AIAA Code of Best Practice for Joint Experimentation

Check List

A. The starting place: Concept/Idea

1. Analyze concept/idea
2. Develop Hypotheses
3. Test Hypotheses
    - Develop Hypotheses tree(s)
    - Link each branch to a relevant and possible experiment or test
    - Review relevance and logic

B. Develop Experimental Campaign Plan

1. Parse the key concept/idea into meaningful parts
2. Determine desired campaign plan vector
3. Determine experimental activities and linkages needed to move along campaign plan vector
4. Develop structure that insures capabilities for valid generalization
    - Balance of control and live play
    - Baseline and control cases
    - Minimize intrusions
5. Map knowledge domain progresssion
    - Discovery experimentrs
    - Preliminary Hypothesis tests
    - Renined Hypothesis tests
    - Demonstrations

6. Control the complexity
    - Number of actors (from Few & Homogeneous to Many & Heterogeneous)
    - Stability of Environment (from Static to Dynamic)
    - Echelon (from One to Many)
    - Function (from Single to Multiple)
    - Information flow (from Stovepiped to Networked)
    - Interaction (from Non-interactive to Fully Interactive)
    - Domain structure (from Poorly Defined to Well Defined)
    - Uncertanty (from Low to High)
7. Analyze requirements and pick appropriate tools
    - Soft Operational Research Tools
        - Brainstorming
        - Expert elicitation
        - Wargaming
    - Solving tools
        - Linear programming
        - Heuristic searching
    - Modeling and Simulation
    - Constructive, virtual tools
    - Live envents
- Real world lessons learned
- Supporting tools
    - Data analysis

- Visualization
- Data mining

8. Develop requirements for Mission Capabilities Package Co-Evolution

- Organization
- Command arrangements
- CONOPS/Doctrine
- Logisitcs
- C4ISR Systems
- Weapons Systems/Other Materiel
- Training/Education
- Personnel
- Leadership

9. Pre-Experiment Phase

- Define Experiment Objective (s)
- Develop and refine the concept(s)
- Identify one or more hypotheses to be tested/characterize variables
- Establish context of the hypotheses
    - Formaualte scnarions and interesting parts of the scenario space
    - Identify ranges of the variables
- Assess feasibility and expected utility of experiment by estimating:
    - Costs
    - Orther resources required:
        - Personnel
        - Facilities

        - Models
        - Databases
    - Execute Appropriate Models to:
        - Establish parameters
        - Explore the scenario space
        - Test assumptions
    - Create Experimentation Plan
        - Specify null hypotheses
        - Develop operational definitions & measures
        - Identify training requirements for:
            - Participants
            - Data collecltors
            - Red/White/etc. Cells
            - Guides/briefers etc.
        - Define learning objectives
        - Develop data collection and data analysis plans
        - Specify required control and adaptation during the experiment
    - Specify the Experimental Structure
        - Dependent variables (objective functions)
        - Independent variables
            - Experimental focus
            - Context and conditions
- Idendify infrastructure needs
    - Assure adequacy of models, simulations and tools

    - Define facility requirements
- Develop configuration management plans
- Specify appropriate Measures of Merit
    - Measures of Performance (MOP)
    - Measures of C2 Effectiveness (MOE)
    - Measures of Force Effectiveness (MOFE)
    - Measures of Polich Effectiveness (MOPE)
- Sepcifdy othe observables of interest
    - Meaningful scale points
- Refine data collection and data analysis plans
- Create experimental environment
    - Provide infrastructure
    - Create scenario
    - Install data driver
    - Install models, C3I
    - Integrate and federate models
    - Instrument for data collection
    - Plan VIP interface
- Select and train paricipants
    - Identify contingencies that training should address
    - Tailor selection, training and assessment proficiency for:
        - Friendly and coalition forces (blue)
        - OPFOR (red) and netural (gray)
        - Control (white team)

    - Data collection and anallysis team
    - Quality control team
    - VIP interface
- Rehearse/Pretest

10. The Experiment Phase

- Maintain the experimental infrastructure
- Run the scenario
    - Simulate non-live effects
        - Insert sensor inpuits, enemy responses, system degradation, operating environment
        - Simulate, represent, predice, and generate effects
    - Maintain consisten time and granularity
    - Ensure replicability
- Ensure valid live effects
- Conduct supporting modeling or simulation activities
    - Conduct sanity check/quality control
    - Run additional base-lining with same inputs
    - Play roles
    - Step through control variables
    - Iterate as part of the plan
- Execute data collection plan
    - Collect data in accordance with plan
    - Identify insights

- Ensure quality control
  - Sample representative observations
  - Ensure continuous collection
- Maintain discipline
  - Maintain the integrity of the experimebnt
  - Control the scenario
  - Applly exit & restart criteria
  - Manage anomalies
  - Document changes/anomalies
  - Manage experiment
  - Manage configuration
- Hold inteim assessments
  - Qualitative
  - Quantitative
  - Evaluate utility of process
  - Identify anomalies
  - Use the “hotwash” to inform the iterative campaign process and enhance quality
  - Visualize data to determine adjustments to experiment
  - Perform intra-experiment adjustment
  - Capture insights
- Prompt “Hotwash”
  - Identify experimental process insights & lessons recorded

- Develop major findings based on availabvle data and preliminary observations
- Identify post-experimebntal issuesl
- Organize for experimental report

11.The Post-Experiment Phase

- Execute data analysis plan
- Conduct additionaldata analyses
  - Sensitivity analysis
  - Extrapolation beyond observed ranges & conditions'explore anomalies/insights
- Identify critical issues
- Generate products
  - Use M&S to clarify ambiguous results
  - Develop comprehensive reports and briefings
  - Conduct peer review
  - Promulgate results
- Refine/imporve M&S
  - Conceptual
  - Executable
- Exploit experimental results
  - Build knowledge base
  - Ensure that "lessons recorded" become "lessons learned"
  - Incorporate results into follow-on experiments

12. Double check the following items to maximize the probability of success and knowledge gains:

- Establish experimental concept credibility early
- Bound the problem efficiently
- Gain high level visibility and leverage
- Achieve a formal agreement to collaborate
- Ensure sufficient inflluence on the scenario to tailor it
- Obtain early involvemtn in the planning process (e.g., Stakeholders)
- Capture sufficient resources for training, data collection, and analysis
- Create a robust experimentation environment, including adequate:
    - Number and variety of experimental events
    - Instrumentation
    - Free play (opportunities to fail)
- Be warry of piggybacking on someone else’s experiment

H Special considerations and check items if required to “Piggyback” on someone else’s experiment (get positive resolution prior to agreement)

1. Maintain control of your experiment
    a. Is there full involvement in the planning process?
    b. Is there back up planning to cope with unplanned events
        - Adverse weather
        - Experimental infrastructure problems
2. Assure visibility of your experiment