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Joint Effects-Based Planning using the Strategy Development Tool at JEFX04

73rd MORSS WG17: Joint Campaign Analysis

June 21-23, 2005



Dr. Christopher M White



Nicholas J. Pioch

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- 
- **Background**
 - **SDT Overview**
 - **Joint Collaborative Planning at JEFX04**
 - **Conclusions**

- **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



- **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



- **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**

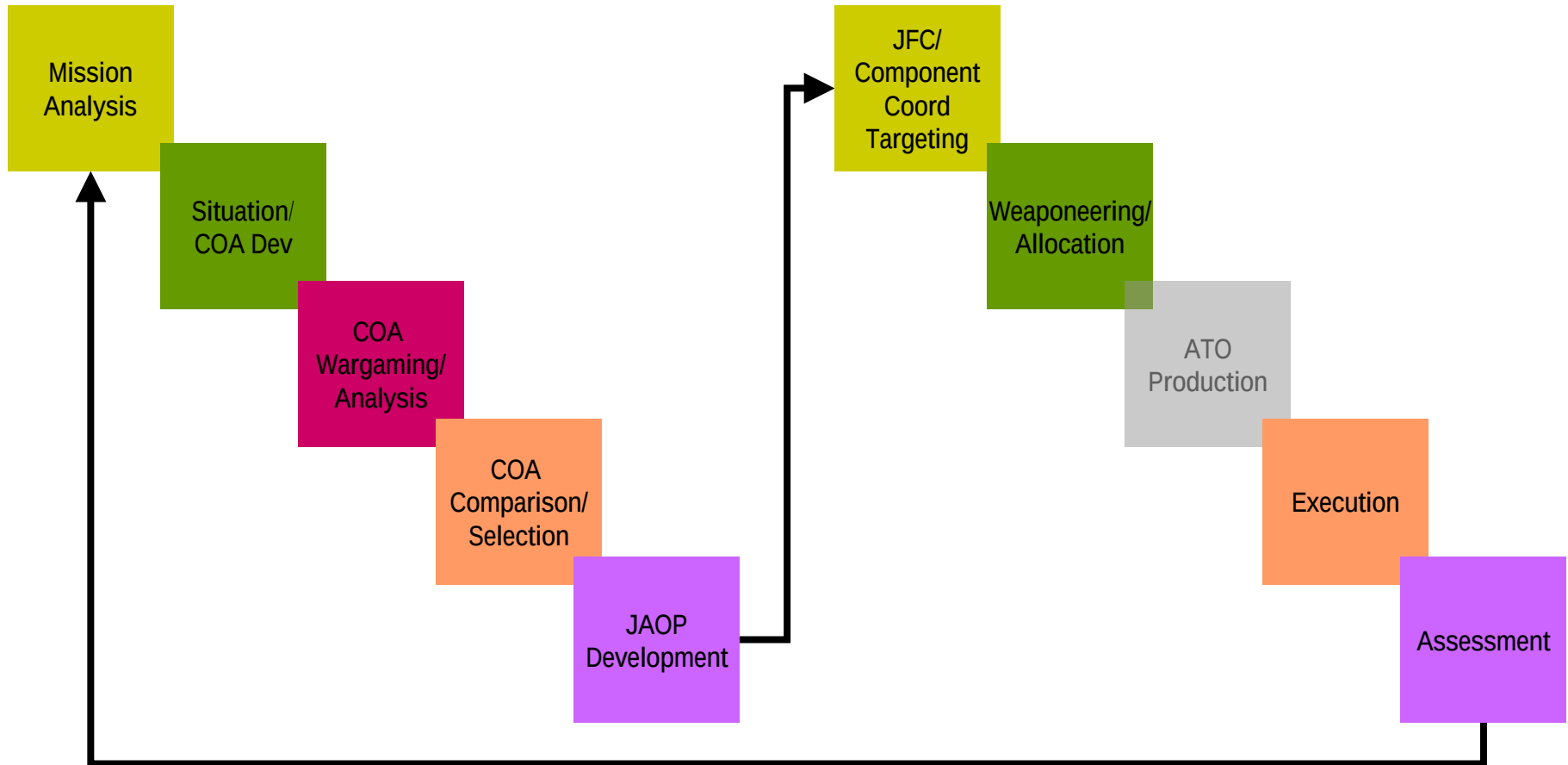


Applying Effects-Based Operations to JP 3-30 Command and Control for Joint Air Operations

BAE SYSTEMS

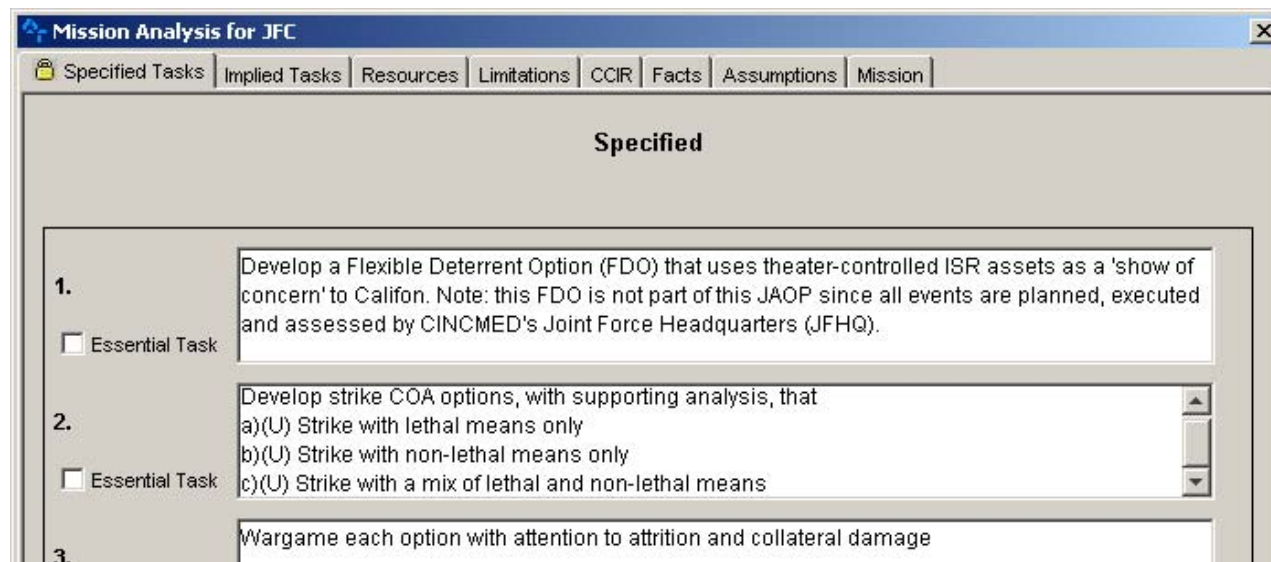
Joint Air Estimate Process

Joint Air Tasking Order Process



Collaborative Joint Campaign Mission Analysis

- Provides central repository for one time entry of mission analysis and commander's guidance data
- Supports real-time collaborative updates by multiple users
- Views of Mission Analysis data for multiple echelons and components



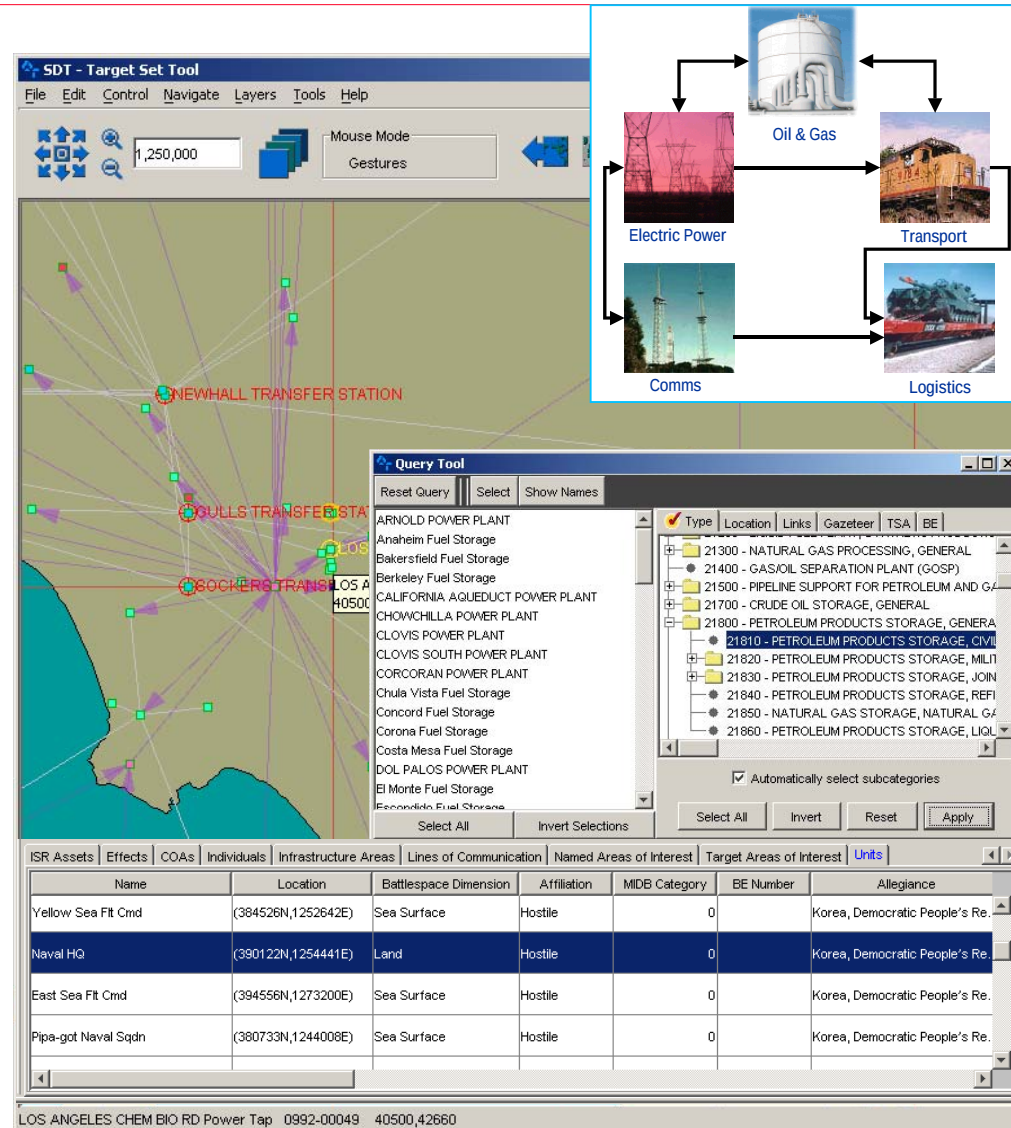
The screenshot displays a software window titled "Mission Analysis for JFC". It features a tabbed interface with the following tabs: Specified Tasks, Implied Tasks, Resources, Limitations, CCIR, Facts, Assumptions, and Mission. The "Specified Tasks" tab is currently active, showing a list of tasks under the heading "Specified".

Task Number	Task Description	Essential Task
1.	Develop a Flexible Deterrent Option (FDO) that uses theater-controlled ISR assets as a 'show of concern' to Califon. Note: this FDO is not part of this JAOP since all events are planned, executed and assessed by CINCMED's Joint Force Headquarters (JFHQ).	☐
2.	Develop strike COA options, with supporting analysis, that a)(U) Strike with lethal means only b)(U) Strike with non-lethal means only c)(U) Strike with a mix of lethal and non-lethal means	☐
3.	Wargame each option with attention to attrition and collateral damage	



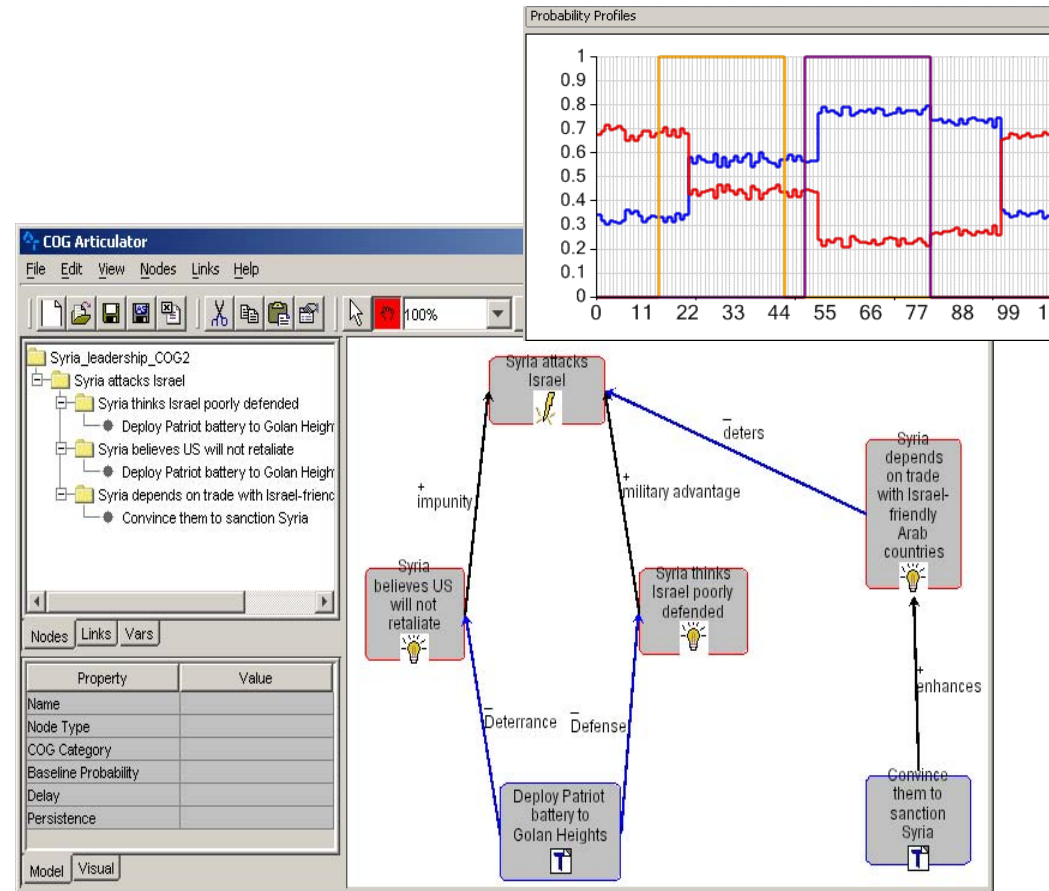
Target System Analysis

- 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



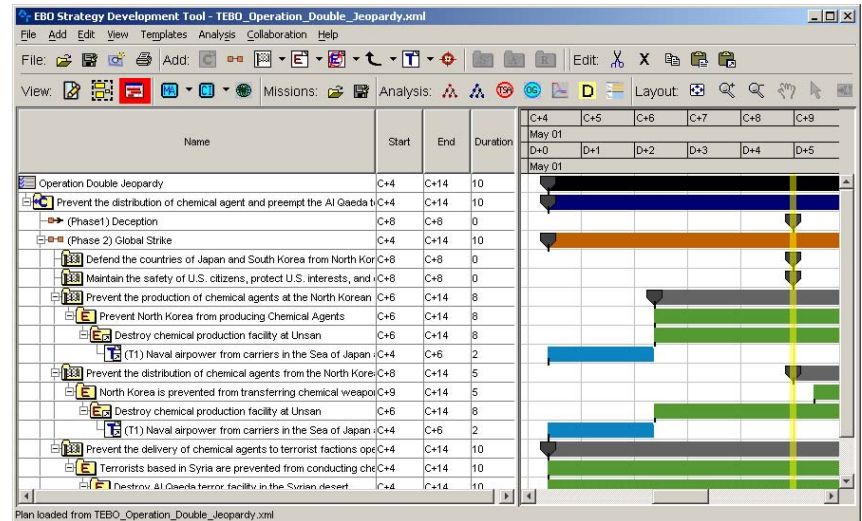
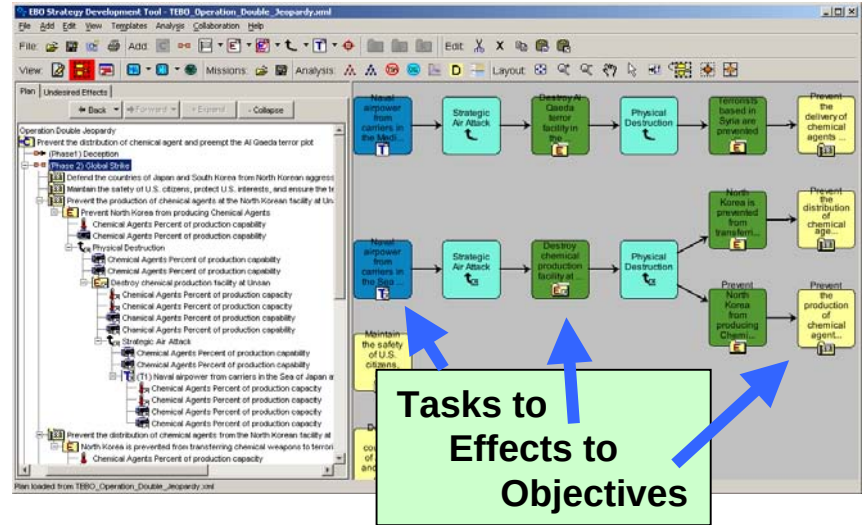
Effects Based Modeling and Analysis

- 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



Planning for Assessment

- **Measures of Effectiveness**

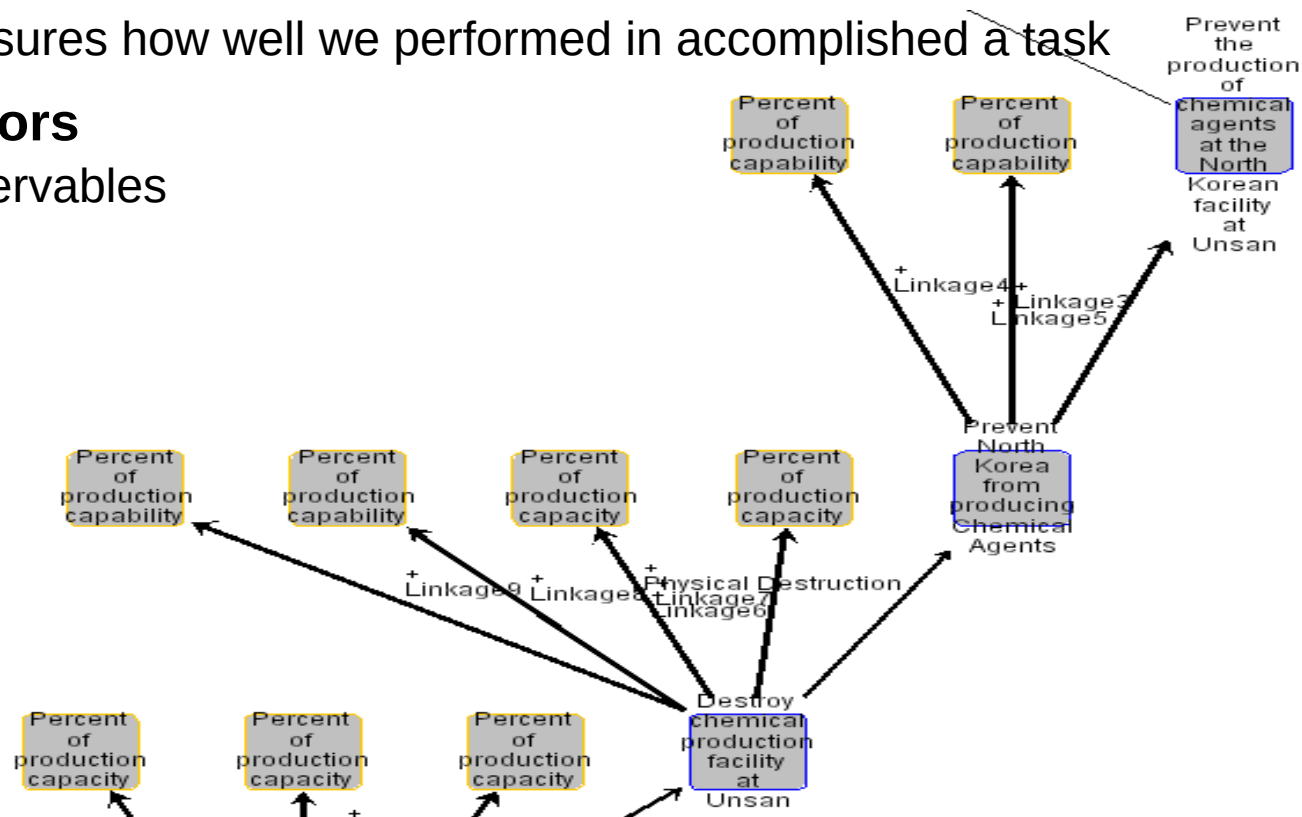
- Defined for each Objective and Effect
- Measures how well we are accomplishing desired effects

- **Measures of Performance**

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

- **Indicators**

- Observables

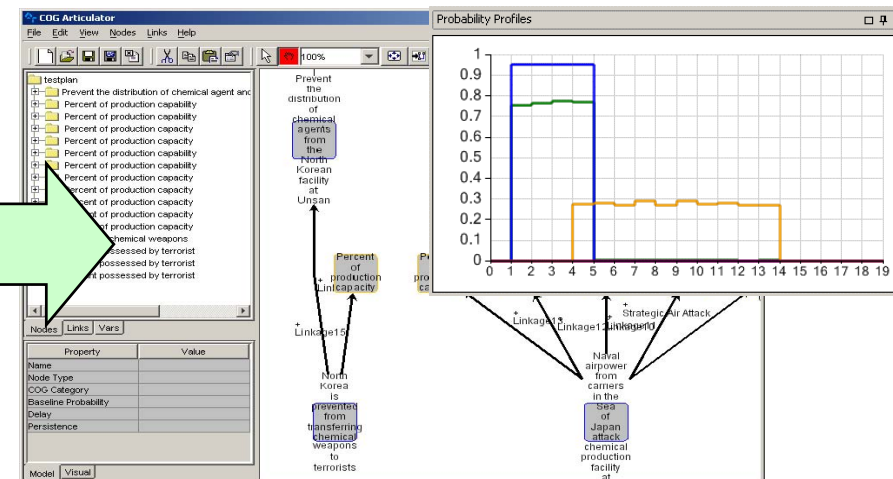
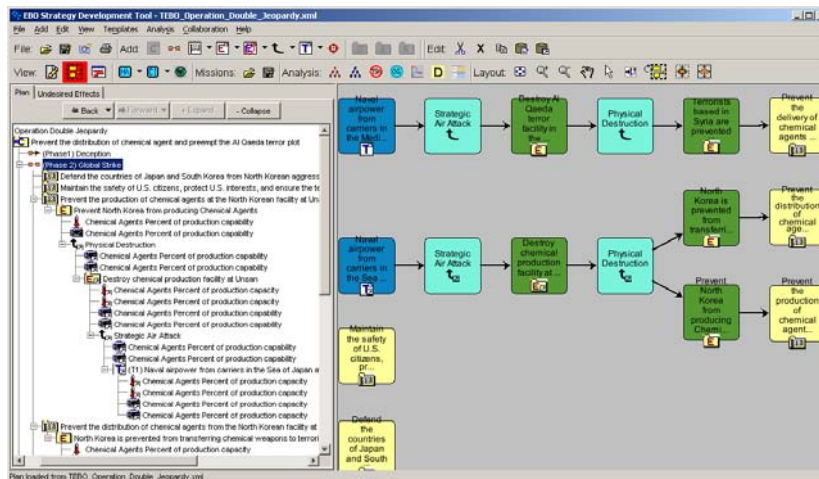


Effects Based COA Decision Support Tools

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

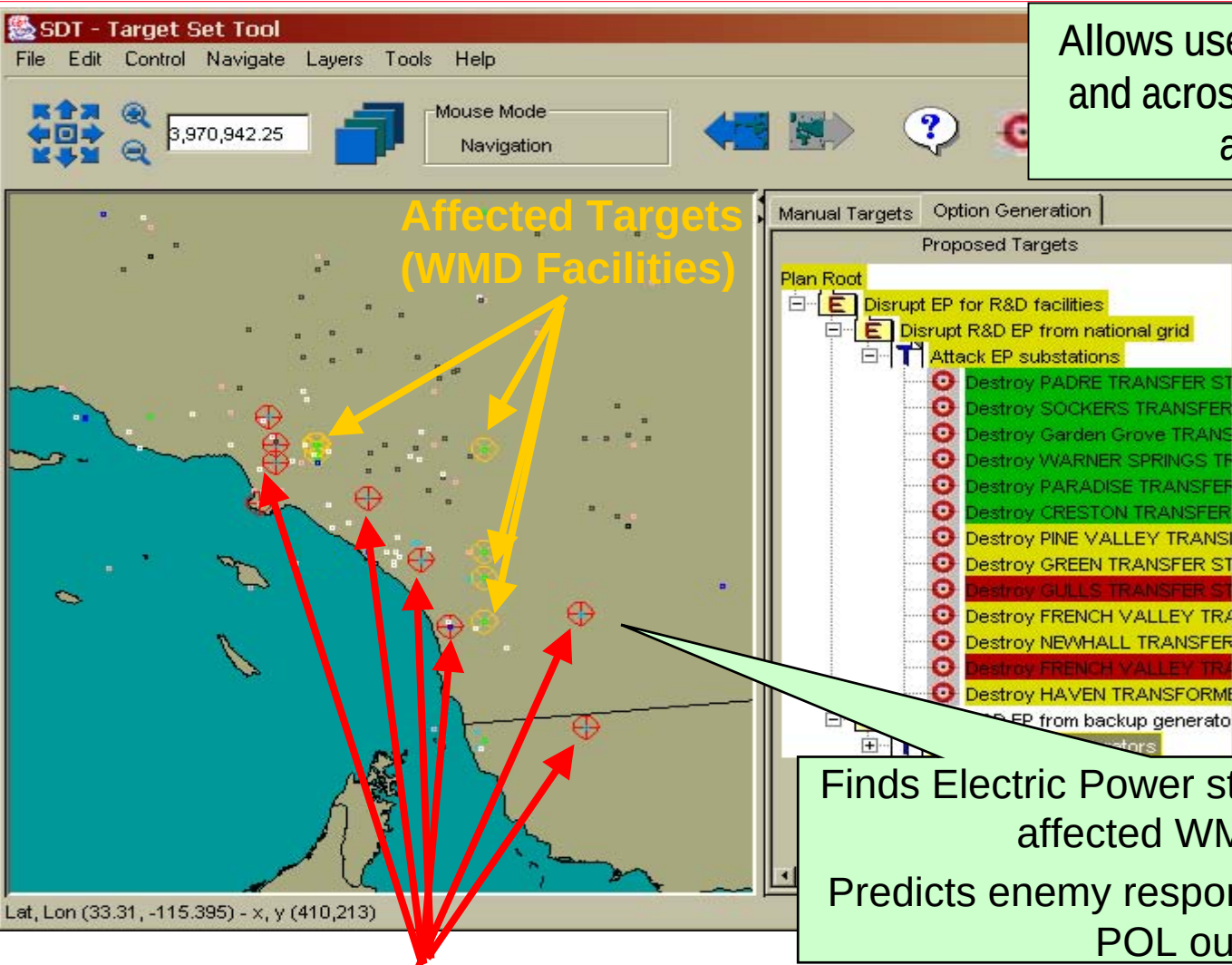
COA Comparison Matrix

Phases	weight	Direct Means	Indirect means
Phase 1	1	50	30
Phase 2	1	40	29
Phase 3	1	50	38
-suitable	2	1	2
-feasible	2	8	8
-acceptable	1	5	5
-complete	1	3	4
-probability of success	3	8	3
Phase 4	1	43	43
Phase 5	1	41	32
Totals	1	224	172
-suitable	2	16	14
-feasible	2	34	26
-acceptable	1	28	29
-complete	1	18	27
-probability of success	3	26	12

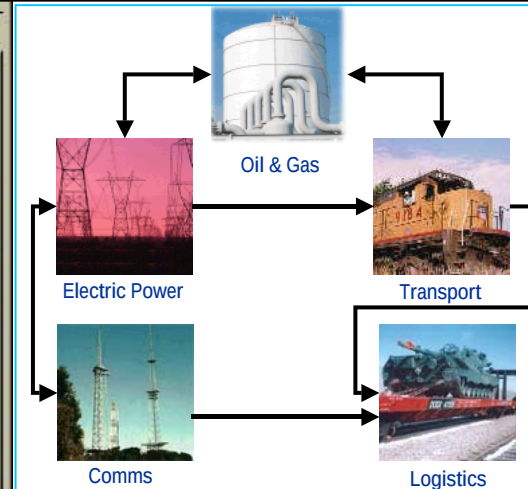


Target Option Analysis

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



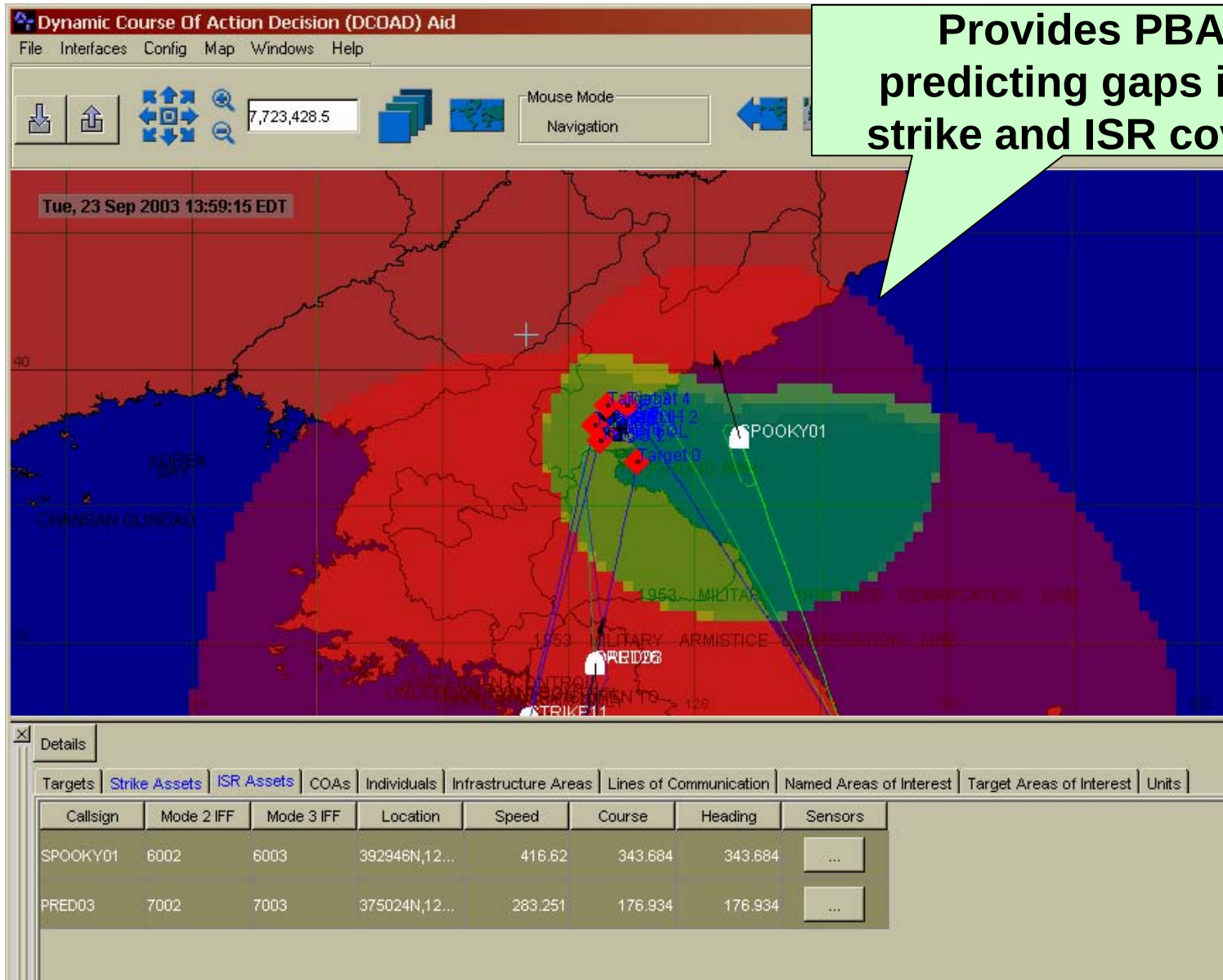
Finds Electric Power strike targets to disrupt affected WMD targets.
Predicts enemy response to electric power, POL outages.

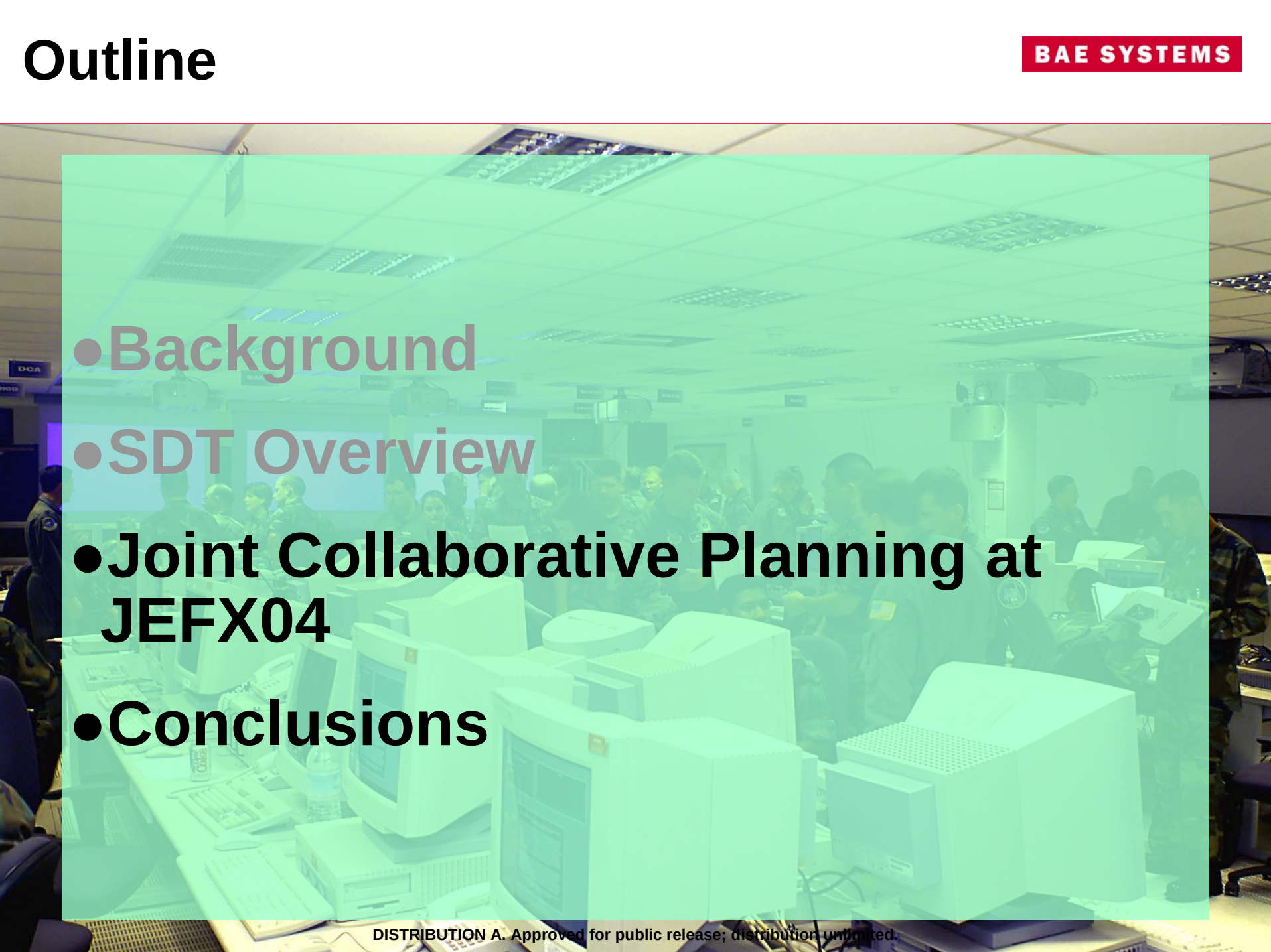
**Strike Targets
(Electric Power Stations)**



Dynamic COA Decision Aid

BAE SYSTEMS



- 
- Background
 - SDT Overview
 - Joint Collaborative Planning at JEFX04
 - Conclusions

- **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

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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

Weaponneering/
Allocation

ATO
Production

Execution

Assessment



- **Joint Forces Commander developed campaign objectives, effects, and commander's guidance**
- **Assigned effects to components (i.e., JFACC, JFLCC)**
- **Each component developed plan for achieving effects**
- **Components planned in parallel coordinating efforts at multiple points**
 - End of Mission Analysis
 - During COA development
 - For wargaming, COA comparison, and selection



- **4 computers provided to team for developing branch plan**
- **Used real-time synchronous collaboration for Mission Analysis**
- **Team developed 2 independent COAs specifying**
 - Operational Objectives, Tactical Objectives, Effects, Causal Links, and Tactical Tasks
 - Measures of Effectiveness and Measures of Performance
- **Used mixture of real-time synchronous collaboration and passing of plan fragment updates as collaboration capability degraded due to bandwidth issues**
- **Merged JFLCC plan fragments at specified times**



- **Team used an average of 3 computers for developing branch plan**
- **Used real-time synchronous collaboration for Mission Analysis and COA development**
 - Mission Analysis screens developed for AF were sufficient for Army use
 - Army equated Causal Link to Purpose for associating Tasks with Effects and Objectives
- **Viewed JFACC plan via screen sharing**
- **Merged plan fragments into JFACC plan at specified times**
 - Bandwidth limitation made it more desirable to develop plans locally and then merge



- **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



- **Dep. Ops Assessment Chief**

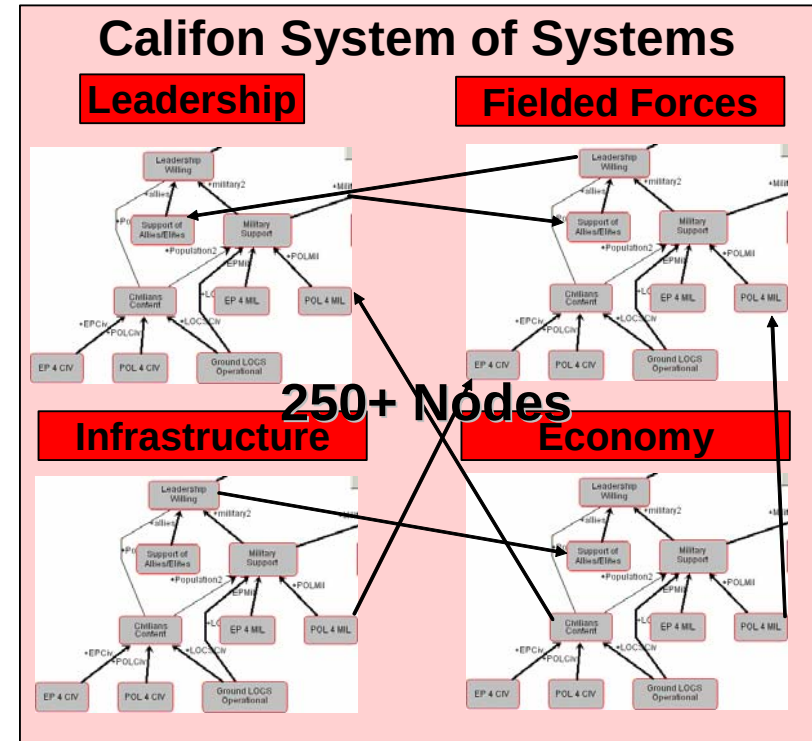
- Built and analyzed complex models (250 nodes, 300 links)
- Iterative process using OAT to analyze incremental model changes

- **Findings**

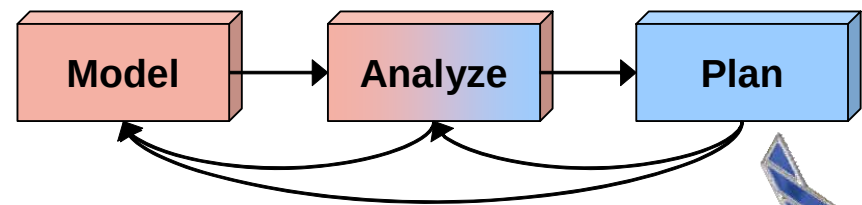
- Need unified tool for both model authoring and analysis
- Need hierarchical navigation, visualization for large models

- **Observations**

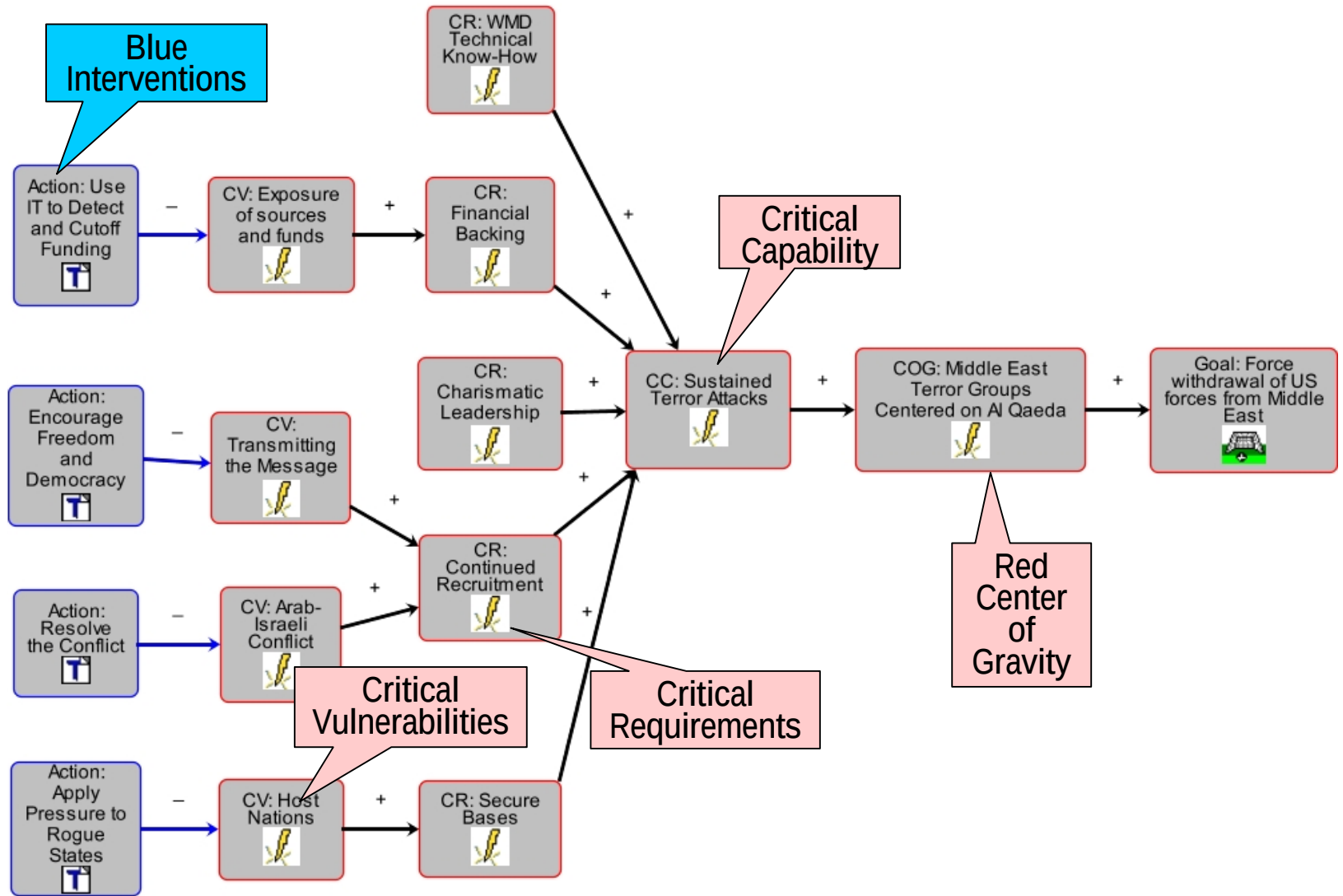
- Other users skeptical of model validity, additional workload
- Models did not inform planning, but were used to validate the plan



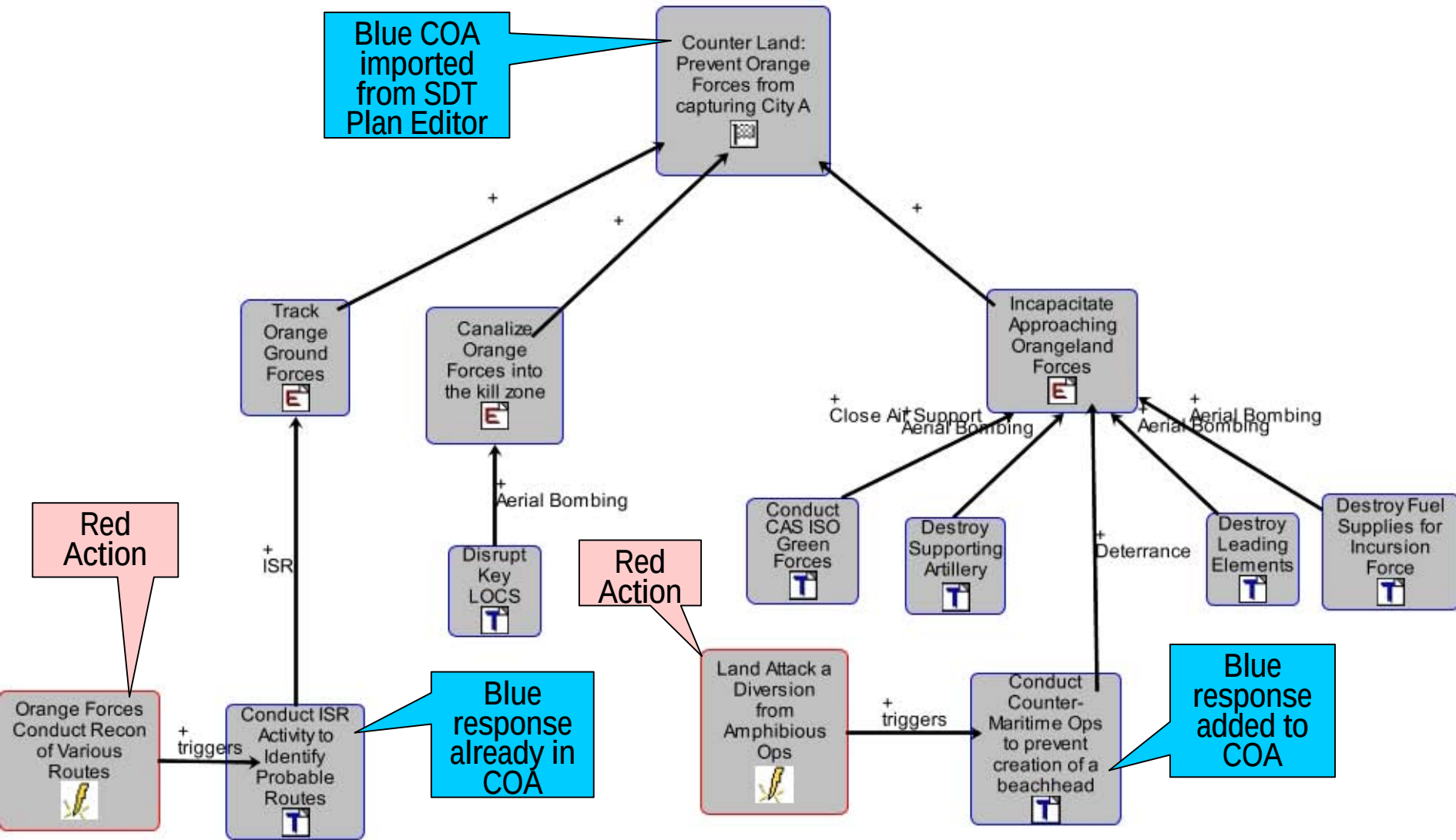
Iterative Modeling Process:



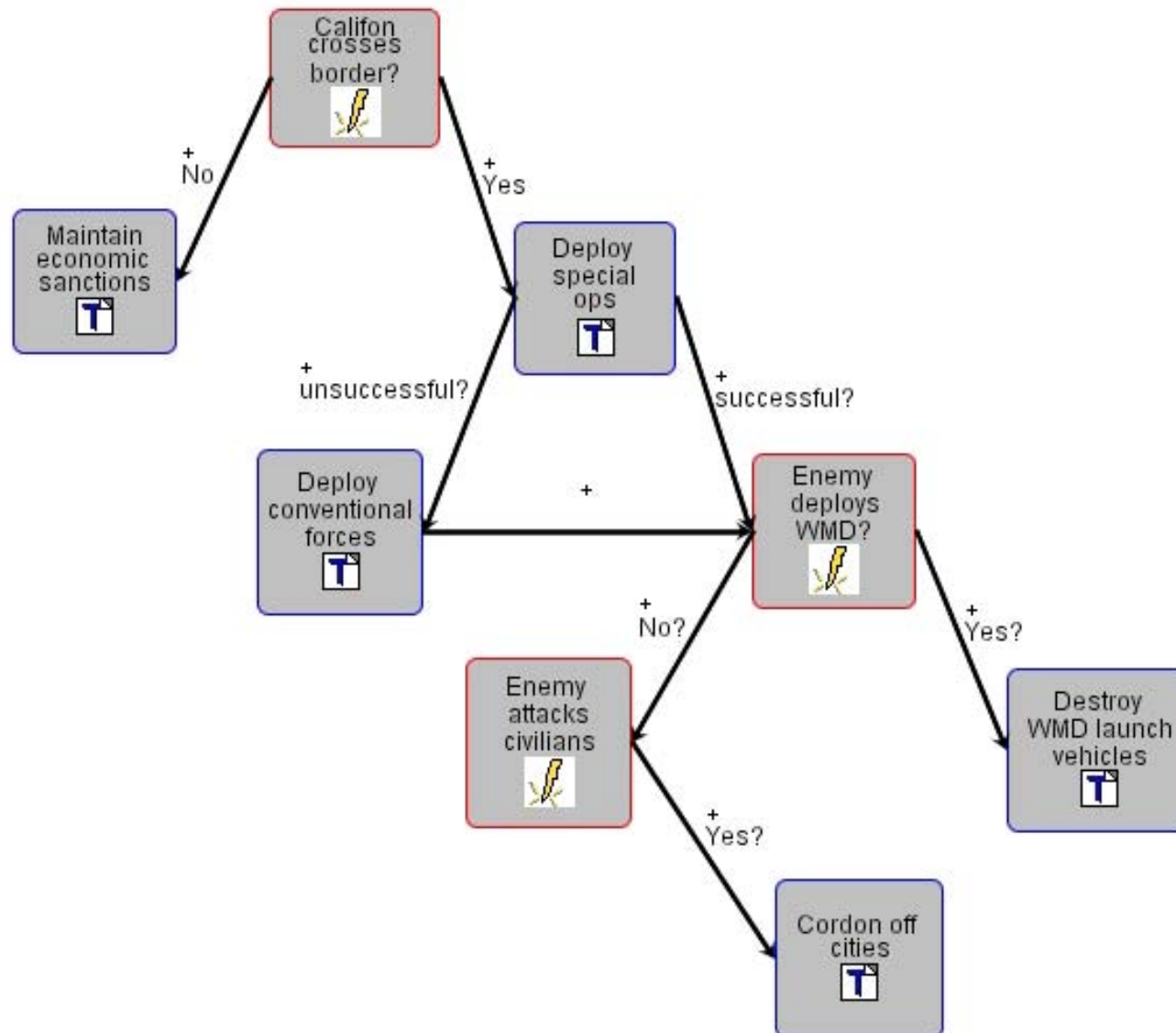
Novel Uses: Strange COG Models



Novel Uses: Blue-on-Red Wargaming



Novel Uses: Decision Tree Wargaming



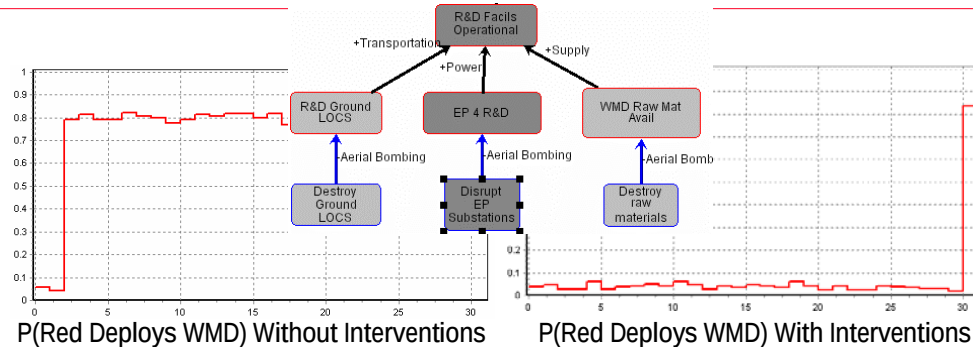
- Appeals to power-users with modeling experience
- Majority of AOC Strategy Team users uncomfortable with added complexity
- Some came to appreciate the value of causal models for effects-based planning
- Need further research in:
 - Qualitative modeling and analysis
 - Visualization techniques for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



Model Analysis Findings: 3 Use Cases

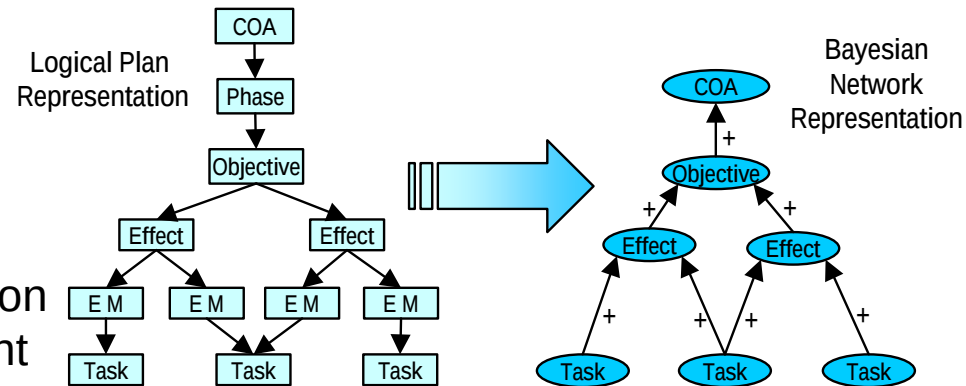
1. Spiral 2 & 3: Predict impact of blue interventions on red model

- Used extensively by Dep OAT Chief
- Intel inputs from ISR Division



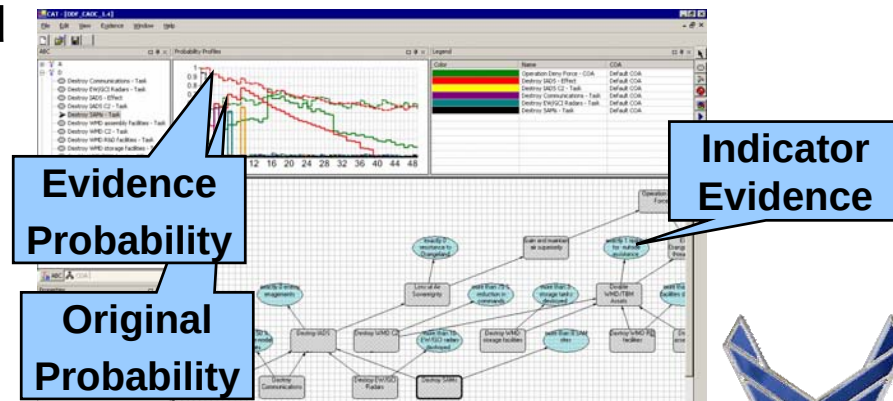
2. Main Ex: Predict blue COA prob. profiles w/out red model

- 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



- **SDT provided EBO support for joint planning during JEFX04**
- **Real-time transparent synchronous collaboration is essential to planning**
- **Air Force and Army planning have some unique requirements that need to be met in a joint system**
- **Effects based modeling and analysis only appeals to a select few power users**
- **EBO ATD JEFX04 lessons learned can be valuable for future Joint EBO related efforts**

