

# Modeling Complex Adaptive Behavior

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CEM IR&D



**MITRE**  
Technology  
Program

# Problem

- Improve effectiveness of special operations conducted at U.S. land border
- Land border environment complex: legitimate commerce, organized drug trafficking, illegal immigration, terrorist activities
- Environment imposes many constraints
  - Port of Entry (POE) physical constraints
  - Traffic volume
  - Limits on referral rate
  - Tactics open to observation



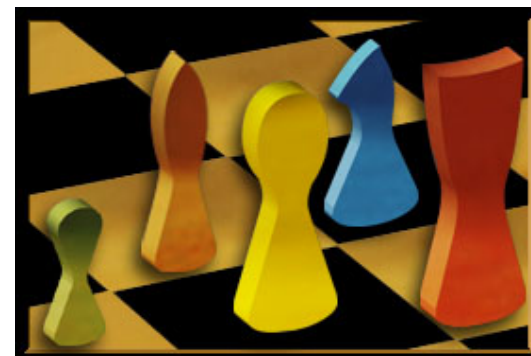
# Background

- **Smugglers believed to practice a variety of well-known deception techniques to thwart effectiveness of special operations**
  - **Camouflaging through use of clever packaging techniques and concealment locations**
  - **Allowing or suggesting continuation of patterns that no longer exist or rapidly changing patterns of behavior**
  - **Presenting a phony or low value target to draw attention from a higher valued target**
  - **Creating a distraction to draw attention from true area of interest**



# Objective

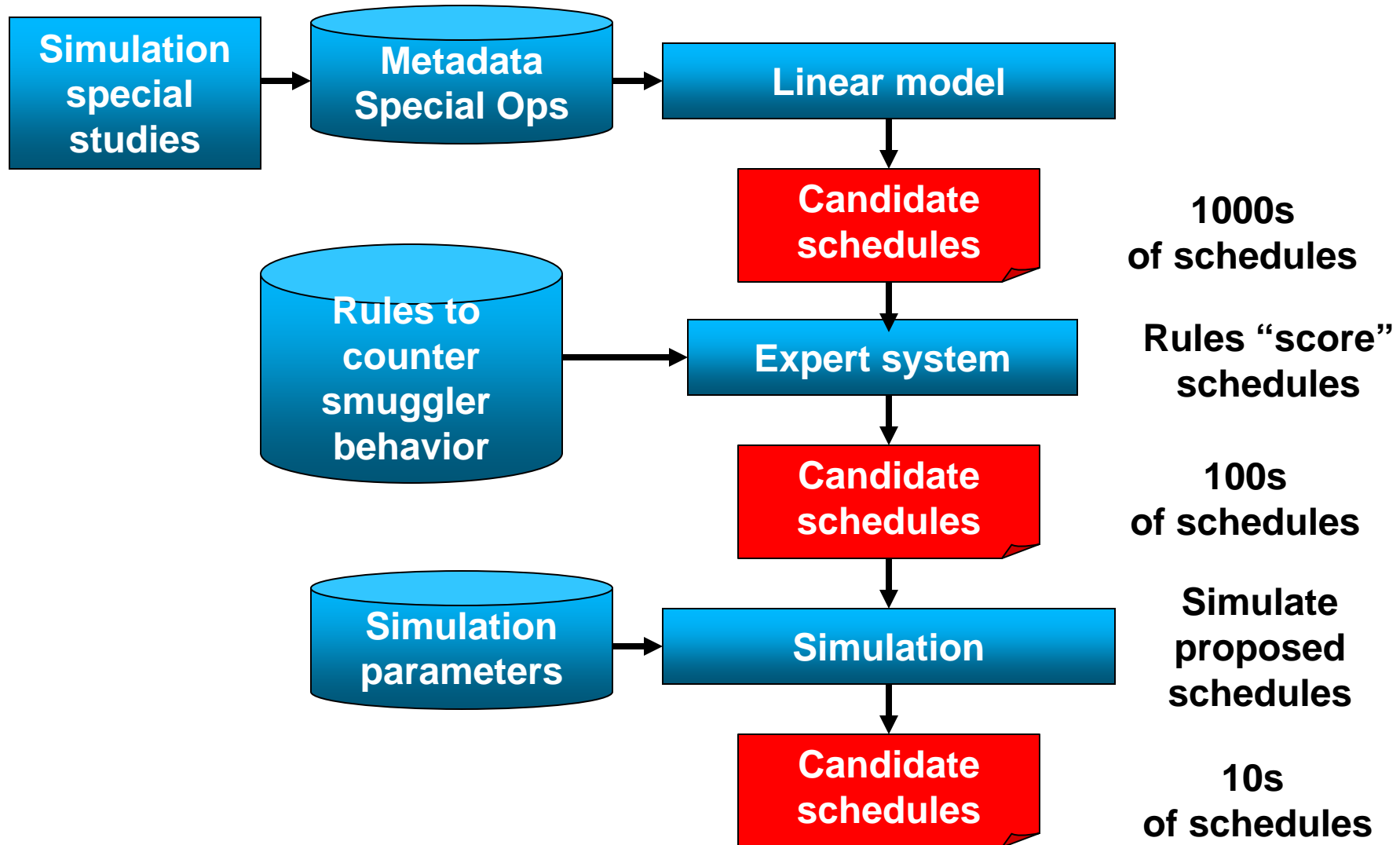
- **Demonstrate techniques for performing scheduling in complex, highly constrained environment**
- **Demonstrate ability to incorporate adversarial behavior model into scheduling process**
- **Demonstrate integration of multiple technologies for schedule optimization**
  - **Linear model**
  - **Expert system**
  - **Agent-based simulation**



# Activities

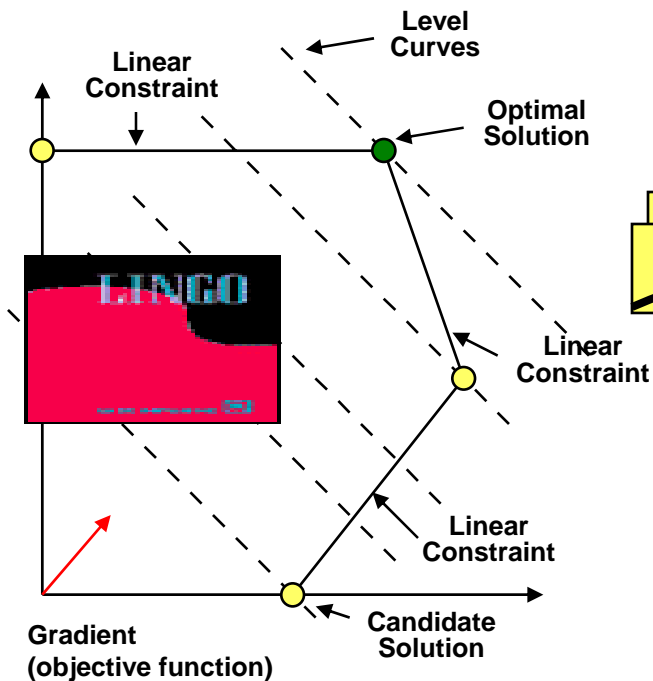
- **Develop linear model to generate large number of candidate schedules**
- **Develop rule-based system to evaluate and score candidate schedules**
- **Enhance existing agent-based simulation of land border to evaluate candidate schedules**
- **Conduct special studies, experiments, and statistical studies to explore smuggler scenarios**

# Highlight



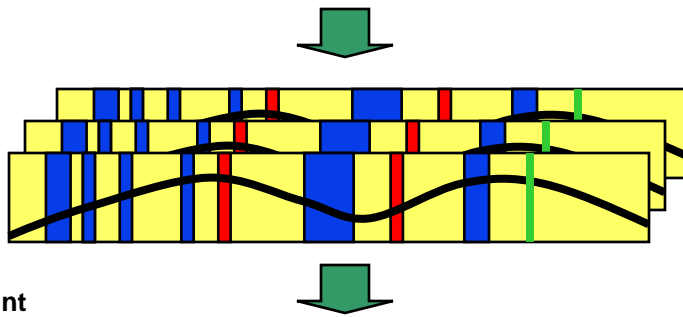
# Highlight/Demonstration

## Linear Model



## Expert System

Candidate Schedules



Score each schedule using expert rules

Rule 1: schedule diversity

Rule 2: schedule coverage

Rule 3: use of dedicated resources

## Agent Simulation

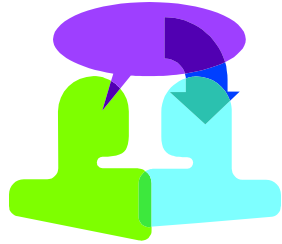


# Impacts

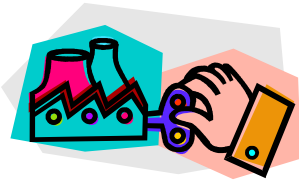
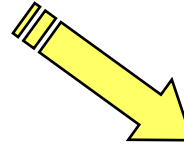
- Improve understanding of smuggler behavior
- Demonstrate specific techniques for countering smuggler behavior
- Improve acceptance and understanding of the role of decision support technology for homeland security



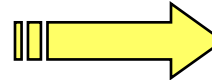
# Future Plans



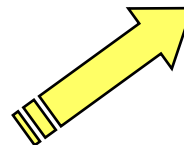
**Conduct technology transfer by demonstrating utility of approach for planning special operations**



**Continue to refine and improve multi-step approach for scheduling special operations**



**Disseminate findings through technical exchanges, briefings, conference papers**



**Effective system for scheduling special operations**

**Understanding of smuggler behavior**