

# **Tools for Effects Based Course of Action Development and Assessment**

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# Outline of Presentation



- **EBO Definition**
- **AFRL EBO Program and Core Products**
  - Strategy Development Tool (SDT)
  - Causal Analysis Tool (CAT)
  - Fusion for EBO (FEBO)
  - EBO Wargaming Simulation (EBOWS)
- **Warfighter Assessment and Technology Transition**
  - JEFX 04
- **Technology Challenges**
- **Summary**



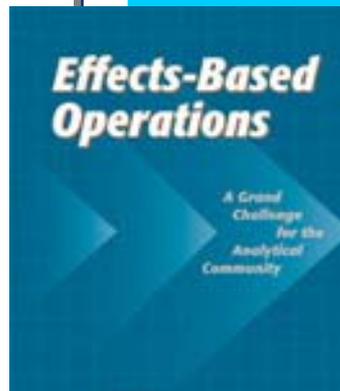
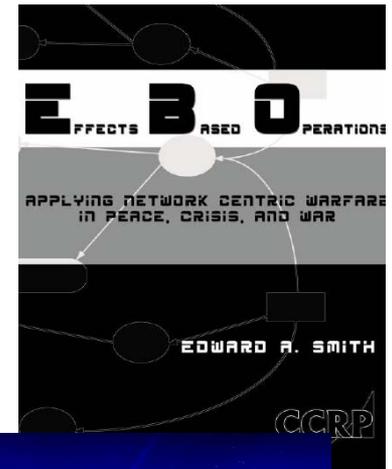
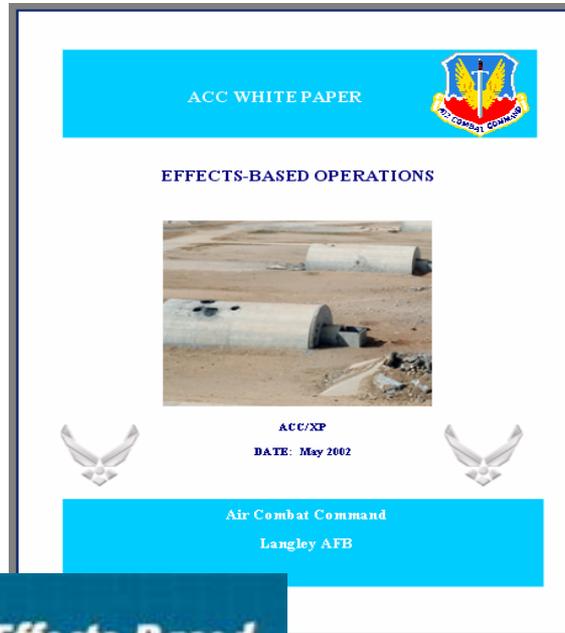
# EBO Definition



## ACC EBO White Paper, May 2002

**Effects-Based Operations:** Actions, taken against enemy systems, designed to achieve specific effects that contribute directly to desired military and political objectives.

**Methodology:** A methodology for planning, executing, and assessing operations designed to attain the effects required to achieve desired national security outcomes.

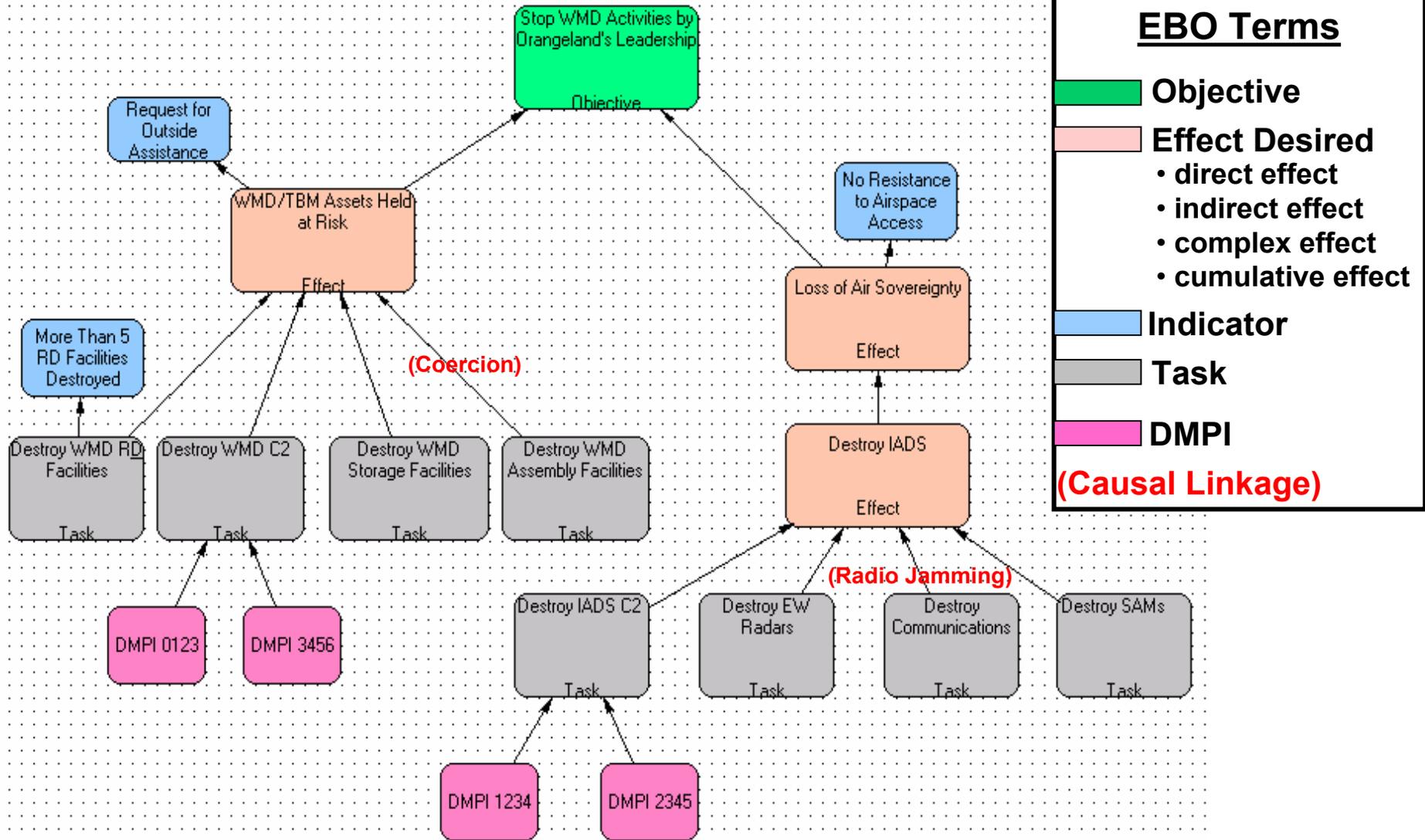


## AFRL/IF Vision

**Develop and Demonstrate New Concepts, Technologies, and Software Tools to Enable More Efficient Effects-based Operations**



# Effects-Based COA Representation (Operation Deny Force)





# AFRL Effects Based Operations Program

(The EBO Advanced Technology Demonstration FY01–04)



- **Purpose:** develop new concepts and software tools to support the warfighter in implementing effects-based operations:
  - Strategy Development Tool (prototype)
  - Causal Analysis Tool (prototype)
    - Causal analysis of plans
    - Campaign assessment
  - JEFX 04 PBA/EBO Initiative
- **Problem:** per AFC2ISRC 2001 Capability Campaign Plan
  - Capability to build and assess an effects-based JAOP (P-2)
  - Effects-based targeting and weapons pairing (P-6)
  - Capability to provide effects-based combat and campaign assessment (A-5)



# AFRL EBO ATD Core Products:

## Strategy Development Tool & Causal Analysis Tool



### • Strategy Development Tool

Supports development of an effects-based COA

- Decomposes COA into effects, tasks & causal linkages
- Specify indicators for success of effects and tasks
- Develop candidate target lists based on target systems analysis
- Strategy and Mission Templates

### • Causal Analysis Tool

Predicts the probability of achieving Commander's intent for a blue COA

- Reasons over cause/effects relations for a given campaign over time
- Tradeoff analysis/drill down capability
- COA assessment during planning
- Assessment during execution based on evidence
- Also known as Operational Assessment Tool (OAT)

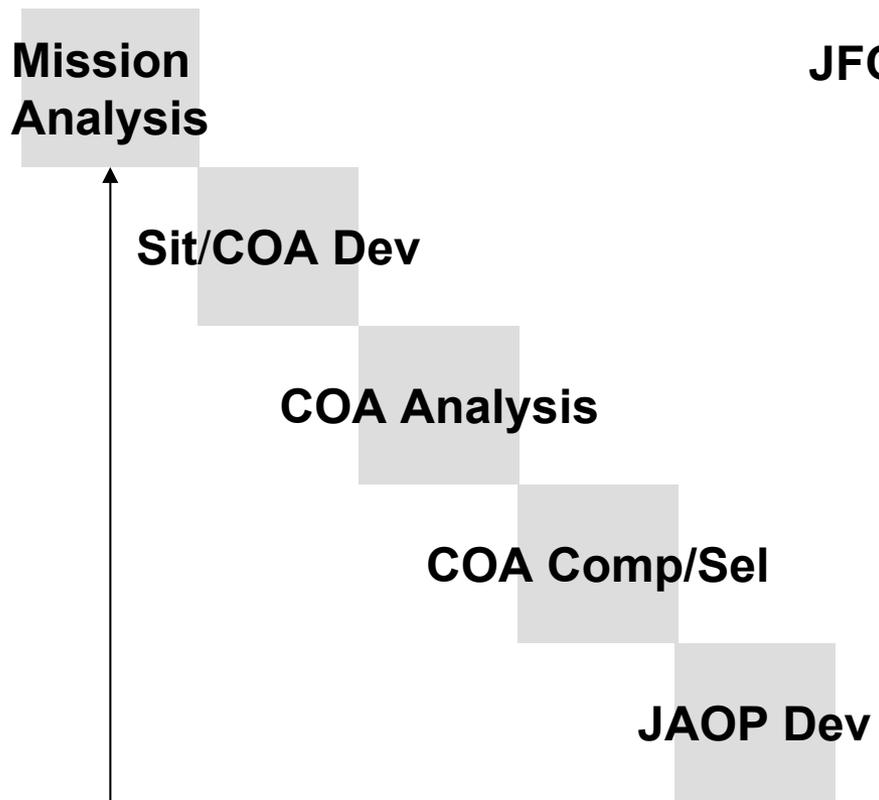
Blue COA ↓ ↑ Probability of Blue COA success



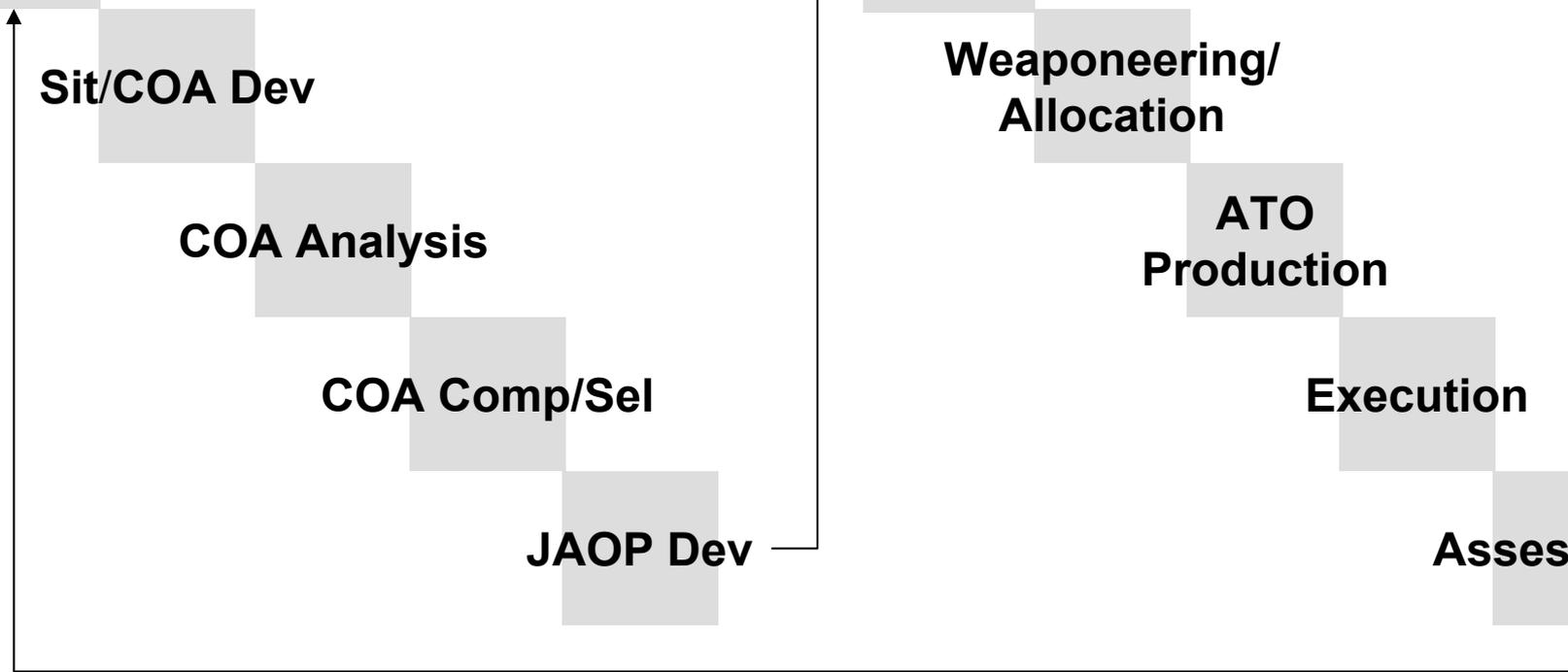
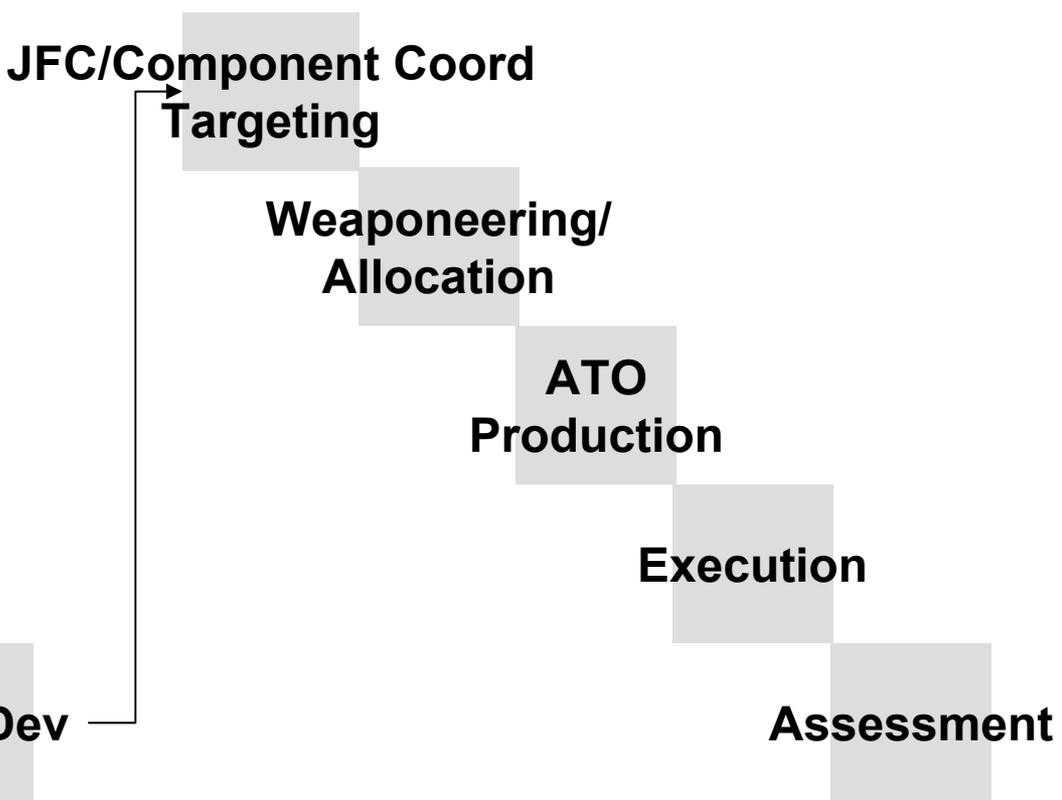
# JP 3-30: Command and Control for Joint Air Operations



## Joint Air Estimate Process



## Joint Air Tasking Order Process





# JP 3-30: Command and Control for Joint Air Operations



## Joint Air Estimate Process

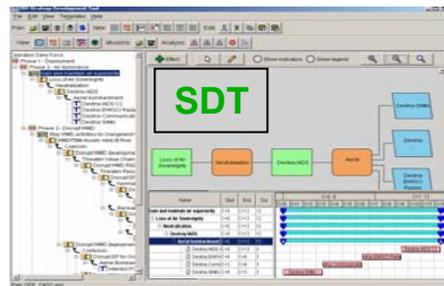
Mission Analysis

Sit/COA Dev

COA Analysis

COA Comp/Sel

JAOP Dev



## Joint Air Tasking Order Process

JFC/Component Coord Targeting

Weaponneering/ Allocation

ATO Production

Execution

Assessment

Strategy Development Tool (SDT)

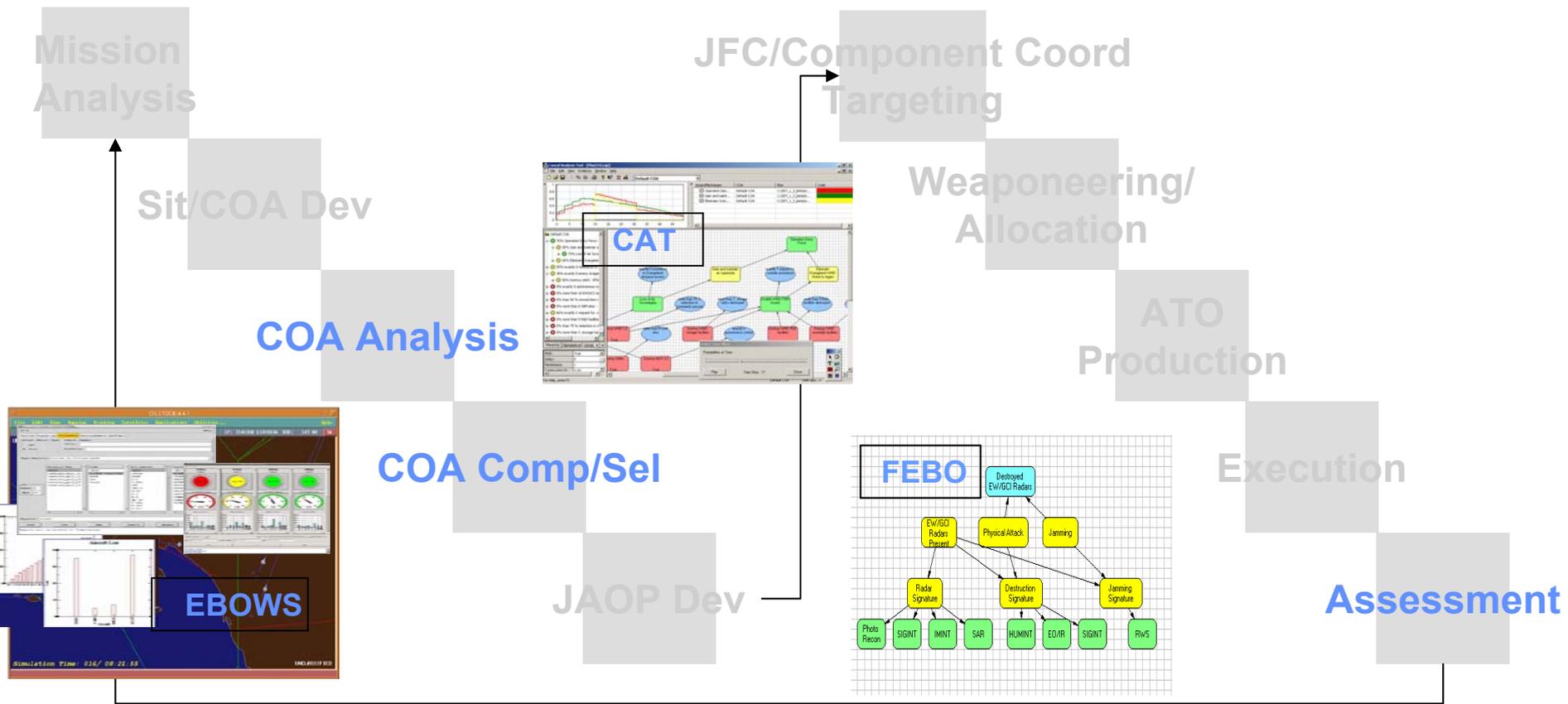


# JP 3-30: Command and Control for Joint Air Operations



## Joint Air Estimate Process

## Joint Air Tasking Order Process



Campaign Assessment Tool (CAT), EBO Wargaming Simulation (EBOWS), Fusion for EBO (FEBO)

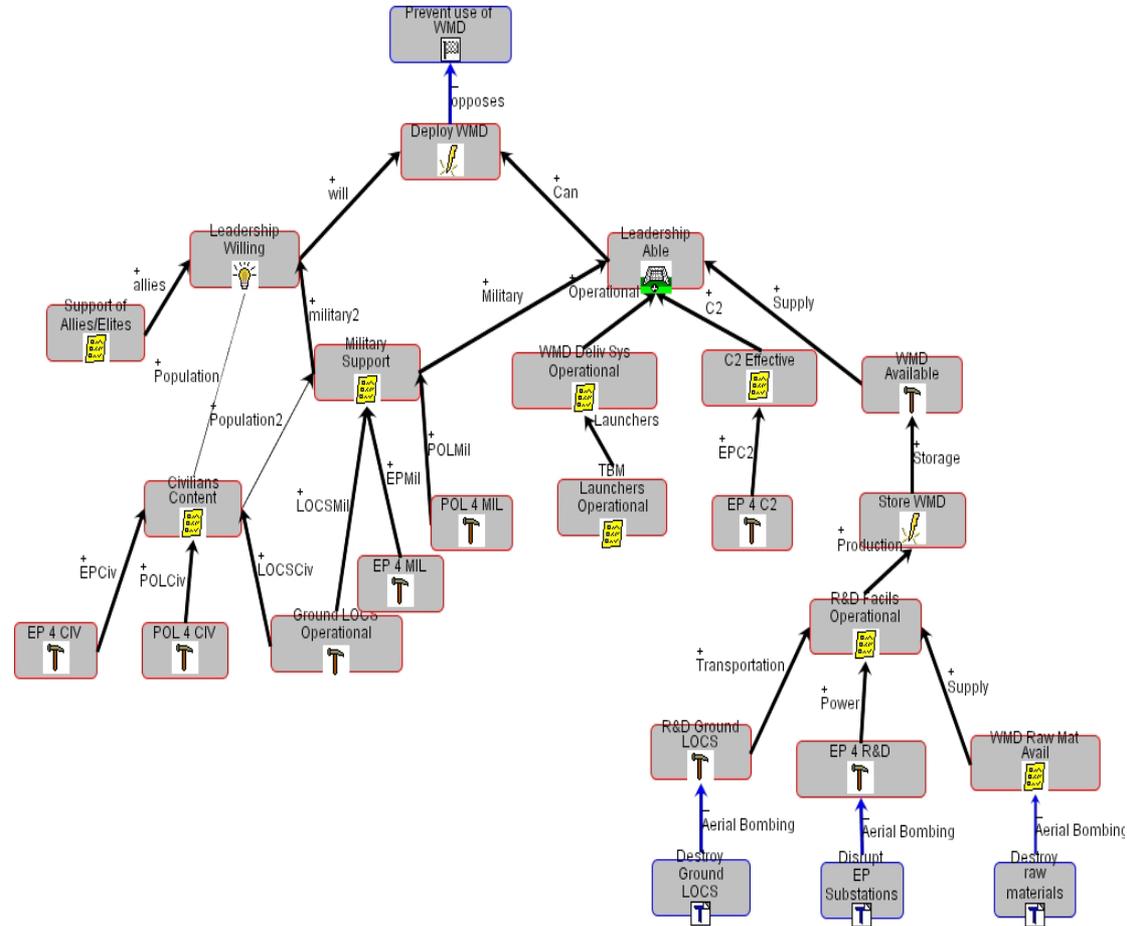




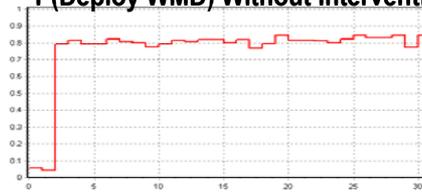
# Adversarial Modeling within SDT COG Articulator



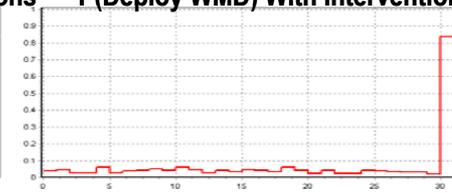
- Adversarial modeling tool to guide/inform blue COA planning process
- Assists in determining what effects are required to create blue interventions
- Links adversarial models w/ blue COA in SDT plan editor
- User specifies causal relationships (+ or – influence, persistence, delay, P() values)
- Blue nodes depict objectives and possible interventions that could reduce the probability of the enemy achieving their high level goals
- Causal chain of effects from highest payoff interventions can be exported to SDT as a plan fragment
- Probability profiles determined w/ CAT
- COG templates under development



P(Deploy WMD) Without Interventions



P(Deploy WMD) With Interventions





# Intervention Analysis with CAT



OAT - [WMD\_ep\_cat]

File View Evidence Window Help

ABC Probability Profiles Legend

Color Name COA  
Deploy WMD NoInterventions  
Deploy WMD Raw Materials  
Deploy WMD Ground LOCS  
Deploy WMD EP

Deploy WMD

Leadership Able Leadership Willing

Store WMD WMD Available Military Support Support of Allies / Elites

RD Facilities Operational WMD Delivery System Operational C2 Effective Valued Assets OK

Ground LOCS 4 RD Facilities TBM Launch Sites Operational Ground LOCS Operational Civil Content

WMD RD Raw Materials Available EP 4 RD FACS EP 4 C2 EP 4 MIL EP 4 CIV POL 4 MIL POL 4 CIV

Degrade Raw Materials Availability Destroy Ground LOCS

Degrade EP 4 RD FACS

Indicator: False  
Name: Deploy WMD  
COAID: B9246FD77D8946E5B25038D6F  
GUID: FE469A131FD211D689CB00B0C  
Leak: 0  
Continuation: 0  
Delay: 0  
Persistence: 1

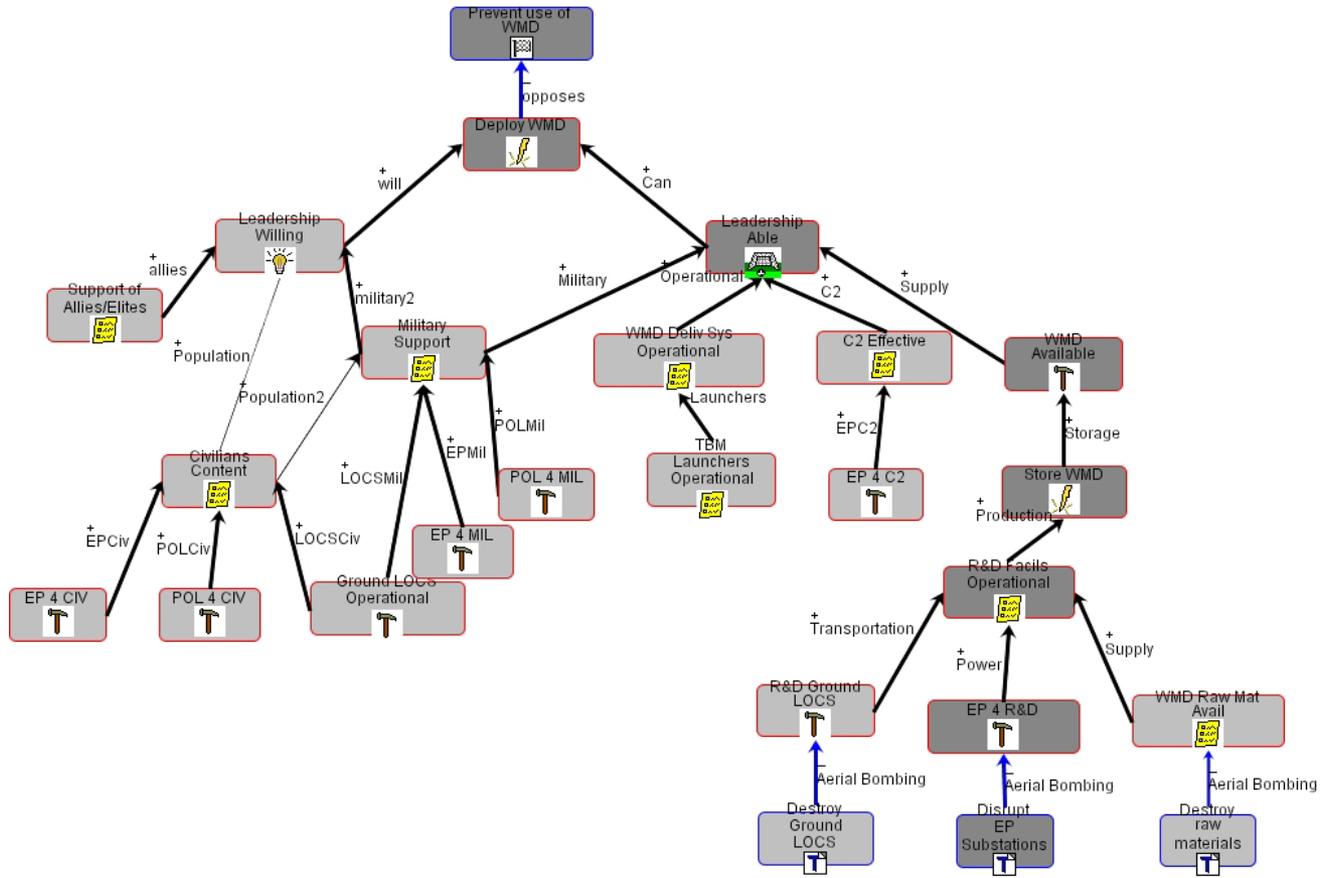
Name: Name of the Action.

Ready

No Bayes Net Running



# Highlighting Causal Chain in COG Articulator





# Strategy Development Tool (SDT)

## Exporting causal chain as a plan fragment



**EBO Strategy Development Tool - ODF\_CAOC\_PHASES.xml**

File Add Edit View Templates Analysis Collaboration Help

File: Add: Edit: View: Missions: Analysis: Layout:

Plan Undesired Effects

Back Forward + Expand - Collapse

Operation Deny Force

- Deter WMD - On Order Disrupt/Destroy
  - Phase 1 - Deployment
  - Phase 2 - Air dominance
  - Phase 3 - Disrupt WMD
    - Prevent use of WMD
      - Deter Deploy WMD
        - will
          - Deter Leadership Able
            - Supply
              - Deny WMD Available
                - Storage
                  - Deter Store WMD
                    - Production
                      - Disrupt R&D Facils Operational
                        - Power
                          - Deny EP 4 R&D
                            - Aerial Bombing
                              - Disrupt EP Substations
- Phase 3 Branch - Destroy WMD
- Phase 4 - Compliance
- Phase 5 - Redeployment

Attributes Relations MOEs

### Objective

Name: Prevent use of WMD

Description:

Catalog Number:

Planning Level: Operational

Priority: 1 Rank Label

Weight of Effort: 100 Percentage Label

Apply Reset

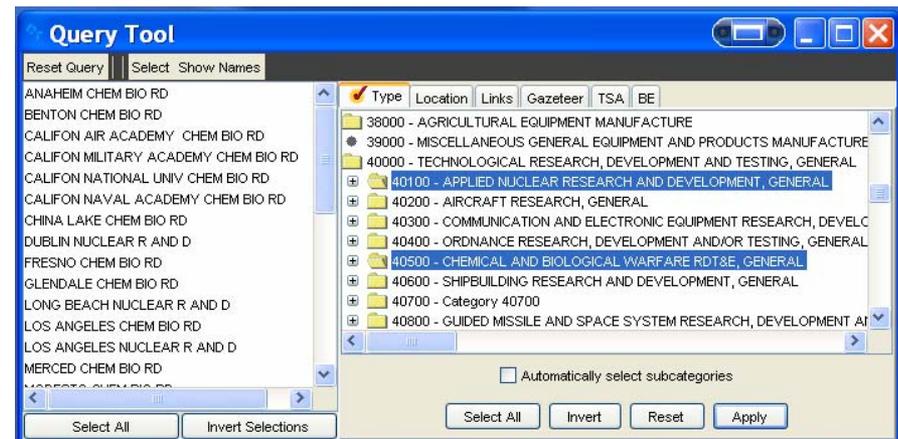
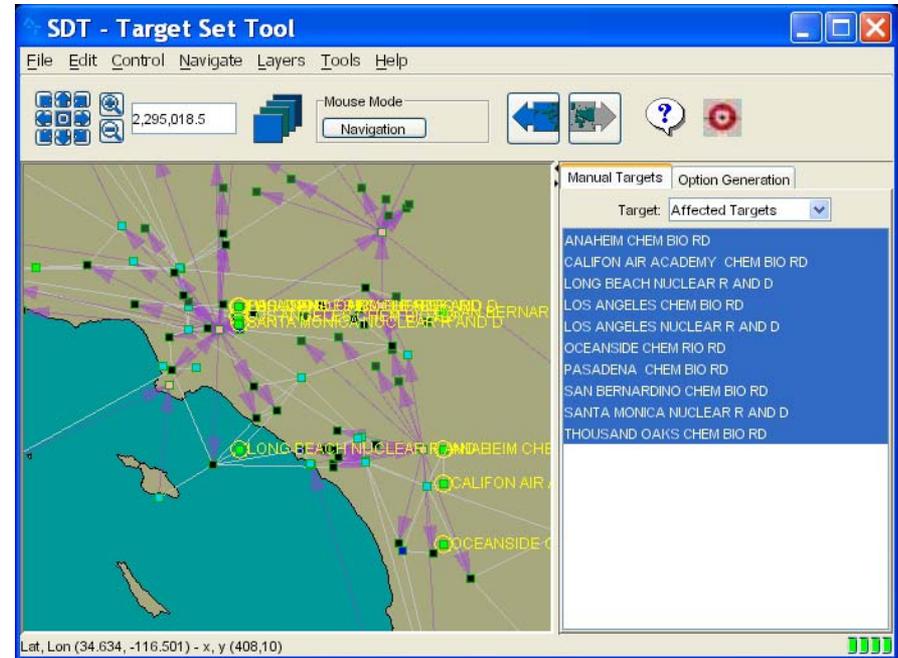
Plan loaded from d:\EBO\_SDT\plans\ODF\_CAOC\_PHASES.xml



# SDT Target System Analysis – Target Set Visualization Tool



- Helps users populate an operational-level plan with potential targets to achieve effects
- Target Set Tool displays known candidate targets from MIDB e.g. power stations, pipelines, etc.
- Query Tool allows user to select targets by type and geographic region
- Links query finds all nodes of a particular type within a specified number of link segments of a given set of nodes
- Used to find direct targets to achieve indirect effects on desired facilities







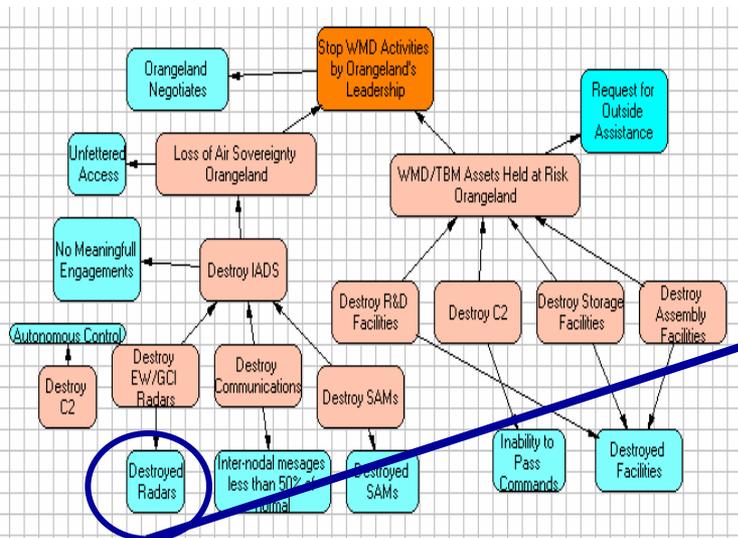


# Fusion for EBO (FEBO)

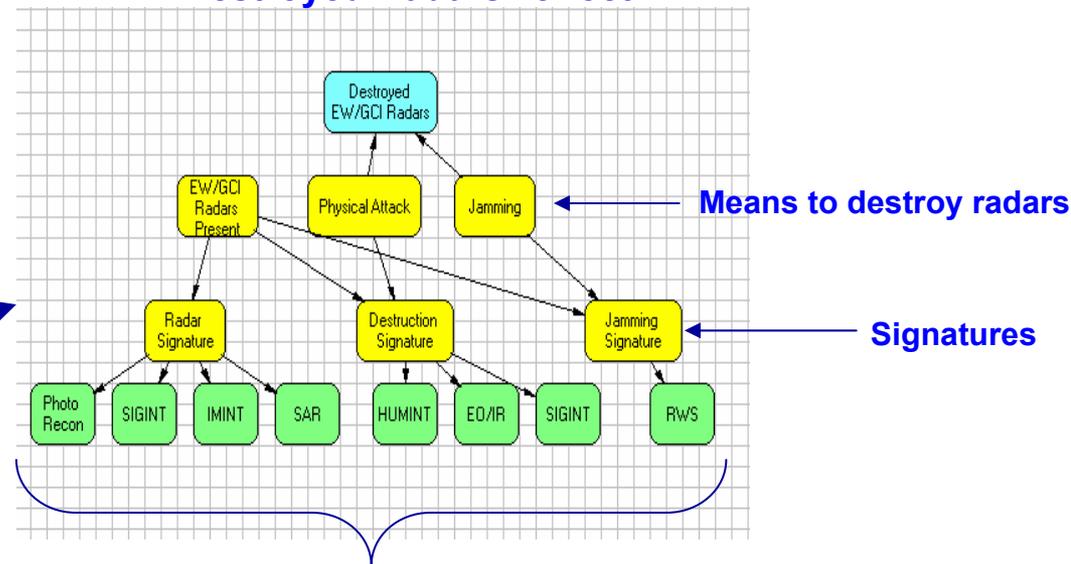


- Determine if MOEs and indicators from SDT are being met
- Provide accrued and fused multi-INT evidence to SDT/CAT
- Based on AFRL Advanced Sensor Fusion Infrastructure
- Monitor planned targets for changes in status

### SDT/CAT Plan Representation



### Expanded causal model for the "Destroyed Radars" effect



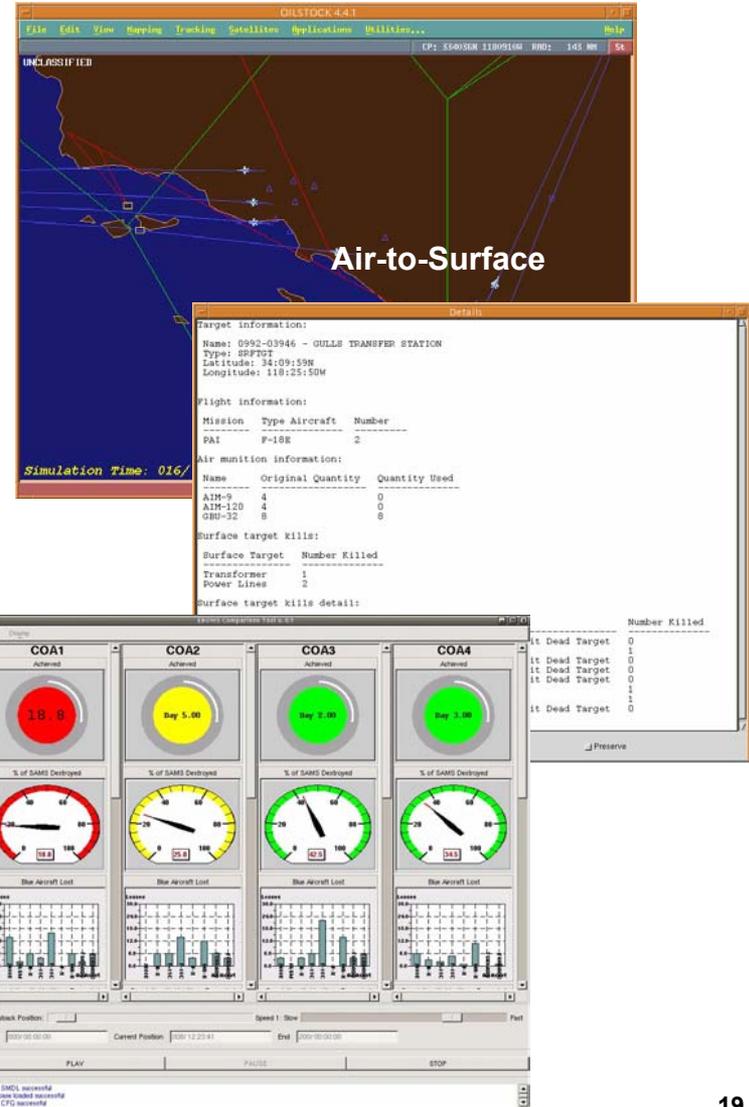
### Accrued INT evidence from fusion products



# Effects-Based Operations Wargaming Simulation (EBOWS)



- Analytic tool for course-of-action (COA) analysis based on engagement-level, attrition-based wargaming
- Capability
  - Course-of-Action (COA) input from the SDT
  - Order-of-Battle, resources, and capabilities input from automated sources
  - Accept variety of input from manual sources.
  - Model corresponding aspects of Opposing Forces.
  - Implement Multiple Blue COAs vs representative Red COAs.
  - Provide flexibility to refine and adjust aspects of each COA.
- Output
  - Side by side comparison of Competing COAs in terms of JFC/JFACC Objectives, Supporting Tasks, and their associated risks.





# Warfighter Assessment and Technology Transition



- **Goal is to transition SDT/CAT as AOC Weapon Systems applications interoperable with TBMCS through web services**
- **April 2003 EBO Workout**
  - **Define required capabilities for an EB integrated approach to strategy development**
  - **SDT/CAT used to shadow the player team**
  - **Led to development of COG articulator**
- **March 2004 Checkmate Strategy Conference**
  - **Air strategists provided with SDT/CAT**
  - **Feedback will be used for tool improvements**
- **JEFX 2004**
  - **AFRL SDT/CAT part of the EBO/PBA initiative**
  - **Feedback from warfighters and assessors**





# Technology Challenges



- **Dynamic Tasking and Assessment**
  - Continuous/streaming ATO cycle
  - Effects Based Assessment
- **Automated parsing of commander's intent**
- **Case Based Reasoning for optimal template use**
- **Adversarial modeling/behavioral modeling**
- **Advanced wargaming tools for EBO**
- **COG and Target System Analysis to help define indirect, cascading and complex effects**



# Summary



- **A tool suite is required to fully realize the benefits of EBO**
- **AFRL has developed a suite of tools for planning, executing and assessing EBO**
- **Tools are prototypes but provide an initial capability to the warfighter**
- **As warfighters experiment with the EBO process and tools, both will mature significantly**
- **AFRL will continue to improve the EBO tool set with a continued focus on the warfighter**