



# Analytical Rigor in Joint Warfighting Framework Presentation

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- Core Challenges of Experimentation
- Why Conduct Campaigns of Experimentation?
- Broad Guidance for Successful Campaigns of Experimentation
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- Need for a Community-Wide Knowledge Base
- Summary



## Background

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- 1999 MORS Workshop on Joint Experimentation
- CCRP Publications Requested by JFCOM J-9
  - *Code of Best Practice: Experimentation* [2002]
  - *Code of Best Practice: Campaigns of Experimentation* [2005]
- More Recent Relevant Publications
  - *Guide for Understanding and Implementing Defense Experimentation (GUIDEx)* [TTCP, 2006]
  - *The Logic of Warfighting Experiments* [CCRP, 2006]
- Quadrennial Defense Review (2006)
- Title 10, Section 485: Joint Warfighting Experimentation
- Joint Concept Development Experimentation Campaign Plan

*We do not lack guidance or relevant knowledge*



## Why Experiment?

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- Experiments are efforts to develop useful knowledge.
- Joint Warfighting Experiments are efforts to develop useful knowledge about Joint “Warfighting”
  - “Warfighting” is a misleading term as mission types proliferate and increasingly include situations where the military is in a supporting role
  - “Joint” is a misleading term as mission partners proliferate to include interagency, multinational, international organizations, non-governmental organizations, local and state governments, and private industry



## Why Experiment? (cont'd)

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- “Experiment” is a misleading term as Title 10, Section 485 defines it to include “analysis, simulations, wargames, experiments, advanced concept technology demonstrations, joint exercises conducted in virtual and field environments and...assessments of ‘red team’ vulnerability”
- Hence, the language is about as useful as “Common Operating Picture”



## Why Experiment? (cont'd)

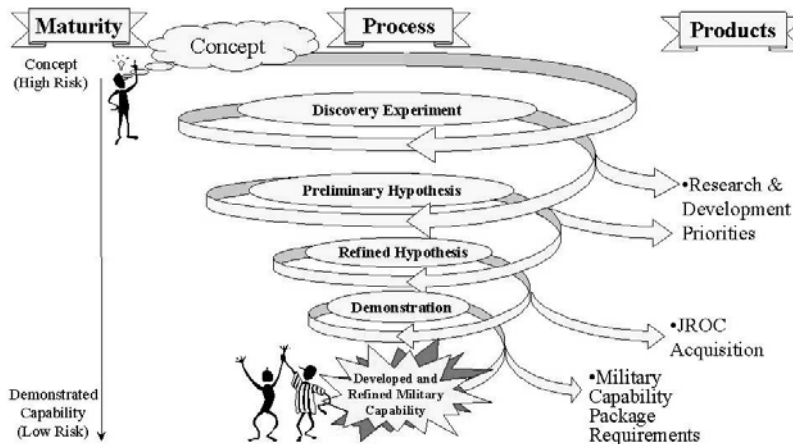
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- From the perspective of the CCRP, the purpose of experimentation is to develop useful knowledge about transformation
  - This includes identifying Mission Capability Packages (MCPs) with substantial positive impact
  - Identifying MCPs or other changes with negative or negligible impact is also very important
  - Knowledge about the circumstances under which MCPs are useful or not useful is also very important



## From Theory to Practice

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Alberts et al., *COBP for Experimentation*. (Washington: CCRP, 2002), 26.



## Core Challenges of Experimentation

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- Clear specification of the idea, including creation of a mission capability package and a conceptual model that articulate the context necessary for success
- Assembly of a multidisciplinary experimentation team including the appropriate domain knowledge (practitioners as well as theoreticians), technical knowledge (for instrumentation and exercise support), and experimentation expertise (design, measurement, and analysis, as well as capture and representation of results)
- Specific articulation of the hypotheses under study, including identification of the controllable and uncontrollable variables of interest



## Core Challenges of Experimentation (cont'd)

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- Articulation of the benefits anticipated from the innovation and the conditions under which they are anticipated
- Development of valid, reliable, and credible measures for the variables of interest
- Experimental design for the individual experiment or (better) the relevant campaign of experimentation.
- If practical, creation of a supporting executable model for the experiment or campaign of experimentation



## Core Challenges of Experimentation (cont'd)

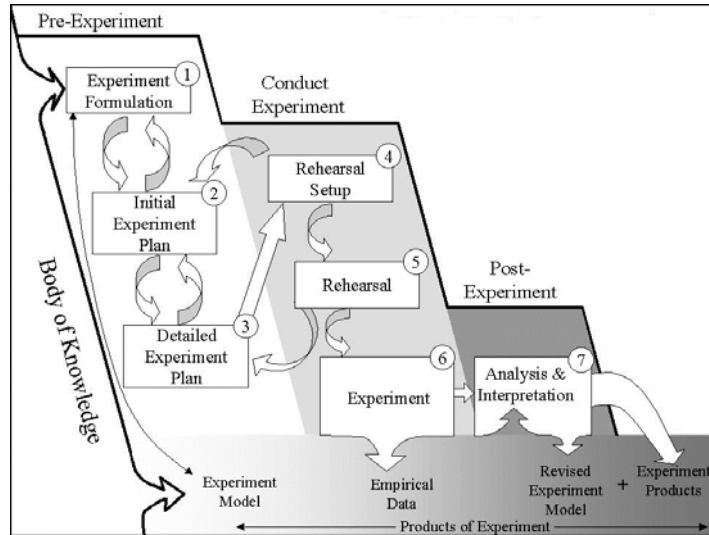
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- Creation of an experimental setting (physical venue, subjects, scenarios, instrumentation, etc.) that enables an unbiased assessment of the innovation(s) and hypotheses under examination
- Documentation of the experiments and archiving the experimentation artifacts that may be useful for others
- Creation of a community of interest that cuts across relevant sets of operators, researchers, and decisionmakers



## Phases of Experiments

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Alberts et al., *COBP for Experimentation*. (Washington: CCRP, 2002), 62.



## Why Conduct Campaigns of Experimentation?

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- Individual experiments lack the breadth and depth necessary to support intelligent innovation
  - To achieve adequate control for validity, individual experiments focus on manipulating a few variables while seeking to control many others
  - The set of controls and assumptions used in a single experiment must be explored in others in order to ensure that the knowledge gain is valid
  - Replication of results is essential in order to avoid undetected problems arising from errors in design, measurement, or biases



## Why Conduct Campaigns of Experimentation? (cont'd)

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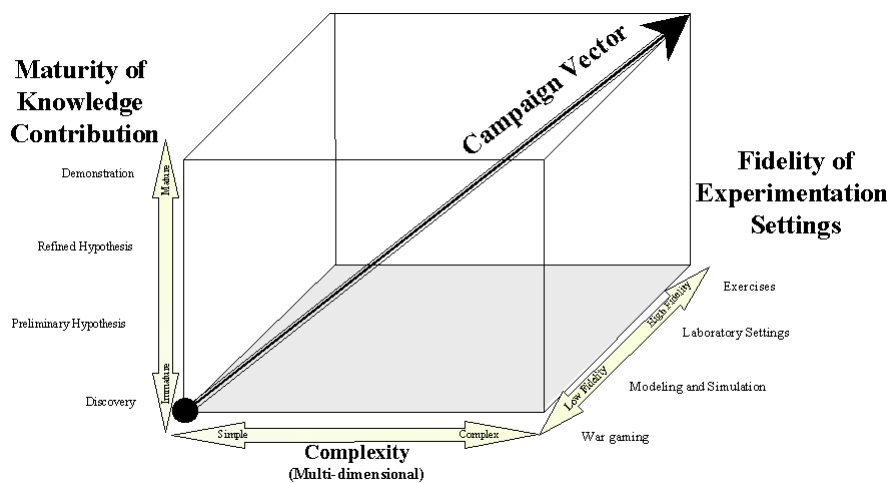
- Campaigns of experimentation benefit the community by:
  - Focusing attention on specific innovations (MCPs) and exploring their potential or impacts
  - Accelerating progress toward specific objectives (e.g., The Manhattan Project)
  - Reducing risks associated with innovations, and
  - Improving the efficiencies of some practice or process
- \* Campaigns of experimentation balance the needs for variety and replication

*Campaigns of Experimentation are intended to improve actionable knowledge*



## The Experimentation Campaign Space

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Alberts et al., *COBP for Experimentation*. (Washington: CCRP, 2002), 49.



## Types of Campaigns of Experimentation

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- Three types in practice:
  - “Natural” Campaigns,
  - Directed Programs of Experiments, and
  - Phased Models of Increasingly Generalizable Studies
- So-called “natural” campaigns emerge (primarily in academia) when researchers with common interests build on one another’s results without any central direction
- Directed Programs of Experiments are centrally designed and controlled so that they will systematically explore a specific issue or knowledge area. Very similar to designing a single experiment
- Phased Models of Increasingly Generalizable Results
  - Common NIH or FDA undertake focused efforts
  - Most useful for exploring DoD transformation initiatives



## Broad Guidance for Successful Campaigns of Experimentation

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- Assume that the planning and execution of individual experiments follow the known best practices.
- Create the conditions necessary for success:
  - Build a strong, multidisciplinary team, and
  - Create an explicit conceptual model.
- Conduct a sound campaign:
  - Plan for, execute, and pay attention to peer review,
  - Maintain the Conceptual Model over time,
  - Create a database, including “metadata” tags,
  - Capture and document experimentation artifacts (scenarios, measurement tools, surveys, etc.), and...



## Broad Guidance for Successful Campaigns of Experimentation (cont'd)

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- Conduct analyses beyond the individual experiments (model-experiment-model, cross-cutting analyses within the campaign, comparative analyses with studies outside the campaign)
- Create a foundation for the future:
  - Widespread distribution of results, across the relevant Communities of Interest (COI)
  - Making data available to other researchers, and
  - Preserving experimentation artifacts and making them available to others in the relevant COIs



## How to Generate and Execute Better Experiments

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- Develop a culture of experimentation
- Establish experimentation as a core DoD competency
- Ensure adequate resources are made available
- Increase understanding about the role of experimentation in transformation
- Develop knowledgeable individuals at all levels to design, plan, and conduct experiments
- Establish standards of excellence
- Encourage sharing of the data collected, the analyses undertaken, and the lessons learned regarding experimentation



## Need for a Community-Wide Knowledge Base

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- A great deal of experimentation has been conducted within DoD and related communities over the past several years.
- No general mechanism exists to track these efforts:
  - Communities of Interest exist in several fields, but these are primarily networks of researchers
  - Despite best practices recognized throughout the scientific community and documented in the existing Codes of Best Practice, data is almost never made available
  - JFCOM is developing a portal that would allow sharing of data and information, but a voluntary portal is only a small step toward a knowledge base



## Need for a Community-Wide Knowledge Base (cont'd)

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- Barriers are ignored or allowed to be artificially strong
  - “Proprietary” data, systems, and results
  - Unnecessary classification barriers, and
  - Failure to share results with non-military partners
- Without a community-wide knowledge base, key questions cannot be answered:
  - What is known about significant issues?
  - What work is currently under way on significant issues?
  - What significant issues have not been explored by experimentation?



## Need for a Community-Wide Knowledge Base (cont'd)

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- Failure to create a community-wide database is expensive:
  - Duplication of effort is an inevitable result
  - Research gaps and untested assumptions are inevitable, and
  - Sharing of experimentation artifacts would also save valuable money



## Summary of Experimentation Today

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- We do not lack technical knowledge about how to conduct:
  - Individual Experiments or
  - Campaigns of Experimentation
- Experimentation is often managed by personnel without the breadth and depth of understanding needed, resulting in:
  - Ambitious efforts that promise much, are constrained by rigorous schedules and limited resources
  - Proceeding from insufficient evidence to efforts at implementation
  - Premature narrowing of focus



## Summary of Experimentation Today

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- Confining experimentation to the near-border region on or near the border between the Industrial Age and the Information Age
- Proceeding by trial and error rather than informed by theory, and
- Failing to capitalize on the creativity of the force