



# **Center for Risk and Economic Analysis of Terrorism Events**

**Estimating Likelihood of Terrorist Attacks by  
Modeling Terrorist Objectives and Values**

**March 15-16, 2007**

**DHS Summit**

**Washington, D.C.**

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# Why Study Terrorists Objectives and Values?

In his book, Why do Muslims Rebel?, Mohammed Hafez cautions that, “Misconstruing the underlying causes of Islamist rage or overreacting to Islamist violence may only intensify militancy, not temper it.”<sup>1</sup>

- Current methods for terrorism risk assessment focus on target vulnerability, terrorist capability and resources, and attack consequence
- Important to understand the influence of values and group dynamics on terrorist organization behavior
- Potential for contributing to probabilistic estimates of terrorist threats



# Terrorism vs. Technological and Natural Disaster Analyses

- Difficult to predict specific time and location of technological and natural disasters
- Yet, we attempt to characterize the probability of technological and natural disaster events
  - Earthquakes – Seismic geological studies
  - Hurricane – Oceanographic studies
  - Industrial accident – Risk studies
- None of these studies predict a specific time or location of an event in advance of its occurrence



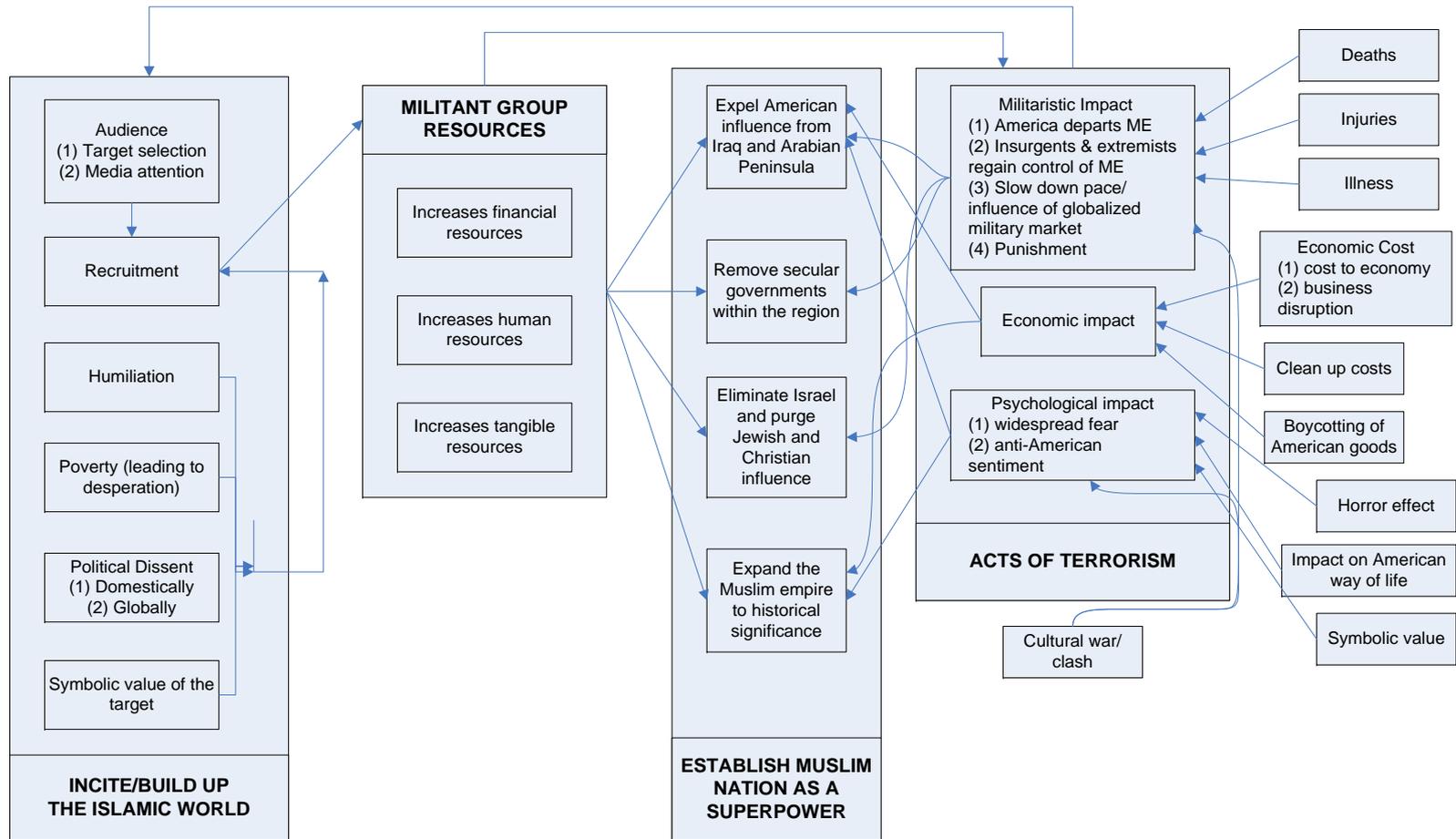
## General Approach

- Studying beliefs and motivations of terrorist leaders
  - Beliefs: What do terrorist leaders believe about the likely outcomes of specific attacks?
  - Motivations: What are the values and objectives of terrorist leaders?
- Using published writings by and about terrorist leaders to infer beliefs and motivations
- Interviewing those who understand terrorist leaders
  - Intelligence experts
  - People who understand and/or empathize with terrorist leaders

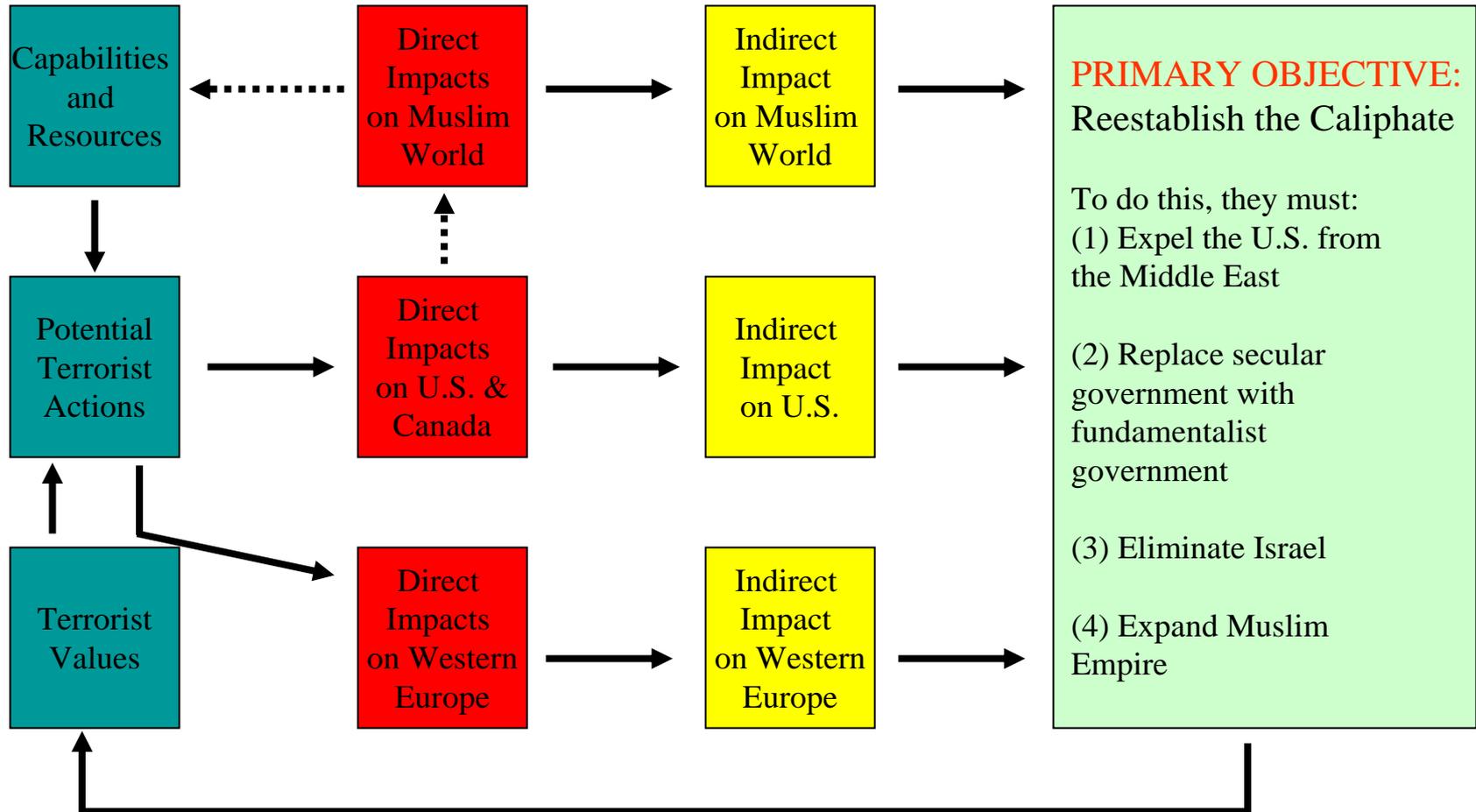
# Analytic Approach

- Conduct proxy value-focused thinking for terrorist leaders
  - Means-ends diagram
  - Objectives hierarchy
- Construct a multi-attribute utility model for evaluating terrorist attacks using the proxy objectives hierarchy
- Use proxy distributions to describe terrorist beliefs about attack outcomes
- Use distributions to describe uncertainty about terrorist trade-offs among conflicting objectives
- Use a random utility model to relate relative desirability of an attack alternative to likelihood of terrorist leaders selecting a particular attack alternative

# Means-Ends Model Version 1

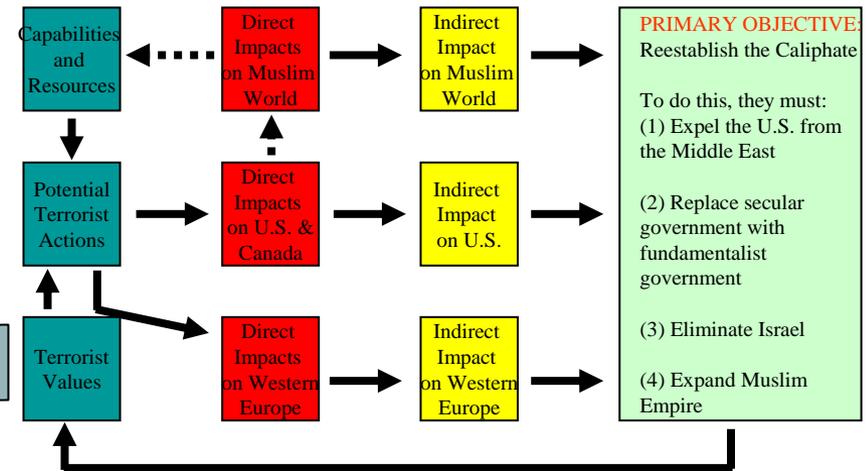


# Means-Ends Model Version 2



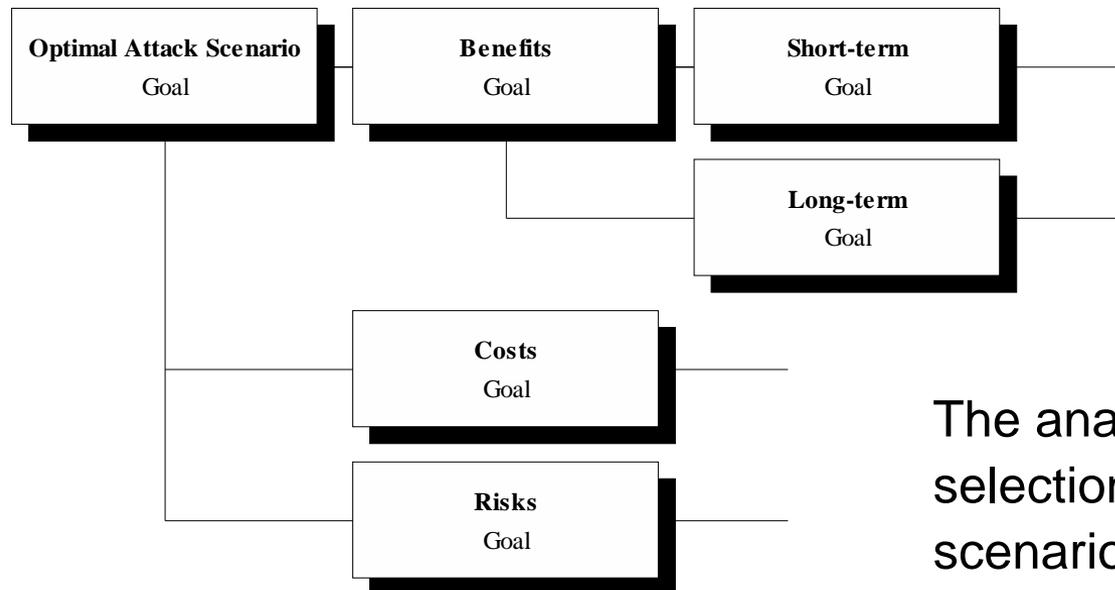
# Values Analysis

- From the means-ends models we can elicit terrorist preferences and values.
- Use multi-attribute utility analysis to elicit and characterize their objectives, values and risk attitudes



**Terrorist  
Motivations  
and Values**

# Value Tree – Objectives Hierarchy



The analysis assumes that the selection of the “optimal attack scenario” is characterized by the most favorable conditions given the set of benefits, costs and risks driving the terrorist

# Objectives Hierarchy Attributes

## Benefits

1. Fatalities
2. Injuries
3. Horror Effect
4. Economic impact
5. Symbolic value
6. Impact upon U.S. allies
7. Impact on American way of life
8. Continuity of Islamic people

## Costs

1. Time required to plan the attack
2. Human resources
3. Cost of the attack

## Risks

1. Probability of success
2. Probability of retaliation

- Attributes define the terrorist attack scenarios as perceived by terrorist leaders
- Each unit is characterized by a numeric property that either precisely defines the unit described or serves as a proxy

# Attribute Measures

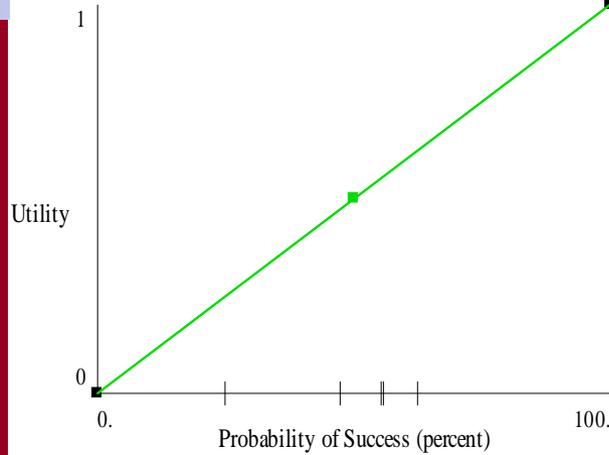
| Measure                          | Units                       | Least Preferred | Most Preferred |
|----------------------------------|-----------------------------|-----------------|----------------|
| Immediate fatalities             | Number                      | 1               | 3000           |
| Injuries                         | Number                      | 1               | 4500           |
| Horror effect                    | % of ER population<br>(ASD) | 0               | 20             |
| Short-term economic impact       | \$ Millions                 | 0.01            | 300            |
| Symbolic value                   | Subjective units            | 0               | 100            |
| Impact on U.S. allies            | Subjective units            | 10              | 0              |
| Long-term economic impact        | \$ Millions                 | 1000            | 252000         |
| Long-term fatalities             | Number                      | 1               | 2000           |
| Impact on U.S. way of life       | Subjective units            | 0               | 100            |
| Continuity of Islamic people     | Number                      | 2000            | 120000         |
| Time required to plan the attack | Years                       | 5               | 1              |
| Human resources                  | Number                      | 30              | 1              |
| Cost of the attack               | \$ Millions                 | 0.75            | 0.001          |
| Probability of success           | Percent                     | 0               | 100            |
| Probability of retaliation       | Percent                     | 100             | 0              |

## Attack alternatives are scored on each attribute measure

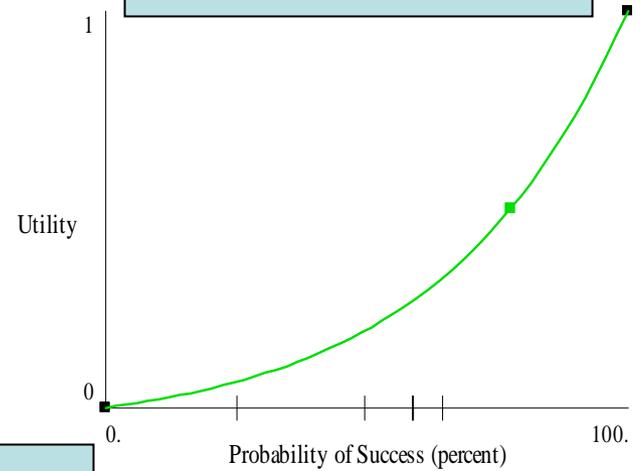
- Quantify how well a given measure meets what she perceived as the terrorist's benefits, costs and risks
- For example, when assessing the number of deaths associated with a 9/11 copy cat attack, proxy distribution for terrorist leaders' beliefs: Lognormal

# Risk Attitude for Attack Attributes

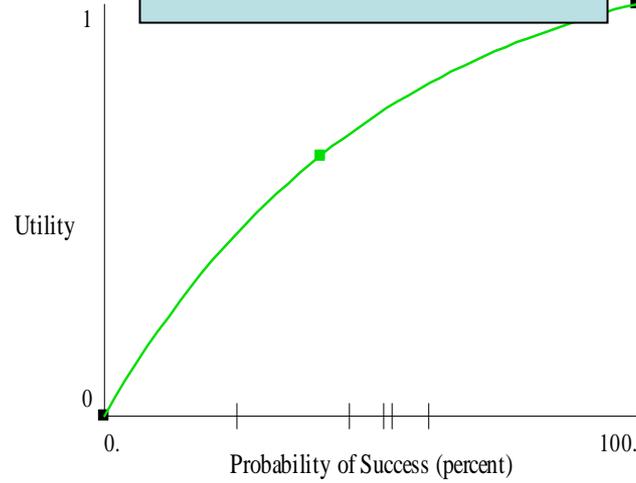
Terrorist Leader 1



Terrorist Leader 2

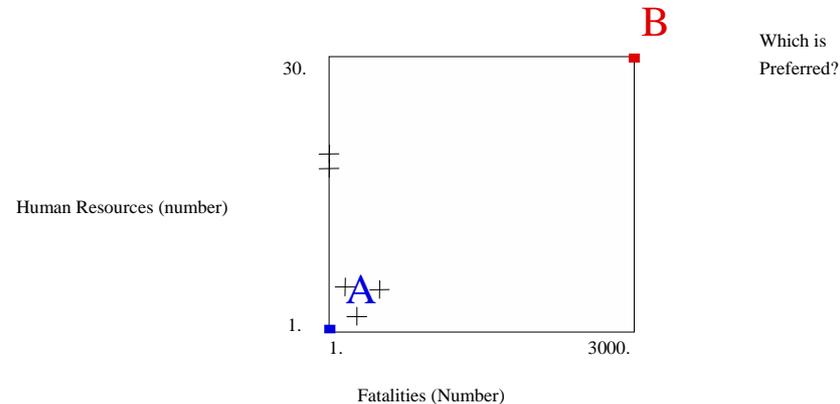


Terrorist Leader 3



# Tradeoffs Among Objective Attributes

- To ascertain the factors influencing the definition of each objective, weights are assigned to create comparisons across attack attributes
- A multiattribute utility function is developed that assigns preferences to relevant attributes
- Proxy trade-offs are constructed for terrorist stakeholders



|                           | A | B    | A-B   |
|---------------------------|---|------|-------|
| Fatalities (Number):      | 1 | 3000 | -2999 |
| Human Resources (Number): | 1 | 30   | -29   |

# Weights for Terrorist Leader

## Percentage Weight for Preference Set Take5

| Measure   | Percentage Weight | Effective Weight |
|---|-------------------|------------------|
| Immediate fatalities                                | 25.3              | 22.944           |
| Injuries  | 0.4               | 0.301            |
| Horror effect                                       | 3.1               | 2.205            |
| Short term economic impact                          | 14.4              | 23.496           |
| Long term economic impact                           | 21.0              | 26.846           |
| Probability of success                              | 1.1               | 0.631            |
| Symbolic value (of the target)                      | 2.3               | 0.519            |
| Impact on U.S. allies                               | 3.2               | 1.569            |
| Time required to plan the attack                    | 0.3               | 0.195            |
| Human resources                                     | 0.3               | 0.088            |
| Cost of the attack                                  | 0.3               | 0.413            |
| Long term fatalities                                | 4.2               | 2.207            |
| Impact on American way of life                      | 11.8              | 11.853           |
| Continuity of Islamic people (religious solidarity) | 11.6              | 6.451            |
| Probability of retaliation                          | 0.9               | 0.281            |

NOTE: Effects of interactions not included.

# Tradeoffs Among Conflicting Objectives

- A second series of weights are developed to account for how the objective attributes do not contribute independently to the understanding of terrorist motivations and beliefs
  - For example, a terrorist might prefer to only lose a few lives and expend a moderate amount of money to carry out an attack. As such, the terrorist prefers this moderate balance of attributes as opposed to getting the best of one and the worst of the other.
- The basis of these preference interactions is modeled through a multiplicative multiattribute utility formula

## Example Multi-attribute Results

|                                      | Decision Maker 1 |      | Decision Maker 2 |      | Decision Maker 3 |      |
|--------------------------------------|------------------|------|------------------|------|------------------|------|
|                                      | Utility          | Rank | Utility          | Rank | Utility          | Rank |
| <b>Dirty Bomb Attack</b>             | 0.782            | 1    | 0.277            | 2    | 0.662            | 1    |
| <b>9/11 Copy Cat Attack</b>          | 0.720            | 2    | 0.268            | 1    | 0.643            | 2    |
| <b>Manpad Attack</b>                 | 0.536            | 3    | 0.335            | 3    | 0.414            | 3    |
| <b>Attack on Government Facility</b> | 0.520            | 4    | 0.475            | 5    | 0.385            | 4    |
| <b>Subway Attack</b>                 | 0.370            | 5    | 0.356            | 4    | 0.261            | 5    |

- Sample model run for 3 different Terrorist Leaders
- The multiplicative formula ranks the attack scenarios for each of the decision makers

# Example Multi-attribute Results

Ranking for Optimal Attack Scenario Goal

Alternative

- Dirty Bomb Attack (seaport)
- 9/11 Copy Cat
- Manpad Attack (Coordinated Simultaneous Attacks)
- Attack on Government Facility - Suicide Truck Bomb (Coordinated Simultaneous Attacks)
- Subway Attack - Suicide Bomber (Coordinated Simultaneous Attacks)

Utility



Alternative failed at least one cutoff

Preference Set = Take5

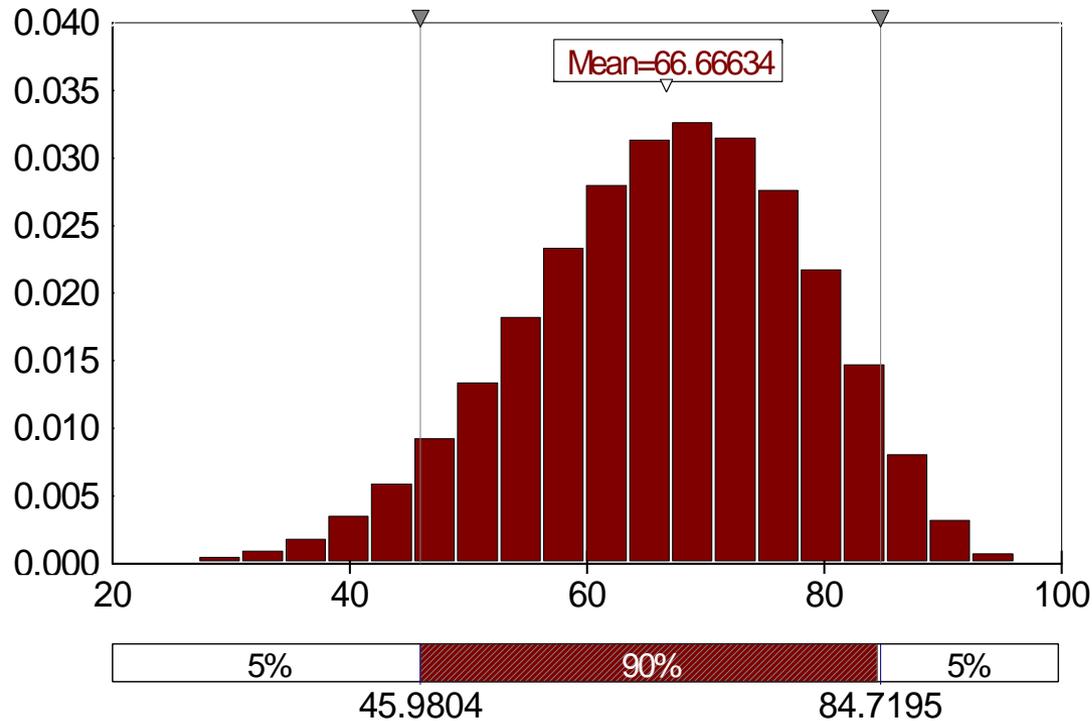


# Uncertainties Captured in Random Utility Model

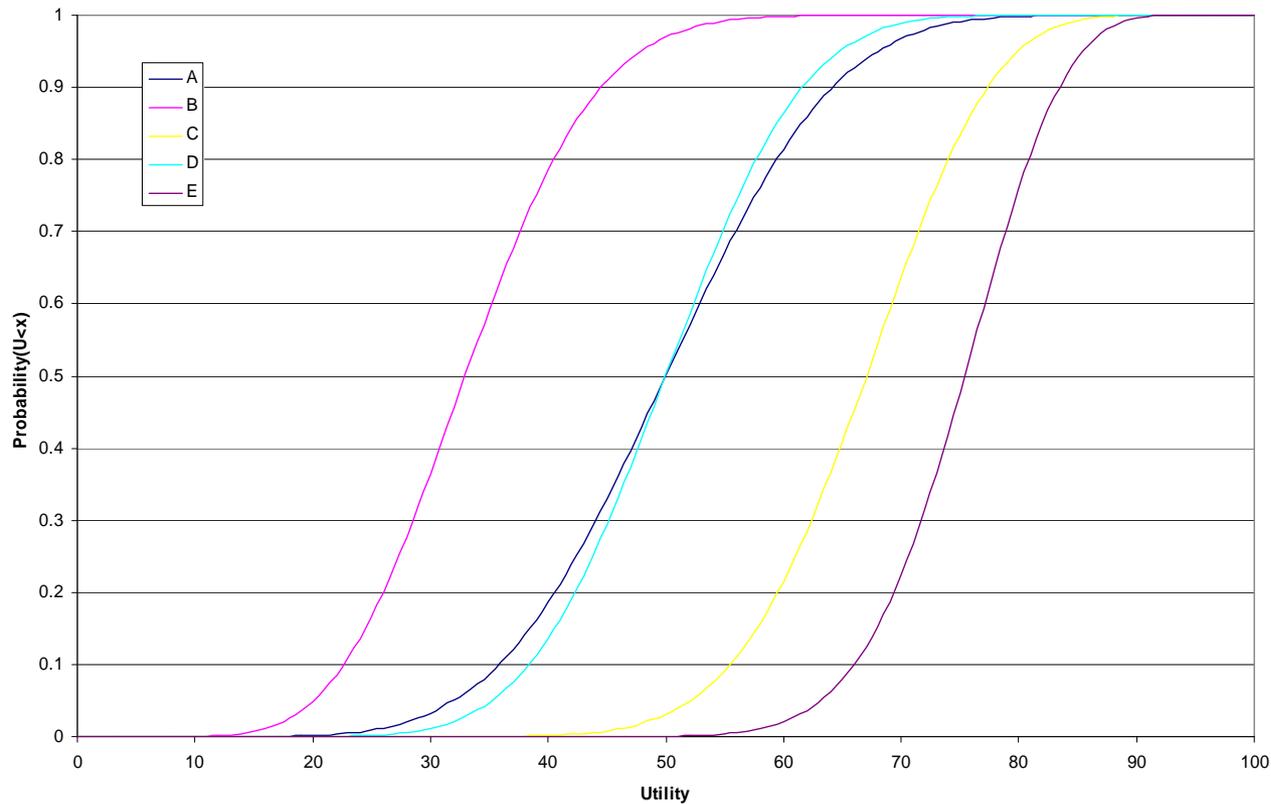
- Outcome Uncertainty
- Value Uncertainty
  - Terrorist Perception of Outcomes
  - Terrorist Utility Function (Risk Attitude)
  - Terrorist Trade-offs (Weights)

# Proxy Utility Distribution for one Attack Option

Distribution for A/C3



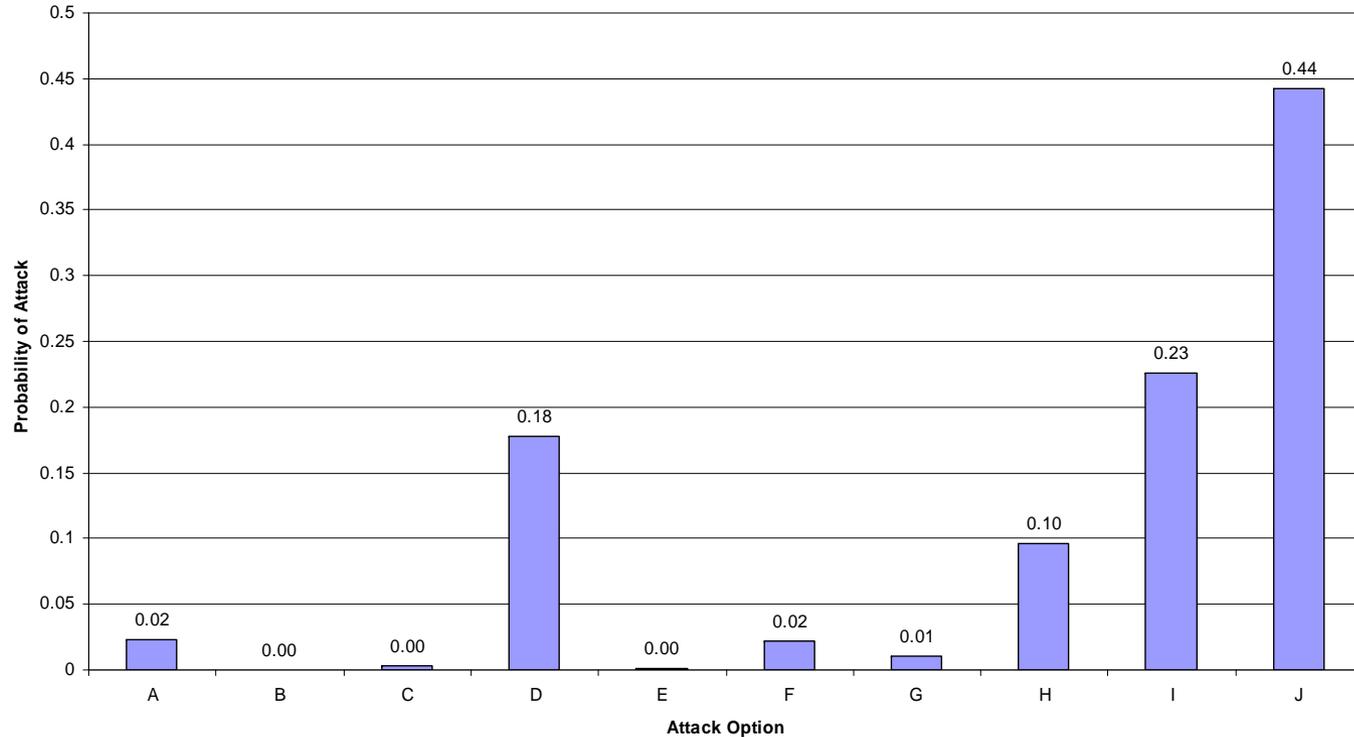
# Proxy Utility Distributions for Competing Attack Options



# Probability of Terrorist Attack

$P(U(\text{attack option}) = \text{Max } U)$

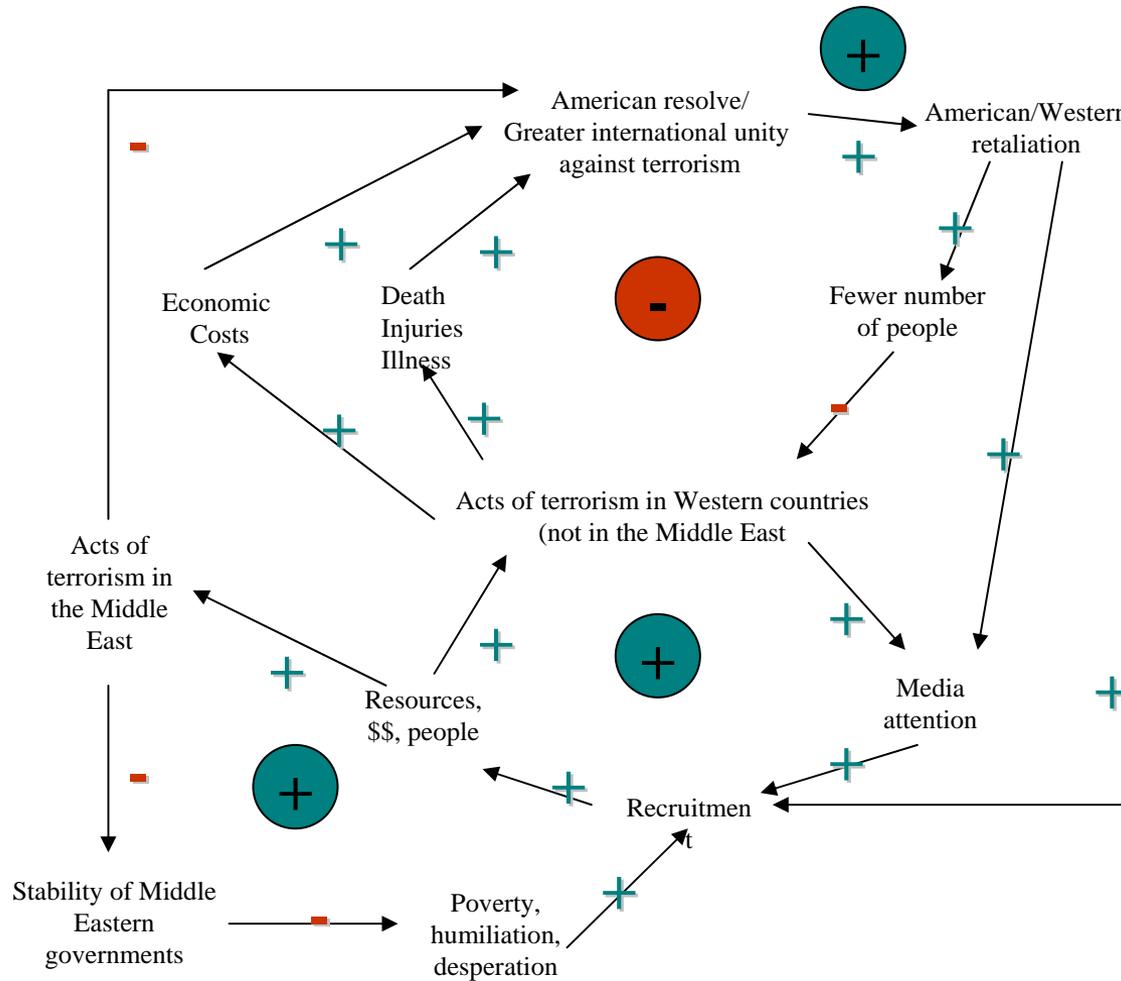
Random Utility Model



# Challenges and Difficulties

- Terrorist leaders not unified
  - Different terrorist stakeholder groups, separated geographically
  - Values and beliefs of terrorist groups may conflict with one another
- Terrorist leadership may change
  - Leadership evolves; some are killed or captured
  - Beliefs and motivations may change over time
- Terrorist beliefs may change
  - Success probabilities and consequence expectations may change due to counterterrorism efforts
- Attack alternatives may change
  - Alternative set is growing due to terrorist advances
- Terrorist values and objectives may change

# Dynamic Nature of Terrorist Threat



## Conclusions: Next Steps

- Select terrorist leader to construct detailed model
- Construct proxy means-ends model and objectives hierarchy for terrorist leader
- Use open source information and past behavior to construct MAU model for this leader
- Construct RUM for this leader
- Validate model

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