; he asked the group to focus on evaluating efforts to develop the C4I Operational Architecture
- Group began fact finding in November 1995 on status of Army Operational Architecture development
- Review of Operational Architecture Development aligns with other ASB efforts and expertise:
  - It extends ASB Work on Technical Architecture
  - ASB is advising Army leadership on numerous aspects of digitizing the battlefield

Members and Other Participants in TRADOC Issues Group

Issue Group Members

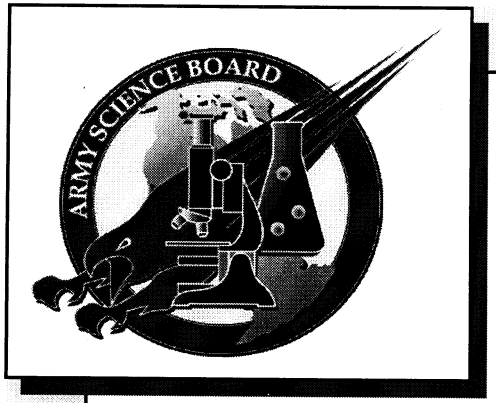
- Tom Mastaglio, Chair
- Irene Peden
- Harry O'Neil
- Jack Woodmansee
- Gershon Weltman
- Walter Laberge
- Phil Dickinson
- Fred Hartman

Other Participants

- Paul Berenson, TRADOC Science Advisor
- Doug Poynter, Staff Assistant to ASB Issue Group
- Tom Douthitt, CAC
- COL Bob Lossius, CAC
- John Pijanowski, DCSOPS
- Roger Carter, Air Force Scientific Advisory Board
- COL Ed Steele, TRADOC DCSCD

Agencies & Individuals Interviewed

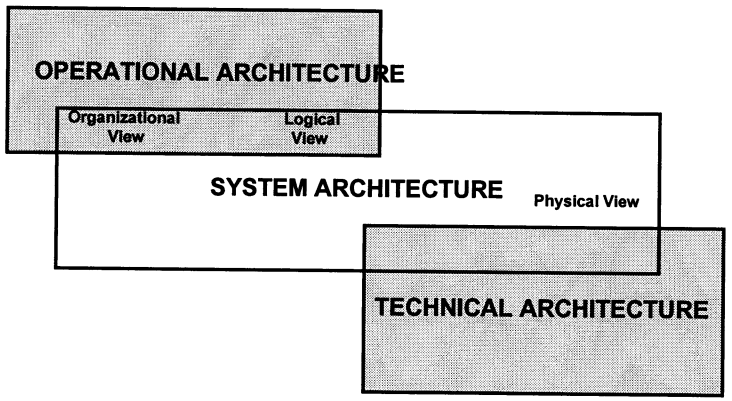
- Army Digitization Office
- DCSOPS-FD
- DCSINT
- DISC4
- PEO-C3S
- CECOM Army Engineer Office
- TPIO-ABCS
- DUSA (OR) - Vern Bettencourt
- OPTEC
- Perot Systems
- J7
- Army Audit Agency
- JWFC
- JTASC
- Air Force Air Combat Command
- DCSCD TRADOC



OBSERVATIONS

OA Is Key to Modeling Army Enterprises

- An Operational Architecture captures the requirements of an information system

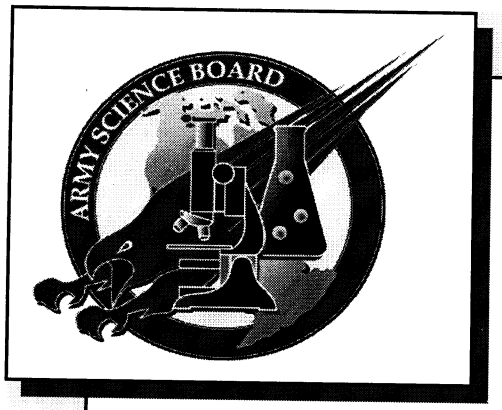


- The Army Enterprise Implementation Plan tasked the DISC4 to use TRADOC as proponent for C4I OA.
- The need for a C4I Operational Architecture is generally accepted

The C4I OA Is the Business Process Model for Army Command and Control

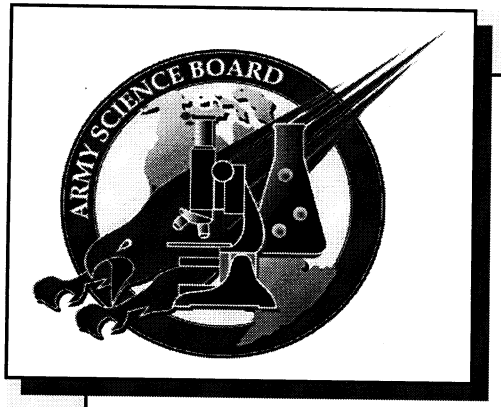
- The OA is essential for capturing requirements and understanding how operational elements will exchange information
- Defining/building an OA is *business process reengineering* (BPR)
- The DoD standard for process and data modeling is IDEF
- TRADOC needs personnel with expertise in BPR and IDEF
- Problem of modeling command and control may not be tractable using a bottoms-up analytic approach

  these are complex system supporting complex processes

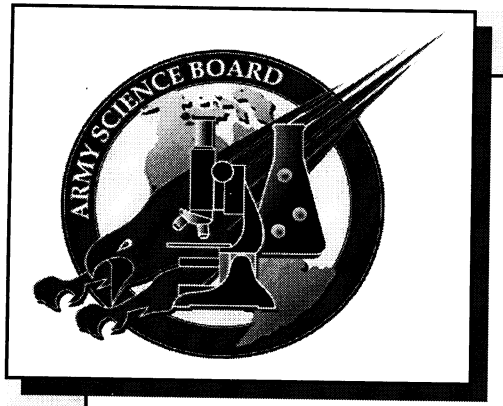


The OA Effort to Date Has Been Limited

- OA modeling efforts have focused on the MRC scenario assuming full support from all combat systems
- OA development for the Force XXI enterprise architecture is only 15% of the its total cost; only part of that has been approved
- OA Process being worked by TRADOC appears to be perpetually stuck in the "getting started" phase due to resource churn
- Effort to develop OA lack a top down perspective
- Tendency has been to "farm out" the "thinking" piece of OA

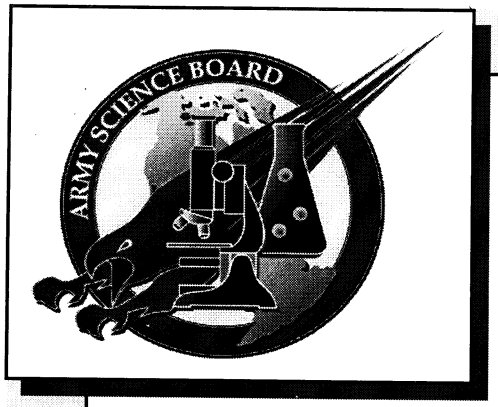


FINDINGS



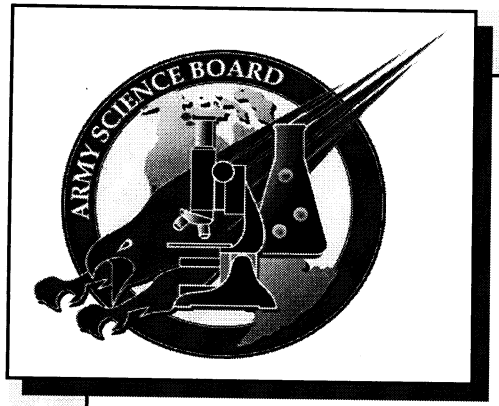
Status of the OA Development Effort

- Current TRADOC OA effort cannot impact Task Force XXI AWE
- PEO-C3S developed their own (minimal) OA to support TFXXI System Architecture development because of schedule
- OA effort does not follow true BPR methodology
- Initial OA focused on TFXXI processes but was not completed
- OA is capturing prototype C^4I process for the digitized force
- Army Enterprise Management Plan discusses OA purpose, process to specify, and envisioned use of OA, but more definition is required to get effort out of "getting started" mode:
  - Too many open ended efforts
  - Need specific interim milestones and steps to achieve them
  - Need closure on current ("as-is") systems



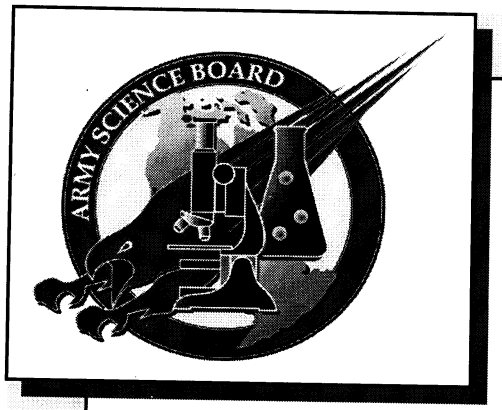
Status (continued)

- The OA is similar to other efforts to model battlefield functions
  - Functional Description of the Battlespace (NSC & STRICOM)
  - Joint Model of Mission Space (DMSO)
  - Combined Mission Space Model (JSIMS JPO)
  - Intelligence Architecture (DCSINT)
  - ATTCIS Model built for NATO C4I Interoperability (J7)
- Current OA definition effort does not adopt a BPR Perspective
  - It is oriented on collecting information and IDEF models
  - The analysis function of BPR is not being accomplished
  - Building Business Process Models has to include analysis



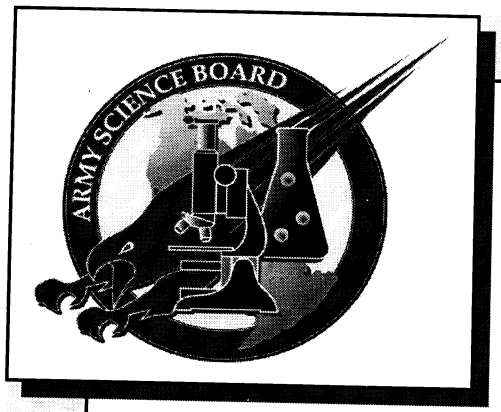
Operational Architectures are Important

- A robust OA will aid future development of both C4I systems and, with digitization, most combat and support systems or platforms.
- OAs could provide the common baseline description of C4I systems to support the CD analytic process in TRADOC
- A flexible definition of the C4I OA could serve many purposes:
  - Establish/clarify information requirements by type and quantity of information needed at all echelons
  - Communicate among users, material and system developers
  - Specification for battle command simulations
  - Use to assess TF XXI
  - Support IW Protect efforts
  - OA's support migration plans for TA compliance

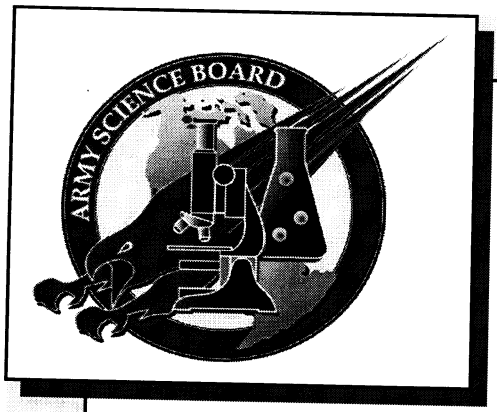


What's Required to Produce a Useful OA for the Army

- An Integrated Process approach to developing the OA is needed
- TRADOC needs to make significant strides in its understanding and use of the IDEF methodology to yield suitable results.
- To fully capture requirements of digitized battlefield requires more than functional detail ($IDEF_0$) - data modeling using $IDEF_{1X}$ will be needed.
- Need a clear definition of who is overall in charge of battlefield information systems.
- There is a need to promulgate a common understanding of the elements of an OA and how they are related.
- Follow Business Process Reengineering Practices

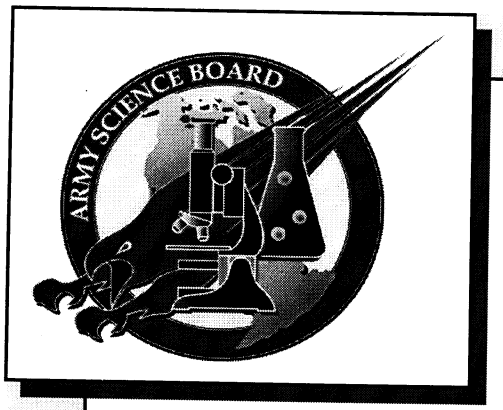


RECOMMENDATIONS



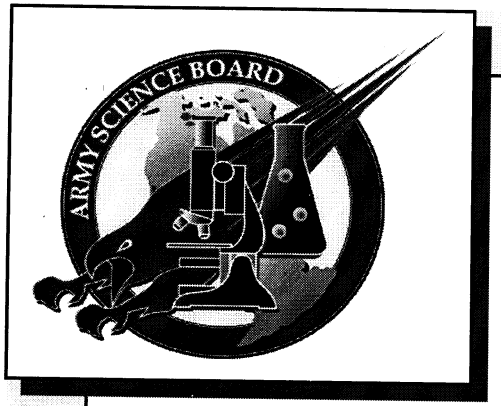
Accept and Promote OA's as Key to Army Enterprise Model

- The DISC4 as Army CIO should aggressively support and collaborate with TRADOC's development of the OA
- TRADOC, particularly CAC, and DISC4 promote OA awareness
- Apply reengineering techniques when developing the OA
- Structure OA to capture a paradigm shift in tactical info systems
  - network broadcasting of and browsing access to information will replace point-to-point message passing - *WWW MODEL*
  - is IDEF modeling is robust enough to capture this?



Institutionalize OA Development

- Develop OA using Integrated Concept Teams (ICT), include:
  - Users from the field
  - Functional proponents from TRADOC
  - A model developer
  - Material Developers
  - System Developers (contractors) where possible
  - Holders of the budget
- Add the OA development as a key part of the TRADOC Systems Requirements Definition Process captured in the "Black Book"
- Make the development of OA(s) an integral part of TRADOC combat development methodology
- Fund OA Development in FY98 POM



Institutionalize (continued)

- Use the OA as a conceptual tool in Combat Development process
  - Use OA as methodology to develop concepts and do analysis
  - Initial OA should not be viewed as a point solution but as a basis for iteration/evolution of concepts and doctrines

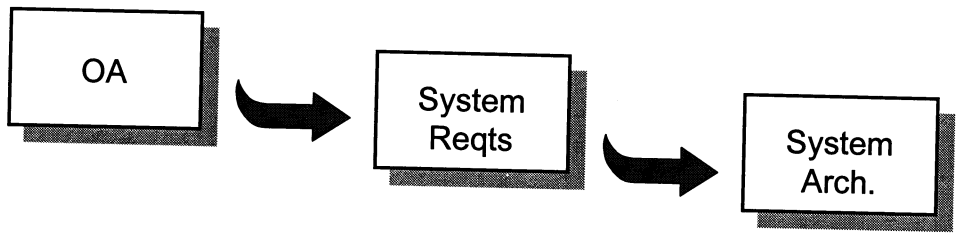
    build-test-build
- Require an OA for all systems that interface with C^2 processes (e.g., C^4I systems, sensor platforms, UAVs, etc.)
  - ICT develop the OA as part of requirements definition
  - TSM/TPIO pass the OA to system development IPT to be maintained until a system is fielded by Material Developers
  - System functional proponent own and configuration manage OA after system fielding

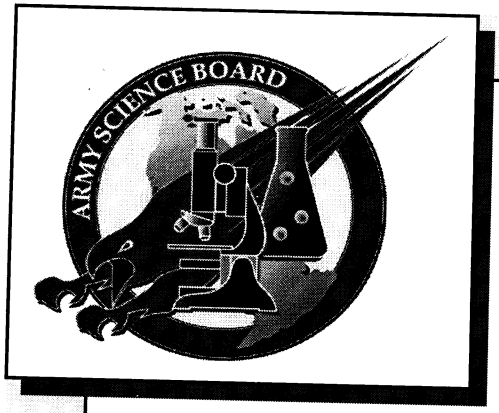
Use Force XXI Initiative as Forcing Function to Establish Process

- TRADOC to continue ongoing OA effort on Division XXI AWE
- Assess OA process and partial products during TF XXI
- Focus OA efforts in support of Force XXI on having a completed product available to use in conjunction with the Division AWE
- Develop both $IDEF_0$ and $IDEF_{1X}$ models in conjunction with the System Architect
- Form and maintain an ICT until all tasks are completed with GO oversight

Kick Off a Focused Effort

- Form a "tiger team" with empowered uniformed leadership
  - Assign ten people to the team for six months
  - Focus on simplified models of key BFA's "as-is"/as-built
  - Give team authority to marshal resources working on OAs from across TRADOC, PEOs and RDECs
  - Consider an approach to OA that supports graceful degradation, information warfare, MOOTW, and the early phases of an MRC
  - Work one case study from OA to System Architecture but don't let it defocus main effort
- Define process to be replicated for future OA developments





SUMMARY

- **KEY OBSERVATIONS AND FINDINGS**
  - OA Is a Key Component of Army Enterprise Model
  - C4I OA Is the Business Model of Command Control Process
  - OA Effort to Date Has Been Limited
  - Operational Architectures are essential for understanding and managing combined warfighting
  - Producing a rigorous OA requires an integrated team approach

- **OVERALL RECOMMENDATIONS**
  - Institutionalize OA Development
  - Use Force XXI as Forcing Function to Get OAs Produced
  - Kick Off a Focused Effort