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Effects-Based Operations using the Strategy Development Tool

73rd MORSS
WG14: Strike Warfare

June 21-23, 2005

Dr. Christopher M. White
Nicholas J. Pioch

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Outline

- Background
- SDT Overview
- JEFX04 Lessons Learned
- Conclusions
Background – History

- Developing an effect-based strategy development tool (SDT)
  - Focus is on planning air campaign operations
  - Compatible with evolving effect-based operations concepts
- Sponsored by AFRL Effects Based Operations (EBO) Advanced Technology Demonstration (ATD)
- Research started in 2001
- Research culminated with JEFX04 EBO tools initiative
- Technology transition includes design inputs for
  - Strategy Planning Tool (SPT) in TBMCS 1.1.3
  - Information Warfare Planning Capability (IWPC) 4.2
Background – Research Focus

- **Mixed-initiative approach using adversary models to guide effects-based plan refinement**
  - Start with strategic-theater-level mission
  - Analyze and model the enemy system of systems
  - Decompose mission into strategic and operational-level effects and tasks
  - Decompose further into tactical-level tasks and target sets
  - Provide indicators and collection requirements for feedback during plan execution

- **Provide tools to analyze**
  - The impact of interventions on the probability of enemy goals, beliefs or actions
  - Target system models to compare predicted outage profiles and workarounds
  - Cross-model network flow models in order to suggest tactical tasks and target sets
Strategy Development Tool Overview

- Collaborative Joint Campaign Mission Analysis
- Target System Analysis
- Effects Based Modeling and Analysis
- Network-centric Effects Based Planning
- Effects Based COA Decision Support Tools
- Target Option Analysis
- Dynamic Coarse of Action Decision Tool
Applying Effects-Based Operations to JP 3-30 Command and Control for Joint Air Operations

Joint Air Estimate Process
- Mission Analysis
- Situation/COA Dev
  - COA Wargaming/Analysis
  - COA Comparison/Selection
  - JAOP Development

Joint Air Tasking Order Process
- JFC/Component Coord Targeting
- Weaponarming/Allocation
  - ATO Production
  - Execution
  - Assessment
Collaborative Mission Analysis

Mission Analysis

- Specified Tests
- Implied Tasks
- Resources
- Limitations
- CCR
- Facts

Commander’s Intent

- Purpose
- Method
- Endstate
- Risk

Central Repository for One Time Entry

- Locked by oaf_chief

Real-Time Collaborative Updates by Multiple Users

- USMCOPN will be successful if Califon’s WMD is disrupted to a point where Califon determines negotiation is preferable to losing their WMD assets completely.

- The end state will be reached when Califon’s WMD no longer poses a threat to regional states or could threaten U.S. deployments into the region.
Target System Analysis

- Visualize IPB data, target system nodes & links
- Query based on target category, location, name, or links
- Specify target lists for strike, no-strike, affect, do-not-affect
Effects Based Modeling and Analysis

- Captures planners/analysts concept of the enemy system
  - Red actions, goals, beliefs, resources
  - Positive, negative causal linkages
- Analyzes probability of effects over time for different blue actions
- Explains blue strategy, based on impact to enemy COGs
- Exports causal chains to plan
- Supports Operational Assessment of evidence on indicators
Network-centric Effects Based Planning

- COA development for deliberate and crisis action planning
- Multiple views into a common plan supports plan development and analysis
- Real-time collaboration facilitates communication between decision-maker and planners
- Plan templates created during deliberative planning can be used for crisis action planning
- Integrated with adversary modeling and analysis tools
- Uses simplified causal modeling semantics
  - Causal strength
  - Scheduled probabilities
  - Delay, persistence

Tasks to Effects to Objectives
Effects Dictionary

- Dictionary of effect verbs with definitions and sample effect statements
- Includes definition sources
- Useful for forming common consensus on planning terminology

**Sample Effects Statement:**
Decapitate enemy leadership.
Planning for Assessment

- **Measures of Effectiveness**
  - Defined for each Objective and Effect
  - Measures how well we are accomplishing desired effects

- **Measures of Performance**
  - Defined for each Task
  - Measures how well we performed in accomplished a task

- **Indicators**
  - Observables
Effects Based COA Decision Support Tools

- COA Comparison Matrix supports decision making process
- Integrated COA analysis tool
  - Analyzes Probability/Timing of actions and effects
- Operational Assessment of plan progress
Target Option Analysis

Allows user to study the enemy within and across systems to identify direct and indirect effects.

Finds Electric Power strike targets to disrupt affected WMD targets. Predicts enemy response to electric power, POL outages.

Strike Targets (Electric Power Stations)

Affected Targets (WMD Facilities)
Dynamic COA Decision Aid

Provides PBA by predicting gaps in TST strike and ISR coverage
Outline

- Background
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- Conclusions
Joint Expeditionary Forces eXperiment ’04

● Biannual joint experiment to
  – Evaluate new tools and processes
  – Drive improvements to TTP, doctrine
  – Primarily focused on Air Operations Center

● Distributed Operations
  – Nellis AFB (AF)
  – Hurlburt AFB (Ground)

● 3 Focus Areas in JEFX ’04
  – Effects-based Operations
  – Predictive Battlespace Awareness
  – Network-Centric Infrastructure

● Our EBO tools played in AFRL’s EBO-PBA initiative
  – Significant changes between Spiral 2, Spiral 3, Main Ex
  – Joint Air-Ground Branch Planning occurred during Main Ex
  – Ground component introduced to EBO tools during Main Ex
Applying Effects-Based Operations to JP 3-30 Command and Control for Joint Air Operations

Joint Air Estimate Process

- Mission Analysis
- Situation/COA Dev
- COA Wargaming/Analysis
- COA Comparison/Selection
- JAOP Development

Joint Air Tasking Order Process

- JFC/Component Coord Targeting
- Weaponing/Allocation
- ATO Production
- Execution
- Assessment

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Main Ex Collaborative Planning

- JFC developed objectives, effects, and guidance
- Assigned effects to components (i.e., JFACC, JFLCC)
- Each component developed plan for achieving effects
- Components planned in parallel coordinating at multiple points

**General Observations**
- Basic design and concept of employment well-received
- Need to be cognizant of bandwidth limitations
- Need more feedback on what has been changed by other users
Collaborative Planning Findings

- JEFX04 demonstrated a prototype real-time synchronized collaboration capability

- An enhanced system would need to provide better support for bandwidth limitations and a larger number of simultaneous collaboration systems

- Need added support for Army planning needs such as
  - Developing a COA Sketch
  - Developing a synch matrix
  - Providing a list of target nominations
  - Assigning resources to tasks
  - Specifying the Method for accomplishing a task
  - Performing mission analysis
  - Multi-echelon planning
System of Systems Modeling

● Dep. Ops Assessment Chief
  – Built and analyzed complex models (250 nodes, 300 links)
  – Iterative process using OAT to analyze incremental model changes

● Findings
  – Need unified tool for both model authoring and analysis
  – Need hierarchical navigation, visualization for large models

● Observations
  – Other users skeptical of model validity, additional workload
  – Models did not inform planning, but were used to validate the plan
Novel Uses: Strange COG Models

**Blue Interventions**
- Action: Use IT to Detect and Cutoff Funding
- Action: Encourage Freedom and Democracy
- Action: Resolve the Conflict
- Action: Apply Pressure to Rogue States

**Critical Vulnerabilities**
- CV: Exposure of sources and funds
- CV: Transmitting the Message
- CV: Arab-Israel Conflict
- CV: Host Nations

**Critical Requirements**
- CR: WMD Technical Know-How
- CR: Financial Backing
- CR: Charismatic Leadership
- CR: Continued Recruitment
- CR: Host Nations
- CR: Secure Bases

**Critical Capability**
- CC: Sustained Terror Attacks
- COG: Middle East Terror Groups Centered on Al Qaeda

**Red Center of Gravity**
- Goal: Force withdrawal of US forces from Middle East

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Novel Uses: Blue-on-Red Wargaming
Novel Uses: Decision Tree Wargaming
Effects Based Modeling Findings

- Appeals to power-users with modeling experience
- Majority of AOC Strategy Team users uncomfortable with added complexity
- Some came to appreciate the value of causal models for effects-based planning
- Need further research in:
  - Qualitative modeling and analysis
  - Visualization techniques for predictive EBO
Model Analysis Findings: 3 Use Cases

1. Spiral 2 & 3: Predict impact of blue interventions on red model
   • Used extensively by Dep OAT Chief
   • Intel inputs from ISR Division

2. Main Ex: Predict blue COA prob. profiles w/out red model
   • Used to compare probability and timing of two alternate COAs
   • Reinforced JFACC’s COA1 selection based on earlier effect achievement

3. Main Ex: Revise probabilities based on indicator evidence
   • Delegated to junior lieutenant not familiar with model
   • Change in probabilities difficult to explain due to red model complexity
Other Observations

● User Interface Observations
  – IWPC more mature, polished, but lacked EBO support
  – SDT seen as having most built-in support for EBO
  – Users desire one unified strategy tool for EBO rather than several
  – Preferred Timeline views with draggable bars
  – Desired having Tree/Properties layout
  – Identified need for SDT-style Mission Analysis screens
  – Users liked the idea of an online dictionary of shared terminology

● Interoperability Observations
  – TBMCS Strategy Management Service (SMS) used to exchange data among multiple strategy and targeting tool
  – SMS “common” plan schema not true union of strategy producer tools leading to data loss on round trips
  – SMS limited to read/write of entire plan
    • Too coarse-grained for true collaboration
    • Needs extensions for updating plan fragments, meta-data for browsing plans, update history
Conclusions

● SDT provides EBO support for the JAEP

● Real-time transparent synchronous collaboration is essential to planning

● Adversary Modeling
  – Needs better integration with ISR Division
  – More automated creation of models

● JEFX 04
  – Early feedback drove EBO tools to fit operational needs
  – Tool flexibility allowed experimentation in novel ways
  – EBO methodology needs to be better trained, indoctrinated to gain broader acceptance

● EBO ATD lessons learned can be valuable for future EBO related efforts including Strike Warfare planning