

Unclassified
MORS Presentation

Using Decision Trees as a Decision Support System for EBO Analysis and Rapid COA Analysis and Selection

*"The military profession, dealing as it does with life and death, should be utterly realistic, ruthless in discarding the old for the new, forward-thinking in the adoption of new means of violence."
—Edward Katzenbach, "The Horse Cavalry in the Twentieth Century"*

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Opinions and recommendations not reviewed or approved by STRATCOM or IDA
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Overview

- Current capabilities to conduct risk assessment and decision-support system (DSS) used for analyzing and recommending Courses of Action (COAs)
- DSS and Process for very rapid risk assessment of "Global Strike" operations or any military operation that may involve use of nuclear weapons (NW) or response to enemy use of WMD
 - Global Strike at STRATCOM is a new mission defined as very rapid design and execution of short duration strikes, conventional or nuclear; not "kicking the door down" use of airpower
- Measures of Success: Policy Effectiveness (MOPE) and Force Effectiveness (MOFE)
- The need to consider full DIMES (including Social) considerations in evaluating COAs, especially if WMD involved
- The importance of real Effects Based Operations--influencing Red decision--in evaluating COAs

Biggest Shortcoming in Successfully Exercising a Global Strike or Countering WMD May Well Be Shortcomings in Speed and Quality of Decision Making; Particularly at National-Level

- Based on state of COA analysis in DoD and tools/procedures for resolving inter-agency debate at national level, it is likely that improvements in COA analysis and decision-making process are far more important than changes to forces or doctrine—especially in situations where a very rapid decision is needed
- Choosing Between COAs Not Supported by any Sophisticated Methods
 - COAs rated by how well they achieve/fit with principles of war like “Simplicity,” Effect on Enemy Center of Gravity”, “Mass”, etc. on a 1 to 5 subjective rating
 - Weights applied to the most important factors, then multiplied by rating for total score
 - Some Theater Commands are pursuing DSS improvements to help, but largely just improving Internet-collaboration
 - CENTCOM’s “Campaign Analysis/Decision Support System”
 - PACOM working with CINC 21 “Decision Focused Operations” and “Adaptive Course of Action” software

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Risk Assessment a key part of Decision Support System . . .

1. Identify relevant risks, by strike option or COA
2. Adjust strike plans/COAs where feasible to avoid or mitigate major risks
3. Fully disclose key risks, issues and uncertainties to decision-makers

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... and Separation into Two Different but Connected Processes, Different Measures of Effectiveness—both feeding the Decision on Which COA to Select

- | | |
|--|---|
| <p>1. Risks to successful execution of military strike, destruction of targets</p> <ul style="list-style-type: none">• Probability of Losses to Allied Forces• Probability of Target Destruction• Likely Collateral Damage | <p>2. Risks to the nation from the different Courses of Action</p> <ul style="list-style-type: none">• What is likely effect of strike/COA on enemy leader?• Diplomatic, psychological, social impacts of different COAs on short and long-term US objectives?• Impacts of using conventional vs. NW? |
|--|---|

Military focuses on these risks while building/refining COAs

National Advisors, Decision-Makers focus on these risks (with risks and probability of strike success a key consideration) while evaluating and choosing COAs

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Essential to Distinguish between Measures of Policy Effectiveness and Measures of Force Effectiveness

- Measures of Policy Effectiveness (MOPE): Quantitative or Subjective Indicators of outcomes that have produced or contributed to producing the desired effect—the success outcome
 - Does Red Leader Back Down? Threat Eliminated?
 - Terrorist Groups Empowered/Inspired or Deterred?
 - Long-run security of U.S. and Allies Enhanced?
- Measures of Force Effectiveness (MOFE): Traditional view of MOE
 - Probability of Target Destruction
 - Friendly Force Casualties
 - Achieve Military Campaign Objectives
- In any war, MOPE should drive decisions—you can win battles but lose the war; or have a Pyrrhic Victory
- In WMD situation, MOPE will dominate MOFE; political, non-proliferation, moral, social considerations likely to override issues of military effectiveness

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Rest of Briefing Covers Scenarios countering Enemy WMD, possible U.S. NW use. For skeptics: Situations where U.S. May Well Use Nuclear Weapons

- Biological/chemical weapons that need to be thoroughly incinerated to be safely destroyed (not dispersed into the atmosphere by conventional explosions)
- Enemy firing WMD at US/Allied forces or Civilians from highly mobile/well hidden targets that cannot be acquired and destroyed:
 - Large numbers of difficult to acquire targets (SCUDs for example) where you must blanket an area with some fire to destroy or disable
 - Large numbers of dispersed targets too numerous for conventional PGM systems to eliminate in time
- Situations when U.S./Allied troops hopelessly outnumbered and only immediate use of NW firepower can stave off defeat
- Critical hardened, deeply-buried targets; leadership or WMD
- Demonstrative/warning detonations of NW to both show determination and shock an aggressor into ending WMD use

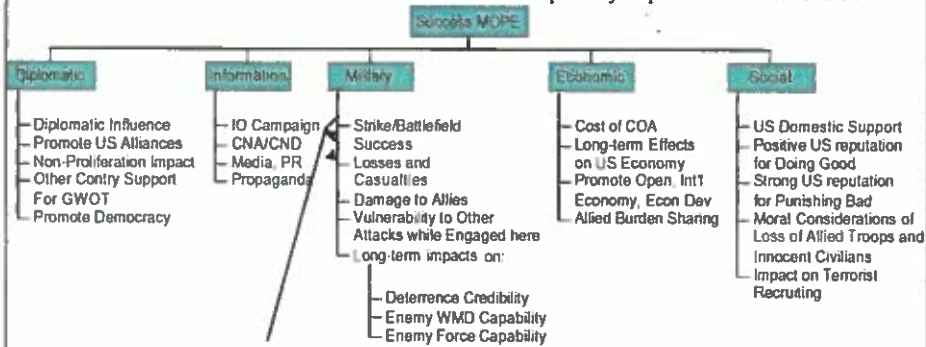
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Counter-WMD, Possible NW Use Decision and MOPE must cover a very wide range of DIMES considerations

Adding "Social" element to DIME model especially important in WMD context



- Immediate Strike MOFE could be a relatively small part of decision
- DIMES considerations very situation-dependent

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... and include real EBO Analysis, "Focused on the Mind of Man" -- Influencing the Red Leader (the key MOPE), not on optimal target destruction (MOFE)

"Effects-based Operations are coordinated sets of actions directed at shaping the behavior of friends, neutrals and foes in peace, crisis, and war. . . . [N]etwork-centric, effects-based operations [are] about focusing knowledge, precision, speed, and agility not on more efficient destruction but upon the enemy decision-makers and their ability to take coherent action. . . . [T]he promise of network centric operations will avail us little if they are applied to sharpening the tools of past wars or tools to pursue the wrong objectives. This is where the concept of effects-based operations comes in. Effects-based operations do focus on the mind of man." -- Edward A. Smith, Boeing Washington Studies and Analysis Office, From Network Centric . . . to Effects-based Operations, 2002

- Military-campaign focused views of EBO (faster/better C2 destruction) risk losing opportunities to achieve "first best" solutions and higher levels of destruction that may be avoided

"Right now, the EBO Cycle is optimized only for deciding if and how the US can 'take down the enemy power grid'."

-- Air-Ground Working Group White Paper, Draft, 5 Dec 2002

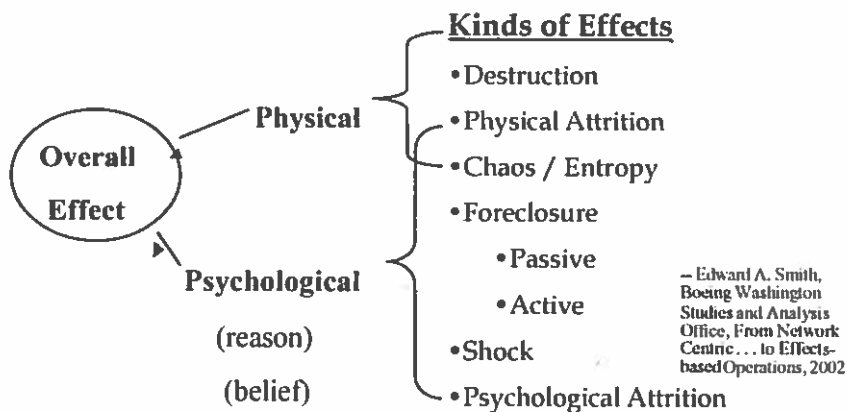
- "Attain Document"/"El Dorado Canyon" -- successful EBO against Libya

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NW Contribute Not just in Target Destruction, but at Psychological Level of Chaos, Shock, Terror, as well as Eliminating Hope for Victory

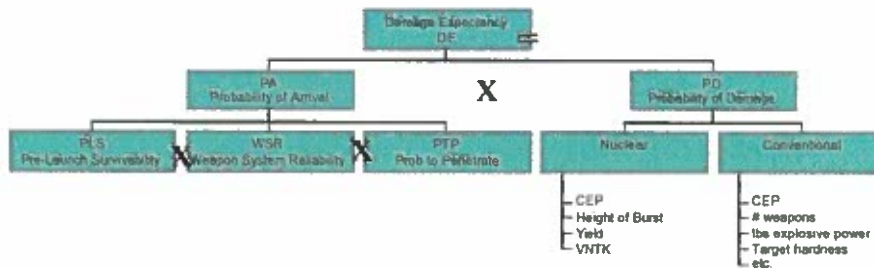


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The "Probability of Arrival/Probability of Target Destruction" Model adequate for Strike Risk Assessment and use as primary Measure Of Force Effectiveness



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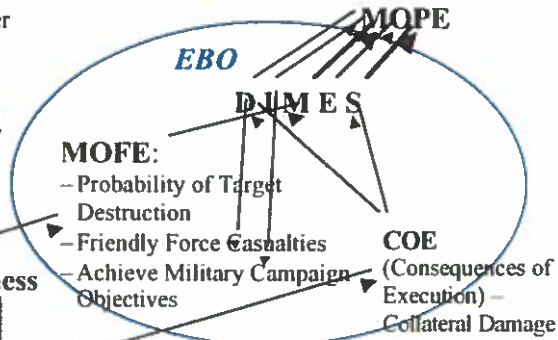
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Question of Nuclear or Conventional Cannot be usefully considered in a strictly military context—must use EBO and full DIMES Measures of Policy Effectiveness

Influencing the Red Leader (EBO) and "Doing the Right Thing" (Social-Moral considerations) likely to dominate NW use decision

Weapons Effectiveness

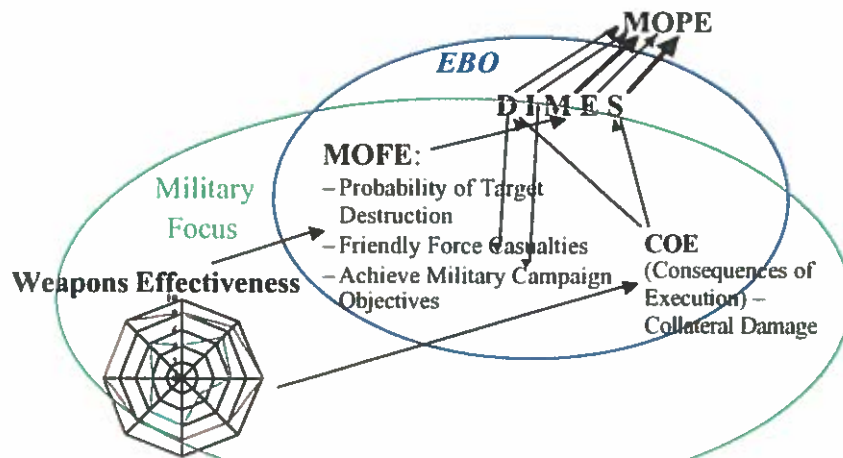


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A Decision Support System is Critical to Integrate EBO and Facilitate Very Fast COA Development

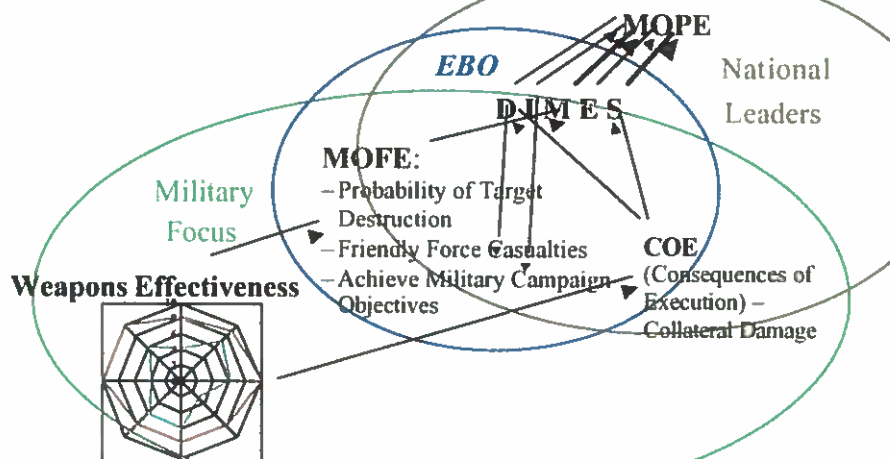


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. . . and integrate National-level Debate into the EBO, DIMES, COA Analysis and Recommendation



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To Do EBO Analysis and Consider the Full Range of DIMES Issues Involved in Counter-WMD Decisions, A "Framework for Analysis"/DSS like a Decision-Tree May be Ideal

- "Our objective in executing effects-based operations is somehow to create a unity of effect that focuses all actions and thereby masses their effects toward a particular behavioral objective. . . . The national leadership must coordinate all the diverse elements of national power so as to create a single overall effect at the geo-strategic level of operations in which each action by each element, military, political and economic, reinforces the actions of the other elements in driving observers toward a desired behavior."
- Edward A. Smith, Boeing Washington Studies and Analysis Office, From Network Centric . . . to Effects-based Operations, To be published 2002

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A Specialized, Nuclear Weapons Use Decision Support System is Proposed to Support EBO/MOPE analysis of COAs: "Counter-WMD Decision Support System"

- This specialized Risk Assessment and Decision Support System (DSS) and Process for simultaneous, integrated strike planning and national-level debate/COA Analysis would be well developed and practiced to achieve:
 - Very quick assessment of risks broadly defined: military, diplomatic, war on terrorism, long-term effects on US and world
 - Considers all elements of DIME
 - As in-depth analysis of Red Leader/country or group as possible to see what COA best influences the "right decision" (EBO)
 - "Players" knowledgeable about nuclear weapons effects and issues inherent in their use, experienced in "thinking about the unthinkable"
 - Very fast analysis and debate to reach both developed COAs and a national agency level consensus (or well-defined areas of disagreement) on best COA
 - Make right decision considering both immediate Red threat and long-term threats/shaping global environment

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Two Separate but Very Integrated Processes in One DSS

Military Strike Planning

- JCS in charge; STRATCOM or Theater Planning
- Develop Military COA
- EBO Analysis
- Evaluate MOFE
- Determine COE for NW use
- Articulate Military Considerations, Participate in National-Level Debate

National Level Decision

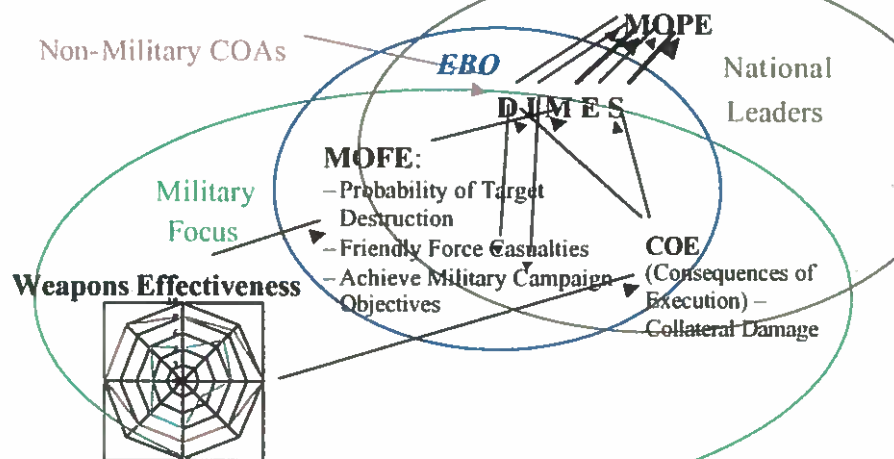
- NSC in charge; run the DSS to facilitate National-Level Decision and integrate with Military Planning
- Develop non-military COA, integrated COA
- Full DIMES Consideration, EBO Analysis
- Evaluate MOPE
- Recommendation to POTUS

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There may also be COAs developed outside the Military, by DOS, CIA, NSC or Other Group that are Considered and May Lead to Modifications to Military COAs



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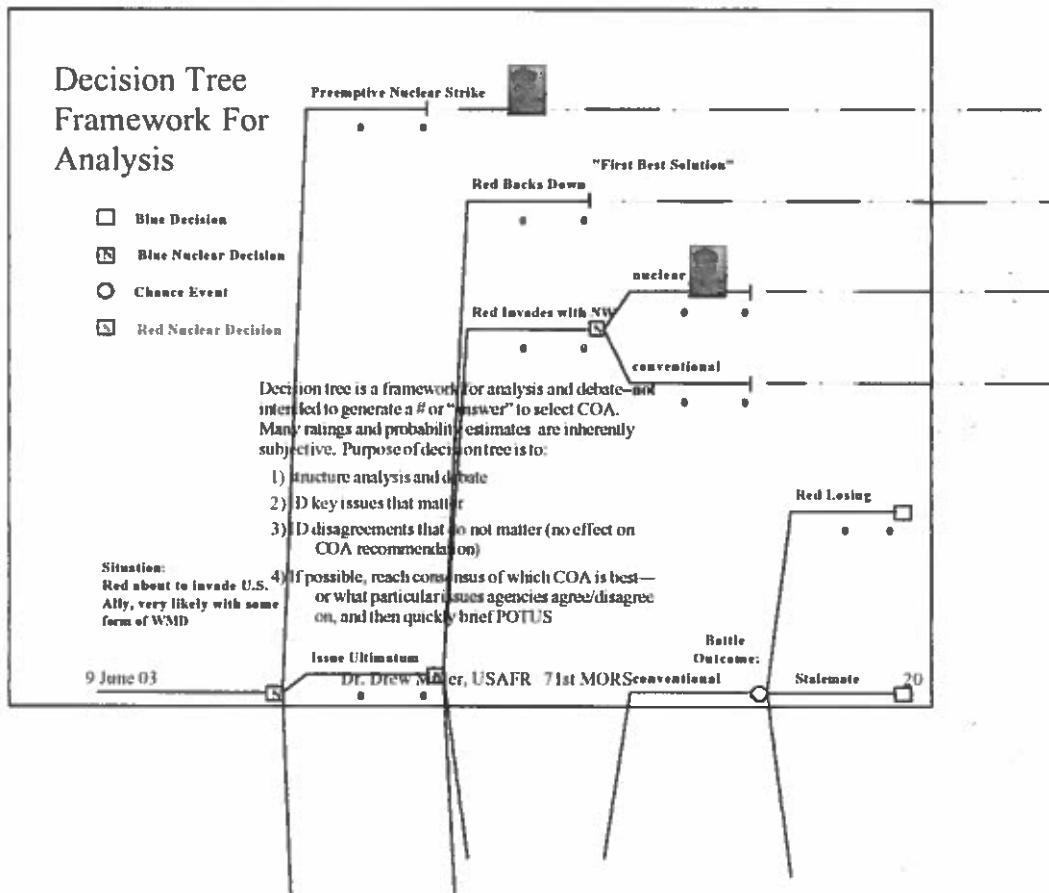
Time Pressures also Demand Simultaneous, Integrated National-Level Debate/Military COA Analysis

- In a crisis dealing with WMD, decision time likely to be a few days or few hours
- STRATCOM Global Strike planning working towards a goal of plan/decision/action in a matter of hours
- If want chance to do an ultimatum and perhaps get a “first best solution”, speed to analyze and decide also vital
- There is no time to first develop military options and then national level debate of the developed COAs. Both processes must be simultaneous—and integrated. As constraints and new ideas arise there needs to be immediate adjustments to COAs, then a fast rethink of the COA recommendation.

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Payoff Matrix Compares COAs, Weighs Policy Effectiveness in terms of EBO, Military MOFE, Consequences of Execution, DIMES. . .

	Payoff Matrix										
	EBO		MOFE			CUE			DIMES		
	Weighted Payoff	Red Leader Behaves	OR	Red WMD Threat Eliminated	Blue Troop Losses	Ally/Third Party Civ Casualties	Red Civilian Casualties	Economy/Environment Damage	US Diplomatic Influence	Non-Proliferation Impacts	
Preemptive Nuclear Strike	93			9	10	10	8	8	7	7	
Red Backs Down	98	10			10	10	10	10	10	8	
Red Invades with NW, Blue uses NW	82			8	6	3	7	3	4	5	
Red Invades with NW, Blue uses Conv	57			6	4	5	3	5	7	5	

"In an analysis aimed at policy-making, an investigation of the relevance of the many factors and contingencies affecting the decision is likely to be more useful than any narrow optimization achieved by sophisticated analytic techniques. A good new idea—technical, operational, or what have you—may be worth a thousand elaborate optimizations, for it may offer a means of overcoming our difficulties." —E.S. Quade, Systems Analysis and Policy Planning: Applications in Defense, RAND, 1968

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. . . with DIMES and long-run considerations as appropriate to situation

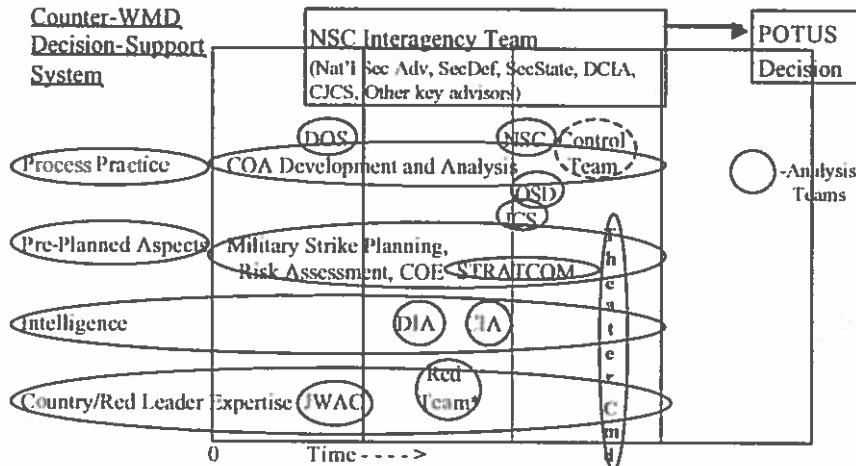
	← DIMES →		← DIMES →		← DIMES →		← DIMES →	
	WOT, Terror-ist Recruiting Impact	World Opinion	Credibility of U.S. NW Deterrence	Danger of Korean Attack	Campaign Cost	U.S. Domestic Support	Moral Considerations	
Preemptive Nuclear Strike	6	5	10	10	10	7	8	
Red Backs Down	8	9	9	10	10	10	10	
Red Invades with NW, Blue uses NW	8	7	6	8	6	6	5	
Red Invades with NW, Blue uses Conv	7	8	3	4	3	5	4	

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Having "Analysis Teams" from Agencies Advising POTUS
Using the DSS is Critical for both faster/better COA analysis
in a crisis and development/testing of policy in peacetime

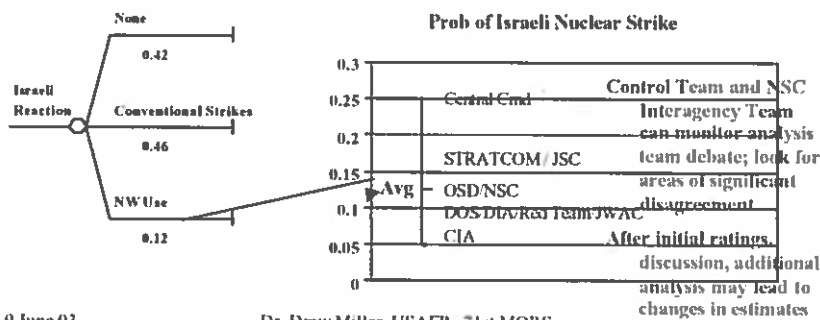


* 9 Dec 03 CIA/DIA/Business/Psych/Drew Miller/USAF/71st MORS

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While Decision Tree DSS process uses subjective ratings of qualitative issues, goal is not to reach a quantitative answer but to use an agreed framework for analysis that helps focus on key issues and identify disagreements that don't matter in context of COAs being considered

EXAMPLE: DOS concerned about Israeli reaction, impact on Mideast Peace if Israel joins fight. Central Command believes Israel may use NW if U.S. refuses to use NW to prevent repeated Red strikes on Israel. Control Team adds Israeli reaction "chance node" to decision tree and "Israeli casualty estimates"/"Impacts to Mideast Peace" to Payoff Matrix. Analysis teams estimate probabilities and payoffs, COA weighted outcomes adjusted—no significant movement in COA preferences.



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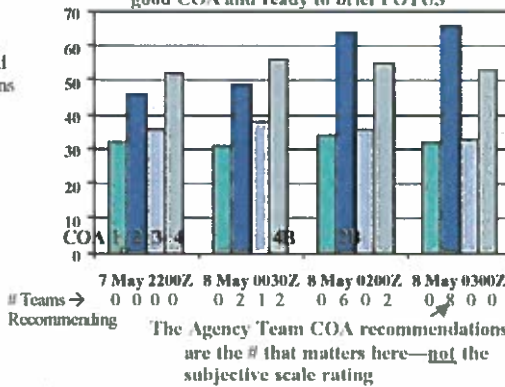
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... hopefully Analysis Team Debate Will Generate Ideas for New COAs, modifications that yield significant improvements

EXAMPLE: Idea to use Islamic ally fighter cap to instead accompany strike package and add a port target Islamic country wants to destroy. SOF raid on Red Leader's summer palace to seize valuables there. Israel warned that SOF/CIA teams operating in country. Islamic ally strike mission conditioned on their non-involvement, more reasons not to launch any strikes. With approval to pursue and success in negotiations, Control Team modifies COA 2 to 2B, analysts adjust probabilities and payoffs. Despite major disagreements on several issues, COA 2B emerges as clear consensus.

Control Team/NSC Interagency Team intervene as appropriate, set deadlines for "voting", direct areas to work on, etc. Can track progress and see if consensus emerges for good COA and ready to brief POTUS



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The Counter-WMD DSS Framework for Analysis should promote better EBO thinking, consideration of "First Best Solutions" and Combined Consideration of Immediate and Long-Term Impacts of COA Decision



Try for COAs that:

1. Allow opportunity for first best solution if possible
2. Backed up by high probability/low cost of destroying Red Threat if he doesn't comply
3. Considering full range of NW use consequences; promoting or minimizing harm to other long-run U.S. objectives

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While weapons capability concerns may show PGMs can substitute for NW in military effect, in some situations the consequences of a long-conventional war and full EBO/DIMES considerations may well call for nuclear fire to lower casualties and better meet objectives

	PGMs do Achieve Military MOE...	MOFE: Halt Red Attack	MOFE: Red WMD Threat Eliminated	Blue Force Losses	Ally/1 st Party Civilian Casualties	Red Civilian Casualties	Non-Prod Impact	Credibility US NW Deterrence
COA 1	Nuclear Preemption	N/A	98%	< 5K	0-50K	25K	No consequences	Enhanced
COA 2	Issue Ultimatum, else Nuke	Yes	85%	< 10K	0-250K	25-50K	No consequences	Enhanced
COA 3	Respond to CB attack with NW	1-2 days	75%	20-50K	50-600K	50-250K	Neutral	Enhanced
COA 4	Respond to CB attack with conv only 9 June 03	2-4 weeks	65%	30-450K	100K-1MM	10-20K	No consequences	Severely Weakened

... but With Much Higher Troop and Civilian Casualties ...

... And damage to NW Deterrence Credibility

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Facilitating Broad Debate, Expert Inputs, and Highlighting Key Areas of Disagreement Quickly For POTUS Decision

EXAMPLE: Abbreviated/illustrative POTUS Briefing Slide based on Counter WMD DSS

- SecDef/DCIA/CJCS/Nat'l Sec Adv/Mrs. Smith recommend COA 1: An ultimatum with Nuclear Strike on CB weapons if Red disperses WMD or invades
- SecState/Mr. Jones/Dr. Mills recommend COA 4: Continue soliciting coalition troops and defend without recourse to NW

	Duration of Conflict	U.S. Troop Losses	Ally/1 st Party Civilian Casualties	Red Civilian Casualties
COA 1: Ultimatum, NW Strike if needed	1-2 days	< 5K	0-50K	25K
COA 4: Conventional Only	2-4 weeks	30-450K	100K-1MM	10-20K

- DOS/NSC believe US reputation/goodwill will suffer greatly from nuclear preemption; large trade losses, UN defeats, and long-term damage to NATO
- DoD/JCS/CIA warn that failure to use NW in face of attack will undermine nuclear defense credibility, increase probability that Country W will acquire NW
- DOS believes Countries J and K will pursue NW if US uses NW; CIA/DoD/Univ X Center for J Studies believe neither country will take action
- DoD, JCS and Central Command warn that troop morale and popular support will suffer with chem-bio strikes on troops that NW could prevent; concern that conventional attacks may disperse Red chem/bio agents into air, not destroy

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The Decision Tree DSS Provides a Valuable Framework for Highlighting Uncertainties, Focusing Analysis on Most Important Risks and Areas of Disagreement, and Promoting interagency, interdisciplinary simultaneous analysis

E.S. Quade's "Principles of Good Analysis" argue for the type of DSS proposed here:

1. "Efficient use of expert judgment is the essence of analysis."
4. "The design of alternatives is as important as their analysis."
5. "Interdisciplinary teams are usually necessary."
7. "For broad questions, comparisons for a single contingency are not enough."
8. "Partial answers to relevant questions are more useful than full answers to empty questions."
11. "A good new idea is worth a thousand evaluations."

E.S. Quade, *Systems Analysis and Policy Planning: Applications in Defense*, RAND, 1968

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The Complexity and Subjectivity of Proposed DSS is not a Weakness—It's Reality of Decision

- Political and Behavioral/Psychological Factors, attempting to predict Red leader and other country reactions is inherently complex and subjective—deal with it as best you can
- While lots of areas to rate; without a framework to list/handle the issues debate is reduced to dialogue without structure or means of weighing. DSS can help focus debate on areas of significant disagreement and identify issues/disagreements that don't matter—i.e. do not affect the COA recommendation
- This is a framework for analysis and debate—not a model intended to generate a numeric "answer"
- Models that appear to provide a clear answer often hide complexity and use simplifying assumptions—can be extremely dangerous
- With automation, tailored system, dedicated cadre to run teams and process and, especially, regular practice, a "7 Days in October" process could be reduced to hours and provide best advice possible for POTUS decision

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GS DSS Methodology will Be Inexact, Incomplete, and Subject to Error—but an Improvement Over Unstructured Discussions

“In an analysis aimed at policy-making, an investigation of the relevance of the many factors and contingencies affecting the decision is likely to be more useful than any narrow optimization achieved by sophisticated analytic techniques. A good new idea—technical, operational, or what have you—may be worth a thousand elaborate optimizations, for it may offer a means of overcoming our difficulties.”

– E.S. Quade, *Systems Analysis and Policy Planning: Applications in Defense*, RAND, 1968

“the cornerstone of a systems analysis under uncertainty is a critical assessment of an appropriate measure of system worth and educated guesses about appropriate possibilities.”

– Albert Madansky, “Uncertainty,” chapter in *Systems Analysis and Policy Planning*

“Our goal is not to eliminate error. That cannot be done. It is to refine the information we do have available and to collate and assess it to provide the best feedback available in a given circumstance. . . . In spite of this uncertainty and despite the challenges involved, the fact remains that we have done all this before and we will have to do so again. . . . [W]e seek a way of using the growing means at our disposal to help commanders and decision-makers conduct the effects-based operations they have always done in a more dynamic, more precise, and more informed way.”

– Edward A. Smith, Boeing Washington Studies and Analysis Office, *From Network Centric . . . to Effects-based Operations*, 2002

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If the Decision Tree Structure can Force More “Real” EBO Analysis, Focused on Red Leader’s Decision, a big plus

- Despite paying lip service to EBO and investing in JWAC and JFCOM studies, changing the mindset of “bombs on target” and adding access to the wide-range of expertise (psychologists, in-depth intelligence on leader/group, influence network, personal/group values, etc) real EBO requires are difficult barriers for military to overcome.
- The Decision Tree’s “Red Decisions” and a controlled process forcing thinking at the MOPE level (rather than MOFE) could help a great deal in moving EBO from “another way to disrupt command and control” to its potential of effective coercion with minimal use destruction.

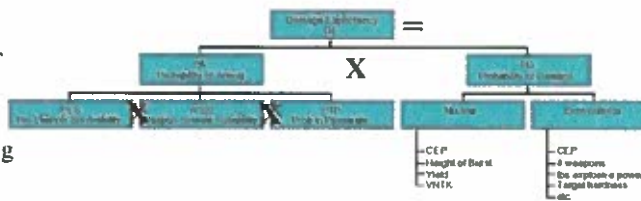
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Models Matter—the Framework for Decision-Making and COA Analysis Could Have a Big Impact on Ways of Thinking and the Process of Analysis and COA Selection

The “Probability of Arrival/Probability of Target Destruction” Model has dominated military strike planning for decades



- A well designed Counter-WMD DSS can merge the quantitative and qualitative/subjective measures of DIMES/EBO and provide a shared framework for analysis to:
 1. overcome traditional military focus on DE/target destruction, and
 2. facilitate better EBO/MOPE analysis.
- If you don't present a powerful new model or framework for analysis to “follow”, planners/analysts/advisors/decision makers will be less likely to change from old ways of thinking.

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Risks, Drawbacks of using Decision Trees as a Framework for EBO/COA Analysis Necessitate Exercises

- Tree can grow too big, cluttered and confusing
- Process must be carefully managed to focus the debate on issues and criteria the NSC/POTUS have set, cut off non-productive discussion, limit the range of issues addressed—without simplifying or omitting options that are critical to explore
- Participants (especially senior decision makers) need to practice using in exercises to be able to use quickly and effectively
- Combining a broad range of DIMES considerations into one weighted, numeric COA rating will offend some as inappropriate or too simplistic
- Top Presidential Advisors need to understand how the analysis and process of interagency teams analyzing COAs using the Decision Tree works, remember that many very subjective judgments are reflected in the analysis, and appreciate the major uncertainties and risks depicted

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Decision Trees Seem to be Neglected in Academia, and Under-Utilized Everywhere

- 20 plus years ago, Decision Trees appeared to be the dominant tool for decision-making under uncertainty, widely used
- Today, far less attention due to more high tech, “sexier”, newer tools
- Business use for major capital investment comparisons, but rare to see, very rarely anything published. Audience observations?
- My observation: Decision Trees still best overall tool for dealing with uncertainty. Academic bias against decision trees since not “old.” Audience opinion?

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RAND’s “DynaRank” An Alternative to Decision Trees Useful for Comparisons using Quantitative and Qualitative Measures

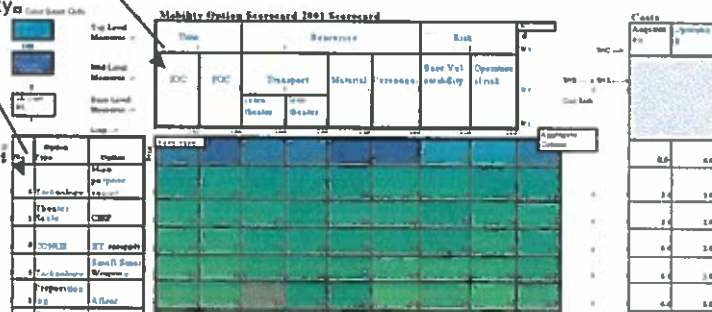
Example of DynaRank “Scorecard” for Capabilities Package comparisons

Measurement / Decision Criteria:

- * FCAACV Cost-Effectiveness Rating
- * Joint Warfighting Capability
 - Near Term – Mid Term – Long Term
- * Flexibility (# different missions contributes to)
- * Adaptability (value over time)
- * Fit with QDR/DPG priorities : CBRNE threat, Joint C4ISR, etc.

Options:
different capability packages

Dyna Rank “Scorecard”:



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