Modeling & Simulation Roadmap for JSTO-CBD IS CAPO

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- IT as a CBDP commodity
- The Roadmap problem
- The Roadmap solution
- Advantages & disadvantages
- FY08 program build
- Impacts
- Beyond the Roadmap

- What are we talking about?
  - Computer processors, servers and platforms
  - Communications protocols and infrastructure
  - Development tools & environments
  - Interfaces (e.g. JCID component of JWARN)
  - Methodologies
  - *Of these, only interfaces and methodologies are likely candidates for CBDP basic and applied S&T.*

- We will focus on methodologies
  - They account for more than 90% of the M&S/B S&T program
  - They are the basis for Modeling & Simulation development
  - They are algorithms and heuristics, alone or in combinations
  - They pose unique research challenges for user requirements

M&S differs from other CBDP commodities

- Not just for tools deployed to the warfighter, but also required to support internal CBDP functions
  - Analysis
  - Training
  - Plans and concept development
  - Programmatics
  - Test & Evaluation

- CBDP M&S draws from a broad pool of basic research
  - Numerical mathematics and information theory, but also physics, chemistry, materials science, atmospheric science
  - Methods are not specific to CBRN
  - Fundamental research product is documentation of:
    - Experiments, observations, theorems, phenomenologies
    - Data and their concise generalizations, i.e. small "m" models
    - Results are not specific to Modeling & Simulation
  - Their research products are usually not software

M&S differs from other CBDP commodities

- **End-user context is more complicated**
  - M&S does not exist in a vacuum
  - In CBDP, M&S is part of a decision support system, for some user-base, to address some set of problems
  - Real world CBRN data used to drive M&S is "dirty"
  - Utility of M&S is based on decision outcomes and risks, not technical performance measures

- **Additional requirements of software VV&A**
  - (I)V&V focuses on technical merits of software solution
  - Accreditation must also consider use-case and risk
  - Chain of evidence begins with the basic research documentation
  - Closest analog for accreditation is military utility of M&S tool

- **These differences suggest that…**
  - M&S should be managed differently from CBDP materiel
  - The research opportunities and objectives may not be obvious

- **What are the CAPO responsibilities to CBDP?**
  - Satisfy known capability gaps in IS basic research
  - Stimulate new capabilities developed from IS basic research
- **CAPO perceptions**
  - BAA is inefficient, too many responses, most wide of the mark
  - Difficult to forecast value of any particular project
  - Unsure whether right things are delivered to Program
- **Symptoms we observed**
  - No objective criteria for evaluating research candidates
  - Mixing of 6.1, 6.2 and 6.3 activities under "6.2"
  - Lack of transparency to proposal writers and reviewers
- **Roadmap strategy based upon**
  - Review of CBDP, DMSO and other DoD guidance
  - Informal interviews (JPM-IS, JPEO, JRO, JCD-X, T&E & others)
  - Participation in BAA review process for FY06 & FY07

- Make CBRN information systems research and methodologies available for transition when mature.
    - Improve alignment of JSTO M&S investments with CBDP needs
        - Formalize process for obtaining best advice at right times
        - Describe and measure the value of CBRN information
        - Develop objective criteria for evaluating candidate solutions
        - Customize approaches to tech push and requirements pull
        - Accommodate M&S requirements for internal Program functions
    - Assert new measures for the health of the research plan
        - What is the "gold standard" for basic research?
        - Revisit periodically to measure progress and realign efforts
- Acknowledge other stakeholder responsibilities
    - Work within the Implementation Plan for CBDP
    - Focus on research, not software development
    - Be consistent with or improve upon existing JSTO business model

- Result of 6.1 and 6.2 research is not usually a software product.
- Real currency of research is the scientific documentation, report or article
- JSTO M&S 6.3 funding limited to accumulating data to support transition

- <u>Budget Activity 1, Basic Research</u>. "… systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind."
  - Examples: Heuristics, information theory, threat agent science
  - Products: Peer reviewed paper or equivalent

- <u>Budget Activity 2, Applied Research</u>. "… systematic study to understand the means to meet a recognized and specific need … translate promising basic research into solutions … short of system development … with a view toward developing and evaluating the feasibility and practicality of proposed solutions …"
  - Examples: Error analysis, scalability and feasibility analyses of 6.1 research
  - Products: Technical report or equivalent
  - Some FY05/06 JSTO M&S efforts were categorized 6.2 but included 6.3 software development activities, which are a PM responsibility.

- **Problem definition**
  - Too little analysis to know what the technical objectives should be
  - Decision problems are harder than they look
  - No connection between tech performance and operational effectiveness
  - Confusion between basic and developmental S&T

- **M&S program management**
  - Too little analysis conducted to know whether M&S is required
  - Need for M&S assumed, but often unsubstantiated
  - Acquisition paradigm leaves Program requirements unsatisfied
  - Competing authorities initiate M&S efforts
  - Who pays, why and how?
  - Confusion between data requirements and M&S

- **These problems usually occur together, but the Roadmap can only address the first.**

- Formalize the process for obtaining best advice *prior* to writing BAA
  - Adopt IPT approach with mix of CBDP and outside participation
  - Specialize strategies for Requirements pull and Technology push
  - Specific objective measures up-front
    - For comparison of competing solutions
    - For greater transparency to proposal writers, and reviewers
  - Leverage existing solutions
    - Not all required methodologies are unique to CBRN applications

- Emphasize peer-reviewed, journal quality report as the basic research product
  - This is the gold standard of research quality
  - Make this an obligation of new and continuing research projects
  - Adds to collective CBDP and DoD knowledge base
  - Provides some assurance that whether a success or failure, the lessons learned are not lost

- Requirements pull IPT functions
  - Recognize whether requirements are adequately defined for tech base
  - Specify the decision context that defines and supports the required capability
  - Define metrics for value of M&S information in decision context
  - Translate operational and analytic requirements into a quantitative specification
  - Determine whether data supporting research are available or must be acquired
  - Determine whether quantified requirements possible without further study
  - Distinguish basic and applied research from customer-developer responsibilities
  - Review published research for acceptable candidates
  - Evaluate research products for satisfaction of requirements and metrics

- Technology push IPT functions
  - Review research proposals from a broad range of disciplines
  - Ask for subject matter reviews on concepts you are unfamiliar with
  - Articulate a concept for using CBRN information
  - Ask for and recognize applicability to CBRN info problems
  - Identify practical research objectives
  - Identify potential customers or recipients for new IS functionality in CBDP

Roadmap advantages

- More efficient use of 6.1 and 6.2 research dollars
- Manages risk in the basic research plan
- JSTO cultivates the state-of-the-art in practices and knowledge.
- BAA review process tailored to benefit decision makers
  - Customers derive benefits of scientific and operational expertise
  - Customers obtain best possible solution for specific needs
  - Expect possibly fewer replies to BAA, but of generally higher quality
  - Tech base able to effectively respond to quantitative requirements
  - Improve concepts for information tools and establish their utility
  - Clearer research performance criteria
- Roadmap is flexible
  - Make CBDP IS research process available for analytic, training and other unwritten requirements
  - Open process further to new ideas or concepts that enhance or extend CBDP IS capabilities
  - Push and pull procedures can run concurrent or not
  - Roadmap performance can be measured with a "gold standard"

- ## Managing the IPTs will require
  - More time
  - More people
  - Wider variety of expertise
  - Commitments to meet regularly
  - Coordination of S&T plan with DHS, DARPA
  - More expensive than current approach

- FY08 begins the transition to technology push
- Articulate a CBDP concept for using CBRN information
- Key questions to ask of any basic research opportunity
    - What is the motivation for the subject as a research topic?
    - What are the prevailing theories or phenomenological approaches?
    - What experiments have been conducted, and how do they reconcile with theoretical work?
    - What kinds of problems do experts think the subject matter could be applied to?
    - What feasibility studies have been conducted?
    - What successful applications of the research? What attempts have failed and why?
- Use what is learned in FY08 to select best CBDP opportunities in FY09 and out
- Asking for written subject reviews, not software solutions

- **Contractors/developers**
    - Easier to write proposals that go to your strengths
    - Implementation contracts revert to Program or Tech. Demonstration Manager
- **Universities**
    - Most viable basic research candidates should come from universities
    - But, many programs not used to proposing for DTRA funding
- **Service Labs/FFRDC Labs**
    - Source of military smarts for technology
    - Likely recipient of an intermediate technology transition
    - Manage application and early development as technology demonstration – very important role
- **CBD Program officials**
    - Best approach to managing risk in basic research plan you will ever get, easier to measure health of a diverse research plan
    - Avoids over-commitment to novelty, balances well with incremental research plans

- **M&S is a poor candidate for acquisition**
  - Requirements documents capture the wrong thing – they describe the tool but not the process and consequence of using the tool
  - Acquisition Program Manager inherits all of the overhead and management apparatus used to make boots and gloves, but has no flexibility to respond to internal Program requirements.
  - Need a Configuration Control Board represented by all CBDP components and users to direct the PM.
  - Example: JICM is a Program of Record, with evolving requirements, managed by a CCB.