TECHNICAL REPORT TR 80-11-312.13

THE DEVELOPMENT OF DECISION AIDS FOR COUNTER-TERRORIST APPLICATIONS

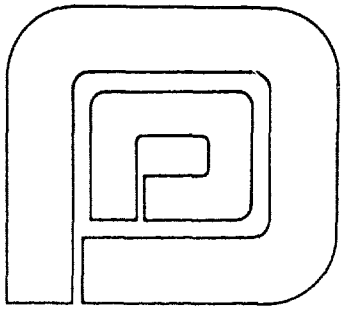
by

Michael F. O'Connor and Paul J. Sticha

Sponsored by

Defense Advanced Research Projects Agency
Contract MDA903-80-C-0194
ARPA Order No. 3831

December 1980



DECISIONS and DESIGNS, INC.
Suite 600, 8400 Westpark Drive
P.O.Box 907
McLean, Virginia 22101
(703) 821-2828

UNCLASSIFIED

SECURITY CLASSIFICATION OF

REPORT D(

AD-A190 396

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
TR 80-11-312.13

ECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
THE DEVELOPMENT OF DECISION AIDS FOR COUNTER-TERRORIST APPLICATIONS

5. TYPE OF REPORT & PERIOD COVERED
Technical report

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Michael F. O'Connor
Paul J. Sticha

8. CONTRACT OR GRANT NUMBER(s)
MDA903-80-C-0194

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Decisions and Designs, Inc.
Suite 600, 8400 Westpark Drive, P.O. Box 907
McLean, VA 22101

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
ARPA Order No. 3831

11. CONTROLLING OFFICE NAME AND ADDRESS
Defense Advanced Research Projects Agency
DSO/CTD, 1400 Wilson Boulevard
Arlington, VA 22209

12. REPORT DATE
December 1980

13. NUMBER OF PAGES
95

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19 KEY WORDS (Continue on reverse side if necessary and identify by block number)

Decision analysis	Mathematical models
Decision making	Computer-aided analysis
Decision aids	Terrorism

20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

Terrorist attacks on the United States and other industrialized nations have increased greatly in recent years. Primary targets for these activities have included Department of Defense (DoD) installations, both in the U.S. and abroad. More sophisticated weapons and tactics have led to a high success rate for terrorist activities. In response, the Defense Advanced Research Projects Agency (DARPA) has begun an extensive program to develop tools which

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

may be used to combat the terrorist threat. This report describes one such tool, a decision aid, to assist the decision makers responsible for resolving a terrorist crisis.

The potential counter-terrorist decision aids described in this report employ decision-analytic methodology. Decision analysis involves the construction of a mathematical model of a decision problem. Typically, a decision-analytic model is developed by decision makers with the assistance of a decision analyst. A decision aid is a computer program which helps a decision maker in this endeavor. This report describes the result of preliminary investigations into the feasibility of developing a decision aid for counter-terrorist applications. This process involves identification of the decision-making authority to use the aid, specification of an appropriate methodology, development of an interface between the aid and available data about terrorist groups and previous terrorist incidents, and development and evaluation of the aid. This report concentrated on the first two of these aspects, although all were considered.

The work described in this report has been fairly specific in that it was based on a Hostage and Barricade incident in progress, the seizure of the Dominican Republic Embassy in Bogota, Colombia, by terrorists from the group M-19 on 27 February 1980. The decision aid deals with specific actions that can be taken with respect to negotiation, confrontation, or attack on the barricade. While this effort is far from completion, the initial success to date with the decision aid indicates that an aid can be developed for Hostage and Barricade-type situations. An important question involves the development of aids for more complicated situations such as airline hijackings where jurisdiction can change several times during the crisis. Decision aids of the type developed here could be used for training, for actual evaluation of decisions, and for communications up the chain of command. Research is necessary to determine whether the benefits to be derived are sufficient for further development. It is recommended that the many agencies pursuing efforts in the general counter-terrorist arena set up better communications to avoid duplication while enhancing the overall effort.

SUMMARY

This report describes the result of preliminary investigations into the feasibility of developing a decision aid for counter-terrorist applications. The development of a decision aid involves identification of the decision-making authority to use the aid, specification of an appropriate methodology, development of an interface between the aid and available data about terrorist groups, and development and evaluation of the aid. The effort described herein concentrated on the first two of these aspects, although all were considered.

A major problem faced in this research is the diffusion of authority concerning counter-terrorism; this makes it difficult to determine who would use a decision aid and, therefore, to what purpose it would be put. The complicated nature of terrorism makes it likely that an aid would have to be tailored to the needs of a particular user. The wide range of functions associated with different users points out the great importance of identifying the user.

In attempting to identify uses for a decision aid, Decisions and Designs, Inc. (DDI) worked with representatives of one potential user group to develop a decision-analytic model which would aid a decision maker in evaluating responses to the Hostage and Barricade incident then in progress in the Dominican Republic Embassy in Bogota, Colombia. This model considered the tendency of the terrorists toward violence or concession, as well as criteria reflecting hostage safety, terrorist resources, and political concerns.

The model structure developed for the Colombian incident was generalized to take into account the major events common to all Hostage and Barricade incidents. The general

incident description considers a variety of actions available to the government, group demands, government responses, group actions at the deadline, and eventual incident outcomes. The description provides a framework which could be the basis of a variety of decision-analytic aids.

The basic model elements of the general Hostage and Barricade description were combined to produce three prototype aids using the modeling strategies embodied by the analyst aids, OPINT, HIVAL, and ITREE. Each of the prototype aids had strengths and weaknesses. However, it was felt that a suitably modified version of OPINT would provide the most natural representation of the incident and would give the user the most relevant information.

As a result of this study three recommendations were made:

(1) Decision analysts should work with decision makers who are or will be faced with actual counter-terrorism decisions. Such meetings would provide a means of evaluating alternative proposed approaches.

(2) The Indications and Warning (I&W) effort should continue, with increased attention to formatting information in a way that provides for quick, easy access to the answers to specific commander's questions. The interface with decision aids should be an important consideration in the design of this system.

(3) The decision aid developed during the current effort should be modified and tested with several user groups to determine the usefulness. If useful, expansion to other types of situations should be investigated.

CONTENTS

CONTENTS (Continued)

FIGURES

TABLES

THE DEVELOPMENT OF DECISION AIDS FOR COUNTER-TERRORIST APPLICATIONS

1.0 INTRODUCTION

Industrial nations in general, and the United States in particular, have been the targets of terrorist activities to an increasing extent in recent years. A significant proportion of these activities has been directed at Department of Defense (DoD) installations, both in the United States and abroad. In addition, allied governments have been frequent targets for terrorist attacks. The terrorist threat has become increasingly sophisticated in both weapons and tactics; this increased sophistication has, in part, led to a high success rate for terrorist activities. Because of the high and increasing threat of terrorism, and the high potential cost of these activities to the United States, the Defense Advanced Research Projects Agency (DARPA) has begun an extensive program to develop tools which may be used to combat the terrorist threat.

The DoD has several responsibilities which make up a part of the total national effort to combat terrorism. Included in these responsibilities are the development and execution of plans to counteract terrorist activities, the protection of DoD sites and personnel, the exchange of information with other agencies, and the supply of a specialized counter-terrorist force. The DARPA research effort has sought to assist DoD in a variety of its mission areas.

The DARPA effort has concentrated on four areas of research regarding counter-terrorism:

- gathering information about terrorist groups, targets, specific incidents, and counterforce effectiveness;

- analyzing the relations among different aspects of the information collected, such as relations among the members of a group, relations between different terrorist groups, preferences of groups for specific targets or tactics, and effectiveness of specific counterforce strategies for various terrorist groups;

- developing a system for forecasting and warning about likely future terrorist activity, making either general predictions for a given group or target, or target and time-specific predictions; and

- planning actions for interdiction or response to terrorist activities, and providing a mechanism for ad hoc action selection, monitoring, coordination, and feedback.

This report describes results of preliminary investigations into the feasibility of developing a decision aid for counter-terrorist applications. Several decision-analytic methodologies were used to develop prototype structures which could be used as the basis for a counter-terrorist decision aid. The advantages and disadvantages of each of these methodologies were determined.

The development of a decision aid involves the following tasks:

- identification of the decision-making authority regarding counter-terrorist efforts, and the types of decisions made at each level of authority;

- o specification of an appropriate decision-analytic methodology for various decisions regarding counter-terrorism;

- o development of an interface between available data about terrorist groups and important decision variables; and

- o development and evaluation of a decision aid for use by appropriate decision makers.

The effort described herein concentrated heavily on the first two aspects, although all aspects were considered.

A major problem faced in this research is the diffusion of authority concerning counter-terrorism. This diffusion makes it difficult to determine who would use a decision aid and, therefore, to what purpose it would be put. The configuration of the aid, including the types of options considered and the methodology used depends greatly on the level of authority of the user of the aid. For example, a decision aid may be used to organize a large body of data at one level of an organization; it may then be used to communicate summarized results to a higher level of authority. Finally, the aid may be used for selection of options, planning, or monitoring at other levels of authority.

The complicated nature of terrorism makes it likely that an aid would have to be tailored to the specific needs of a particular user. The wide range of functions associated with different potential users points out the great importance of identifying that user.

In attempting to identify users and uses for an aid, analysts of Decisions and Designs, Inc. (DDI) worked with representatives of one potential user group to develop the

prototype aid described in Section 3.0. In this initial application, the representatives of potential user groups served as surrogates for a decision maker in the Hostage and Barricade situation in Bogota, Colombia. This application occurred during the actual takeover of the Dominican Republic Embassy in Bogota during February 1980.

The prototype aid was briefed to several experts knowledgeable about the general decision-making process in terrorist situations; the briefings were well received, but no specific user was identified for further aid development. Therefore, DDI analysts worked to develop a general aid to be used for a decision regarding commitment of a counter-terrorist force during a Hostage and Barricade terrorist incident. That effort is described in Sections 4.0 and 5.0 of this report.

2.0 POTENTIAL DECISION AIDS

2.1 The General Nature of Decision Aids

Decision analysis involves the construction of a mathematical model of a decision problem. The model is intended to be, as much as possible, isomorphic to the actual problem. Typically, a decision-analytic model is developed by decision makers with the assistance of a decision analyst. The analyst translates elements of the problem which are of concern to the decision maker to corresponding model elements within the decision-analytic framework. In successful interactions between the decision maker and decision analyst, the decision maker may concentrate his effort on the problem at hand, while the decision analyst is concerned with the construction of a complete and accurate representation of the problem within the decision-analytic model.

A decision aid is a computer program which helps a decision maker to develop a decision-analytic model of a particular problem or set of problems. There are basically two types of decision aids, those which are used by the decision analyst to aid in model development and calculations, and those which seek to replace the decision analyst, thus allowing direct interactions between the decision maker and the decision-analytic model. This report is concerned with the second type of decision aid.

In developing a decision aid which interacts directly with the decision maker, the task of the decision analyst--namely, translating problem elements to model elements--must be performed to some extent by either the decision maker or by the decision aid. A successful aid permits its users to devote their time to aspects of the problem, rather than details of the model. The major task in developing a successful

decision aid is devising a way in which a model may be inferred by the aid while minimizing the involvement of the decision maker with the mathematical details of the model.

DDI has developed several computerized decision aids, both for DARPA and for other organizations. The considerable variation in the success these aids have found in use seems to be closely related to the type of decision problem for which the aid is used. Computerized decision aids appear to be most successful in situations characterized by:

(1) repetitive decisions versus ad hoc decisions;

(2) available time in hours versus days;

(3) data management versus data in head of decision maker;

(4) moderate involvement versus high involvement; and

(5) time reducing versus time producing.

The ideal situation for the use of the decision aid is one in which a single decision or set of closely related decisions must be made repeatedly under very strong time pressures. Such a situation requires the integration of much objective data, but there are few subjective inputs. Lower involvement implies that the decision maker is more willing to entrust the decision to a computer aid rather than a complete analysis. The major concern is reduction in decision-making time.

Some of the five situational characteristics specified above relate to the goal of minimizing the decision maker's involvement in translating problem elements into model elements; these conditions make the translation task easier or

allow some of the translation to be done in advance. Specifically, repetitive decisions allow a generic model structure and parameter assessments to be specified in advance; the model may then be tailored to the case at hand. If many of the data are objective, there may be a relationship between the data values and decision options which is relatively invariant over the particular decision problem. Extreme time pressures would make simple heuristics for model development more attractive because they reduce analysis time while producing satisfactory solutions.

Decisions which do not meet these conditions are more suitable to the use of decision analysis with the assistance of a decision analyst. In these problems, the decision is not similar to other problems and involves consideration of many subjective values. There is high involvement in the outcome of the decision, as well as several days to make a decision. Thus, the decision maker is willing to spend the extra time involved for decision analysis in order to produce an optimal decision.

2.2 Methodologies for a Counter-Terrorist Aid

As discussed earlier, the type of decision aid developed depends on the specific decision to be made by the user. The aid developed for counter-terrorism is to be used by the person or agency that must make a decision with respect to counter-force action. That is, the user of this aid must decide whether the government should negotiate or attack, and if negotiations occur, what the government should offer or demand.

To be useful in such an urgent decision situation, an aid cannot require much time to implement; and, for that reason, model structuring and parameter assessment must be done in advance. Specification of model values in advance

greatly reduces the time required to reach a decision. However, the time savings is accomplished at the cost of lower accuracy and flexibility. This time/flexibility trade-off is a major consideration in aid development. The need for rapid, in-depth analysis of trade-offs with respect to potential actions has led DDI to develop a variety of computerized decision-analytic models. Each model is appropriate for a well-specified subset of decision problems. They all provide the capability to rapidly structure a model of the decision problem and to perform sensitivity analyses. However, even with these models as tools, at least half a day is usually required to represent the structure of most decision problems. In many cases, much more time is required. To be useful in decisions about the commitment of counter-terrorist forces, a more rapid response capability is required.

To develop a user decision aid for counter-terrorist applications, it is necessary to find a model structure which accurately represents the factors important to the choice among counter-terrorist actions, which gives reasonable answers even when the representation is strained, and which provides the user critical information in a timely fashion. Three different modeling strategies were used to develop a general user aid for terrorist incidents involving Hostage and Barricade. Each of the resulting models was implemented as a computer program using general analyst-aiding software. The ability of the aids to satisfy the conditions stated above was then determined. The methods used were multi-attribute utility analysis (MAUA) and both very general and restricted forms of decision tree analysis. These analytical methods are embodied in the computer programs named HIVAL, ITREE, and OPINT, respectively.

2.2.1 Multi-attribute utility analysis - A first approach to a counter-terrorism decision aid uses multi-attribute utility analysis. MAUA techniques are used for the evaluation of a set of options that can be characterized as having values or scores on a (potentially large) number of attributes. The MAUA implementation requires the development of a hierarchical structure that has several general attributes (or factors) at the top. These are successively decomposed into more specific subattributes until a level of detail is achieved that provides for direct scoring of options with respect to the subattributes.

Given a structure, all attributes must be weighted in terms of importance. This can involve either an absolute or a relative weighting procedure depending on whether input scores are based on an absolute scale with well-defined end points or are assessed on a relative scale where 0 is the worst of the options under consideration and 100 is the best.

Given the structure and weights, options are scored with respect to all subattributes. The scores are weighted and aggregated up through the hierarchical structure, yielding more general attribute scores at all levels including the overall top level.

MAUA procedures were developed for scaling options with which no uncertainty was involved. However, the approach can be used with uncertainty by including a set of scenarios at one of the higher levels of the structure. Each scenario has the same substructure under it, but scores and weights can and do differ. The weight given to each scenario is related to the probability of that scenario as well as the performance differences among the options on that scenario.

MAUA structures are easy to understand, and the HIVAL software provides for sensitivity analyses on certain weights in the model. Specific advantages and disadvantages of the use of the approach for counter-terrorism aids are discussed in Section 5.2.

2.2.2 Analysis of decision trees - A decision tree is a complex sequence of acts and events. The structure begins with several acts for evaluation. Each act is succeeded by any number of events that could lead to different outcomes (or consequences). Events can be followed by more events or by future acts. Representation of all the potential sequences of acts and events yields a decision tree that usually has a fairly large number of branches given a problem of even moderate magnitude. At the end of each branch is a consequence that can be evaluated in terms of several attributes (a single-level MAUA). These respective consequence utilities are weighted by the probabilities of the branches associated with them. The entire decision tree is "rolled back" to yield expected utilities for the different nodes in the tree as well as overall expected utilities for the acts under consideration. The act with the highest expected utility is recommended.

This decision tree approach has the distinct advantage of being able to model the complex dependencies involved in decision making under uncertainty. A valid representation of all the major uncertainties can be developed. A major problem with such an approach is that the tree fast becomes a "bushy mess." Stepping through the tree to obtain a feeling for the resultant implications is sometimes difficult, especially upon initial introduction to the technology.

ITREE is a software package which can represent and analyze a very general class of decision trees. ITREE provides for sensitivity analyses of both the importance

weights of attributes (such as hostage safety, political implications, and the like) and the probabilities of important events (such as a shootout). Specific comments on its use in the Hostage and Barricade situation will be made in Section 5.3.

2.2.3 Restrictions on decision trees - Some of the complexity of a general decision analysis may be avoided by restricting the class of decision trees considered by the analysis. One set of restrictions which has proven useful for a variety of decisions is embodied in the decision aid, OPINT. OPINT is a methodology for evaluating a single decision, the value of which depends on the outcome of a single uncertain event. Furthermore, the probability of any outcome of the event is assumed to be independent of the action chosen. These restrictions allow the analyst to assess independently the probability distribution over the outcomes and the value of each decision option given the outcomes.

The probability of the event of concern may be estimated by considering the state of many other probabilistic, influencing variables. An influence tree may be constructed to represent the dependencies among these variables, and between the event of concern and the influencing variables. With the OPINT approach, the critical element is that the influencing variables have no effect on the value of the decision options other than their indirect effect through the event of concern. Thus, although a very complex model may be used to estimate event probabilities, the overall model structure retains a high degree of conceptual simplicity.

The OPINT approach involves first defining the set of acts. A set of attributes that characterizes the value of the act/event combination is also defined. An influence diagram is created to illustrate the interdependencies

among the events and to provide for the assessment of all necessary conditional probabilities. All dependencies are appropriately represented in the influence diagram. Then the probabilities of specific events are assessed for all the other event combinations in the diagram upon which these specific events are dependent. Probabilities are combined according to the rules dictated by the influence diagram to yield the overall probabilities of the top-level events in the structure. The acts are scored on all the attributes for each of the top-level events.

The attributes are assigned importance weights by comparing the range of utility associated with each across all events. These attribute weights are used to combine scores across attributes within each event to yield a score for each action for each event. These scores are weighted by event probabilities to yield overall expected values for actions.

The OPINT methodology provides for sensitivity analyses on both event probabilities and attribute importances. Specific advantages and disadvantages for the counter-terrorism aid will be discussed in Section 5.1.

3.0 APPLICATION TO COLOMBIA

In examining the feasibility of the types of decision-analytic aids discussed in the previous section, extensive effort has been made to locate appropriate decision makers and then to apply the techniques to their problems. Locating such decision makers who have the time to discuss potential decision-analytic aids has been difficult. As an alternative to working for an involved decision-maker, it was decided to develop a prototype aid for a real situation, preferably a Hostage and Barricade incident. The developments in Colombia provided the opportunity, and DARPA made available DoD-related personnel who possessed the expertise to assist in the development of the aid. A brief description of the incident and modeling effort follows.

On 27 February 1980, terrorists from the group M-19 seized the Dominican Republic Embassy in Bogota, Colombia, taking 51 hostages, including 21 foreign diplomats who were there at a reception celebrating the anniversary of the independence of the Dominican Republic. Among the hostages was the United States Ambassador to Colombia, Diego Asencio. The terrorists' initial demands included the release of 311 terrorists in Colombian jails, demand of $50 million, transport to a foreign country, and printing of messages in newspapers of all involved countries. The incident continued until 27 April 1980, when the terrorists released the hostages in return for safe passage out of Colombia and approximately $2 million. Negotiation with the terrorists was handled by the Colombian Government.

While this incident was occurring, DDI analysts met with the experts who were throroughly familiar with the situation in Bogota, as well as the events leading up to the incident and the nature of the terrorist group. The purpose

of this meeting was to develop the prototype decision-analytic model which could be used to help an appropriate decision maker plan a response to terrorist activity. The Colombian situation provided material with which the experts were very familiar. However, since actions in this incident were being carried out by the Colombian Government, the model was developed from the viewpoint of an appropriate Colombian decision maker.

The model was developed using the methods embodied in the OPINT software, discussed briefly in Section 2.2.3, which can be used in performing a decision analysis on situations in which the following conditions hold:

- A single decision is made in which an alternative must be chosen from a well-specified set.
- The value of the action depends on the outcome of an uncertain event. It may be possible to assess value directly, or it may be composed of several criteria.
- The probability of any event outcome does not depend on the action chosen.

As discussed in Section 2.2.3, the method proceeds in several stages. First, the alternative actions are identified. Then, the event and its alternative outcomes are specified. Following this, utilities are assessed for the alternative actions conditional on the outcome of the uncertain event. These utilities represent the value of the option to the decision maker and may be based on one or more criteria of value. The probability of each event outcome is then determined, possibly considering other events which influence the main event of concern. Finally, all assessments are combined to arrive at an index of the overall value of each

alternative. This index is the expected utility of the alternative, or the average conditional utility weighted by the event probabilities.

Three actions were considered as alternatives for the Colombian Government:

- Give in - reach a quick negotiated settlement;
- Hit - use military action to neutralize terrorists and, if possible, save the hostages; and
- Wait - continue negotiating until the situation changes.

In order to satisfy the assumptions of the model, the event of concern must be defined to be independent of the action chosen. The event chosen was the tendencies of the terrorist group for either violent action or concenssions. This event may be viewed in some sense as the "personality" of the terrorist organization. Six possible outcomes of this event were identified:

- KILL+ - the terrorists would kill all hostages;
- KILL2 - the terrorists would kill a small number of the hostages;
- NLETH - the terrorists would physically harm the hostages, but would not kill any of them;
- RESTR - the terrorists would continue their current level of restraint with the hostages and would not modify their demands;

- REDUC - the terrorists would treat the hostages more leniently and would reduce demands somewhat; and

- WITHD - the terrorists would reduce their demands to free passage from the country.

The tendencies of the terrorists toward violence or concession are affected by several factors. Among them are the terrorists' perceptions of eventual Colombian concessions, pressures from within the specific cell holding the embassy, and pressures from other cells within the M-19 group and from other terrorist groups. The influences among these events are illustrated in the diagram in Figure 3-1. In this figure, an arrow from one event to another event indicates that the probability of the latter event depends on the outcome of the former event.

Assessments of utility considered seven criteria of value. These criteria addressed the implications of the actions on hostage safety, counterforce factors, terrorist resources, internal and international politics. The overall utility of an alternative conditional on the outcome of the event of interest was the weighted sum of the individual criterion scores. The overall index of merit for each action is its expected utility. The expected utilities of the options, as illustrated in Table 3-1, indicate that the Wait option is the preferred alternative, although it is only slightly better than the Hit option.

The decision model serves as an example of a model which could be used in a situation in which United States officials were deciding among alternative responses to a terrorist incident. There are several areas in which the model could be used. First, different governmental agencies (e.g., Defense, State, etc.) would use the decision-analytic

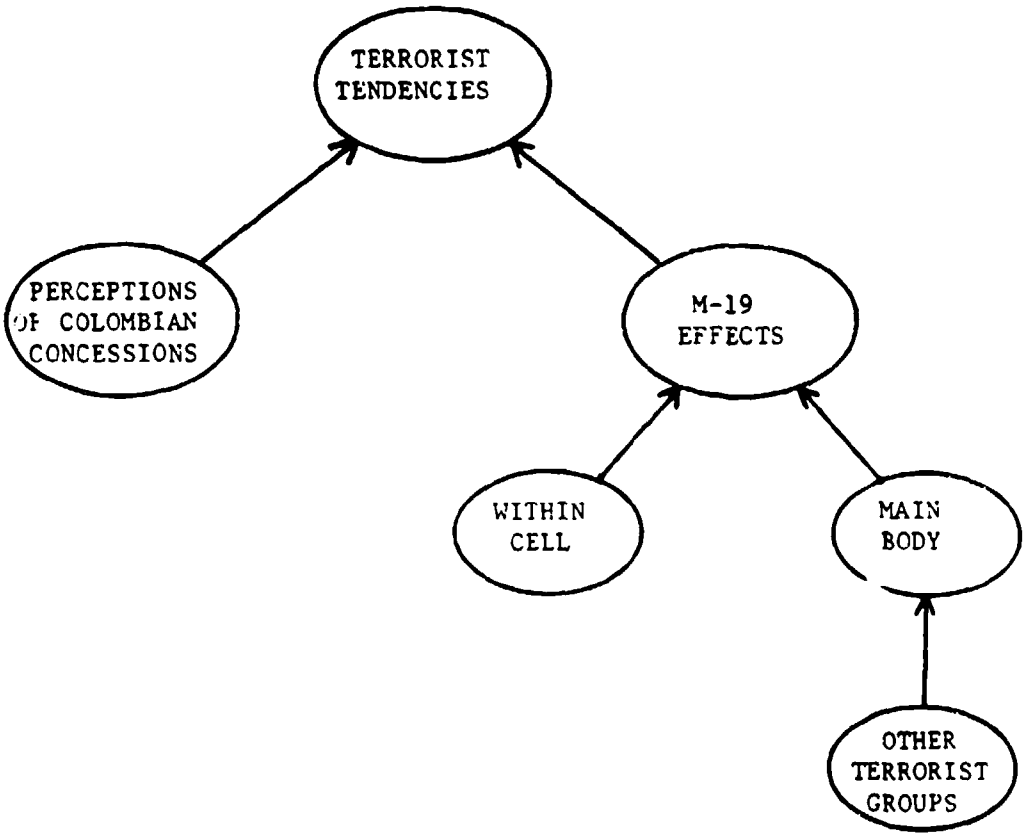


Figure 3-1
INFLUENCE DIAGRAM FOR UNCERTAIN EVENTS

	EXPECTED VALUE						
	KILL+	KILL2	NLETH	RESTR	REDUC	WITHD	TOTAL
GIVE IN	0	-3	-10	-34	-8	0	-55
HIT	0	-2	- 6	-20	-5	0	-33
WAIT	0	-3	- 6	-17	-4	0	-30

Table 3-1
EXPECTED UTILITIES

framework to develop responses to the incident. The model could then be used by the White House to evaluate these alternative proposals. If a military action were decided upon, the model could be used by the appropriate military personnel to determine the optimal timing of the response.

The Colombian problem illustrates one situation in which a decision-analytic model could be used to aid the effort to combat terrorism. The extent to which this model could be used in similar situations depends on whether decision makers could be found for whom this model would be appropriate, and whether the assumptions of the model are satisfied by the situations in which it would be used. Specifically, one of the main assumptions of the model is the independence of event probabilities and actions. It may be the case that this assumption is not satisfied by many problems, and more complex decision-analytic models would need to be created. Nevertheless, the example indicates the potential usefulness of decision analysis in aiding decision makers involved in counter-terrorism.

4.0 GENERAL HOSTAGE AND BARRICADE INCIDENT

The Colombian model illustrates the applicability of decision-analytic methods to a specific incident in the area of counter-terrorism. The usefulness of this analysis for other incidents depends on the extent to which different incidents vary and the extent to which this specific incident may be viewed as a prototype of the general class of Hostage and Barricade incidents. A first step in developing a general counter-terrorism decision aid is to determine the generalizations which may be made about Hostage and Barricade incidents. These generalizations must then be placed into a framework, so that it is possible to catalog any situation and to build an appropriate model for any specific incident.

A second step in the construction of a counter-terrorism aid is the specification of the general factors which must be considered in deciding what response to make to a terrorist incident. The questions which were asked for the Colombian model must be asked in general. That is, it must be determined what options are available to the decision maker, what are potential terrorist responses to these options, what are likely eventual outcomes of any option, and what are the important considerations in evaluating the outcomes. The answers to these questions form the core of any model used to aid a decision maker in making the best response to a terrorist threat.

These two steps provide the groundwork on which any decision aid is based. It is critical that these steps accurately reflect the range of alternatives, responses, and outcomes relevant to the situations in which the aid will be used. The framework described here provides a first step, which must be refined through extensive discussions with

experts and careful analysis of existing data about past incidents.

4.1 Generalizations From Past Incidents

The similarities and differences among Hostage and Barricade incidents were determined by examination of those incidents recorded in the Terrorist Research and Analysis Program (TRAP) data base, which includes information about terrorist groups and incidents. Critical variables were then organized in a decision-analytic framework that would be compatible with a number of decision-aiding methods.

4.1.1 A summary of Hostage and Barricade terrorist incidents - A review of the TRAP data base produced the Hostage and Barricade incidents shown in Table 4-1. Highjackings are not included as Hostage and Barricade incidents; instead, they are treated separately. Although the coverage of Hostage and Barricade incidents is not complete, the data summaries indicate the type of information considered in defining a general framework for describing Hostage and Barricade incidents.

4.1.2 Framework for general Hostage and Barricade scenario - The data displayed in Section 4.1.1 provide a framework for a generic scenario which could form the basis of a user decision aid. Figure 4-1 illustrates this structure as a decision tree combining the possible events and government actions which determine the course the incident will take, as well as its outcome. If all combinations were possible, the resultant event tree would contain 5600 branches, each of which describes a potential Hostage and Barricade scenario. Not all of these scenarios are possible, and of those that are possible, not all make sense. However, a substantial number of them do make sense.

HOSTAGE AND BARRICADE INCIDENT	STOCKHOLM 75	MUNICH 72	ORLY ROCKETS II 75	ANKARA 79 TURKEY (EAGLES)
TYPE OF SITE	GMW Embassy Stockholm, SWE	Israeli Athletes Sleeping Quarters	Wash Room - Orly Airport	Egypt Embassy
WHOSE RESPONSIBILITY	Swede Govt	FRG Police	French Govt Police	Turkish Police
# HOSTAGES	12 VIPs	9 Athletes (2 killed in tkovr)	10 +20 wounded in tkovr	16 VIPs +2 killed 1 wound in tkovr
GROUP I.D.	SPK of GMW, M2J of GMW	BSO of PLO	PFLP of PLO	PLO
# TERRORISTS	6	13	3	4 PLO
GROUP CAPABILITY	Handguns 4 Shotguns 1 Auto Weapons 1 Dynamite, Grenades	? Yes	H-2 Grenades AW-1 Anti-Tank, Heat Missile	AW-4
DEADLINE ESTABLISHED	Yes	Yes	Yes	No
PASSED?	Yes - Demands Rejected	Yes	Yes	
REPARATIONS?	Yes	No	No	
RESULT	Shootout During Attempted Escape	Dropped Demand for Release Shootout During Amnesty	Gave Safe Passage	Demands Lessened
SURRENDER?	No	No		Yes-4
SHOOTOUT?	Yes	Yes	Yes	
ESCAPE?	Failed	No	Amnesty	
HOSTAGES KILLED?	2	9		
TERRORISTS KILLED	2, 4 CAP.	10		
DURATION	12 hours	18 hours	17 hours	1 day, 21 hours
FACILITY DAMAGE	Yes - 100K+	25-100K	25-100K	25-100K
DEMANDS $K RELEASE PRISNRS OTHER	20K/Terrorist 26 GMW Pris. Safe Passage	200 Held by ISR Safe Passage	Safe Passage	Own Group Statement

Table 4-1

SUMMARY DATA FOR HOSTAGE AND BARRICADE INCIDENTS

HOSTAGE AND BARRICADE INCIDENT	KARACHI 74	DUTCH PRISON 74	MANAGUA 78	TURKEY 71
TYPE OF SITE	GRC Freighter	Prison Chapel, Hague	Nat. Palace	Victim Home Erkan
WHOSE RESPONSIBILITY	Pakistan Govt Target-Greece	Dutch Govt	Nicaraguan Govt	Turkish Govt Police
# HOSTAGES	3	22	1015 VIPs-Conges 14K 1W in tkovr	1, +2 Wounded
GROUP I.D.	BSO of PLO ANYOLP of PLO	ANYOLP of PLO	FSLN of Nicaragua Sandinist	TPLF of Turkey
# TERRORISTS	3	4	25	2
GROUP CAPABILITY	Unknown	Unknown	Auto Weapons	Sten Gun
DEADLINE ESTABLISHED PASSED? REPARATIONS?	Yes No No	No	Yes No	No
RESULT SURRENDER? SHOOTOUT? ESCAPE?	Amnesty Given No No Yes	Raid-4 Captured 4 Captured Raid on Chapel	Demands Reduced During Negotiations; Govt gave in; Pres. assas. No No Yes	Shootout; 14 yr old girl rescued No Yes No
HOSTAGES KILLED?	No	None	No	No, Rescued
TERRORISTS KILLED	No	None	Escaped	Yes-1+1 Wounded
DURATION	1 Day, 6 Hours	4 Days, 12 Hours	1 Day, 20 Hours	2 Days
FACILITY DAMAGE	None	None	None	Low
DEMANDS $K REL. PRISONERS OTHER	- Own Group Amnesty	Selves	Met-1 $10 million Own Group, Other Group Statement Safe Passage	- Amnesty, Safe Passage

Table 4-1

SUMMARY DATA FOR HOSTAGE AND BARRICADE INCIDENTS (Continued)

HOSTAGE AND BARRICADE INCIDENT	BANGKOK 72	SCHONAU TRAIN 73 AUSTRIA	SCHONAU, AUSTRIA 73	TEHRAN 79
TYPE OF SITE	Israeli Embassy	Marchegg Train & Vienna Airport	Schonau Transit. Camp	US Embassy
WHOSE RESPONSIBILITY	Thai Govt -Aimed at Israel		Aus Govt	Iran Govt Khomeini
# HOSTAGES	6 VIPs + 3 escaped during tkovr	6	None	102 VIPs + 1 killed 2 wound-tkovr
GROUP I.D.	BSO of PLO	CARLOS of MLG PFLP of PLO	BSO of PLO	FEDAYEEN
# TERRORISTS	4	2	6	100
GROUP CAPABILITY	H-Guns Auto Weapons	Auto Pistols Grenades Auto Weapons	?	Machine Guns Auto Rifles
DEADLINE ESTABLISHED?	Yes	Yes	No	No
PASSED?	No	Yes		
REPARATIONS?		No		
RESULT	Demands Reduced to Safe Passage	Demands Lessened	3 Captured at Camp	
SURRENDER?	No	Neg. Settlement	3 Others Crossing Border	
SHOOTOUT?	No			Yes-95 SW
ESCAPE?	4-Yes	2-Negotiated	No-Captured	
HOSTAGES KILLED?	No Released	No		
TERRORISTS KILLED	No	No	No	
DURATION	22 Hours	15 Hours		4 hours
FACILITY DAMAGE	None	None	None	100K+
DEMANDS		Part Met-Not Prisoners		None
$K	None	No		
REL PRISONERS	30 of own group	Rel Arab Terr		
OTHER	Safe Pass to EGY	End trans of jews		

Table 4-1

SUMMARY DATA FOR HOSTAGE AND BARRICADE INCIDENTS (Continued)

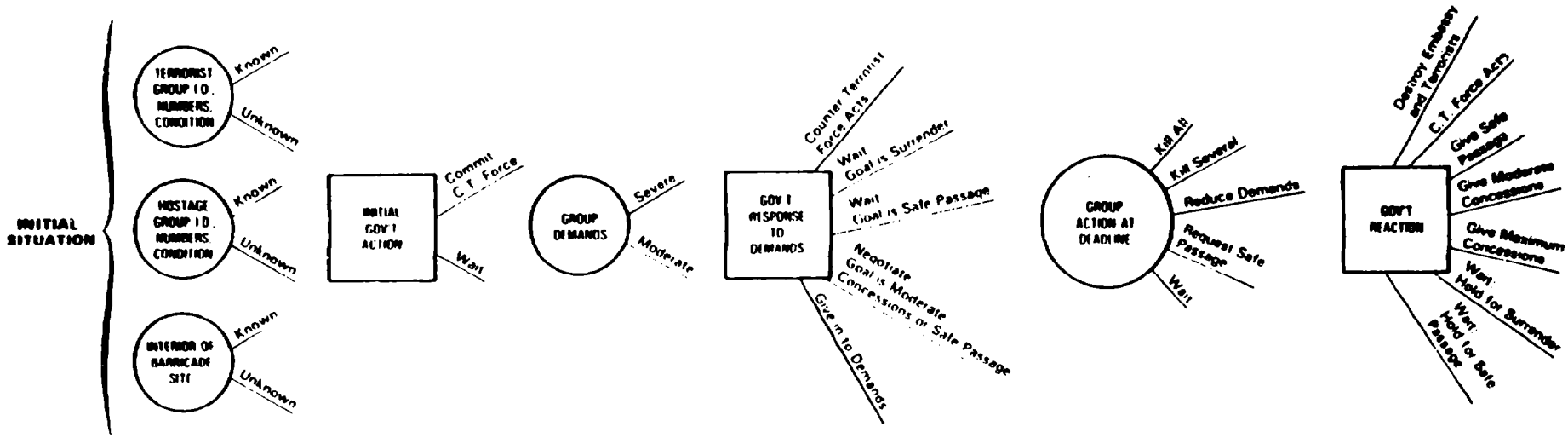


Figure 4-1

GENERIC HOSTAGE AND BARRICADE SCENARIO STRUCTURE

Even though this structure admits a large number of potential incidents, it is a simplification which may not capture some of the subtle differences among incidents. For example, it is assumed that a deadline is set and that the terrorists do not take any action prior to that deadline. Other assumptions occur in the form of omissions. For example, the number of actions on each side is restricted. There are many options for both sides that involve deception, mixed strategies over time, and the like. The structure is thus somewhat restricted, but analyzing this structure would involve many of the considerations involved in analyzing more complex scenarios, and such an analysis could therefore be of great benefit to the decision maker.

Because this framework is in the form of a decision tree, it is compatible with the implementation of a decision aid using a general decision-analytic program, such as ITREE. With simplification, the structure could be made compatible with OPINT, or the structure could be viewed as the basis for a MAUA using an aid based on HIVAL.

4.2 Available Government Actions

In any incident a variety of actions are available to the government. The actions may represent subtle and complex strategies involving considerations of specific personalities involved, timing of concessions or threats, deception or delay tactics, and other specific considerations. At a more general level, however, a number of actions reflect broad differences in the government's strategy in dealing with terrorist incidents. This analysis identified the following five such actions:

- HIT - Use military action to neutralize terrorists and save as many hostages as possible. If this action is successful or if the terrorists surrender,

it may be possible to free all hostages and capture the terrorists. It is more likely that a hit will lead to a shootout involving deaths of hostages and members of the counter-terrorist force as well as terrorists.

- o GIVE-IN - Make the concessions necessary to arrive at a quick settlement. This action leads to large concessions.

- o WAIT FOR SURRENDER - Hold out for surrender. Offer no settlement other than surrender. Do not negotiate.

- o WAIT FOR SAFE PASSAGE - Hold out. Either wait for or offer safe passage only. Do not negotiate for anything else.

- o NEGOTIATE FOR MODERATE CONCESSIONS - Such concessions should not involve release of prisoners. Often a government different from the host government gets involved here.

These descriptions represent classes of actions available to the government at the time terrorist demands are made. Some terrorist responses will make other actions available. For example, if the terrorists kill all hostages, the government may attack the terrorists without consideration of hostage safety.

4.3 Terrorist Responses

Just as in the case of the government, the terrorists have a variety of possible actions they may take in response to government actions. These responses may depend on subtle aspects of the government actions, or terrorist perception

of government intentions. However, this analysis will be restricted to consider broad classes of terrorist responses.

The responses of any terrorist group to different situations are not independent, but reflect a coherent policy regarding violence and willingness to negotiate. Capturing this policy allows for great economy in the problem representation. Consequently, one concern in describing terrorist responses is finding a way to characterize group responses to different government actions in a consistent manner.

4.3.1 Classes of terrorist response - The following five responses represent general classes of actions available to the terrorists:

- o KILL ALL HOSTAGES - This could occur if deadline passes, or it could be a reaction to a failure of government to make concessions.

- o KILL ONE OR TWO HOSTAGES - This could occur as an attempt to stimulate conciliatory government action at deadline or after. A potential result is a government attack.

- o WAIT--SETTLE FOR MODERATE DEMANDS - If the government negotiates, require significant government concessions, including money and safe passage and, perhaps, a statement or some other conciliation.

- o WAIT--SETTLE FOR SAFE PASSAGE - Hold out for at least an offer of safe passage.

- o SURRENDER - This could occur if government attacks or as a result of failure to get concessions.

4.3.2 Characterizing groups by likely response to government actions - The task of finding a small number of variables to characterize the responses of terrorists to government actions is in many ways the same as the task of characterizing personal behavior by a small number of personality traits. Because of this similarity, the effort to organize terrorist group behavior shares some of the advantages and disadvantages of personality theory.

The chief advantage of the personality theory approach to terrorist behavior is that it offers a compact and conceptually simple description that predicts the responses of terrorists in a variety of situations. The characterization is relatively independent of government action, so that it may be used, for example, as the event of interest in an OPINT model. In a decision aid, the role of such an organizing variable would be to reduce the number of assessments required of the user.

However, a personality theory makes accurate predictions only to the extent that the behavior in question is predictable by a small number of internal variables. In his classic critique of personality theory, Mischel[1] highlights the importance of situational variables in determining behavior. If the low predictive validity of personality theories carries over into the group domain, the low accuracy of the organizing variables used in a decision aid would severely limit its usefulness.

There is reason to hope that it is possible to characterize terrorist responses in a way that is both economical and accurate. The strategy followed in this analysis seeks to predict specific behaviors by developing specific

[1]Mischel, W., Personality and Assessment (New York: Wiley, 1968).

organizing variables which are tailored to predicting terrorist responses to government actions. Ajzen and Fishbein[2] have demonstrated that this technique can produce accurate predictions. Four government actions were considered in developing this index: violence, nonconcessions, show willingness to provide safe passage, and show willingness to negotiate. The potential terrorist responses to these actions are shown in Table 4-2. Combining all possible terrorist responses to key government actions yields a total of thirty-six group reaction profiles. Of these, ten seem plausible; these ten are identified in the last column of Table 4-2.

Table 4-2 gives an example of a way to characterize the responses of terrorist groups to a variety of government actions. It would be possible to enhance this representation by placing the tendencies on a numerical scale. In this way, additional information could be obtained about the terrorist groups.

4.4 Incident Outcomes

Although the terrorist response is a concern of government decision makers in planning their actions, the overriding concern is the final outcome. The outcome can vary from quite favorable, in which the terrorists surrender, to quite unfavorable, in which many hostages are killed, the terrorists derive resources and ideological benefit, and there are substantial negative political implications. The outcome depends on both the government action and the terrorist group disposition in a general way illustrated below.

---

[2]Ajzen, I. and Fishbein, M., "Attitude-Behavior Relations: A Theoretical Analysis and Review of Empirical Research." Psychological Bulletin, 1977, 84, 888-918.

POTENTIAL DISPOSITION PROFILES

TERRORIST RESPONSE	GOVERNMENT ACTION: NO CONCESSIONS WAIT	SHOW WILLINGNESS TO PROVIDE SAFE PASSAGE ONLY	SHOW WILLINGNESS TO NEGOTIATE	LIKELY?	TEND #
VIOLENCE	Violence	Violence	Wait-Hold	+	1
			Reduce Demands	No	-
		Wait	Wait-Hold	+	2
			Reduce Demands	+	3
		Reduce Demands	Wait-Hold	No	-
			Reduce Demands	No	-
	Wait	Violence	Wait	No	-
			Reduce Demands	No	-
		Wait	Wait	+	4
			Reduce Demands	+	5
		Reduce Demands	Wait	No	-
			Reduce Demands	+	6
	Reduce Demands	Violence	Wait	No	-
			Reduce Demands	No	-
		Wait	Wait	No	-
			Reduce Demands	No	-
		Reduce Demands	Wait	No	-
			Reduce Demands	+	7
SURRENDER	Violence	Violence	Wait	No	-
			Reduce Demands	No	-
		Wait	Wait	No	-
			Reduce Demands	No	-
		Reduce Demands	Wait	No	-
			Reduce Demands	No	-
	Wait	Violence	Wait	No	-
			Reduce Demands	No	-
		Wait	Wait	No	-
			Reduce Demands	+	8
		Reduce Demands	Wait	No	-
			Reduce Demands	+	9
	Reduce Demands	Violence	Wait	No	-
			Reduce Demands	No	-
		Wait	Wait	No	-
			Reduce Demands	No	-
		Reduce Demands	Wait	No	-
			Reduce Demands	+	10

Table 4-2

A SET OF GROUP DISPOSITION PROFILES

4.4.1 Outcomes considered - The following seven representative outcomes, ranging from very favorable to very unfavorable, were constructed:

- o TERRORISTS SURRENDER;
- o GOVERNMENT HIT--OPERATION SUCCESSFUL;
- o NEGOTIATED SETTLEMENT--SAFE PASSAGE;
- o SHOOTOUT--GOVERNMENT HIT, TERRORISTS VIOLENT;
- o NEGOTIATED MODERATE CONCESSION;
- o HOSTAGES KILLED--DESTROY TERRORISTS; and
- o MAXIMUM CONCESSIONS.

4.4.2 Relation of outcome to group response tendency - For any of the ten group dispositions, it is possible to specify one or two most likely outcomes given the government action. The result of this procedure is shown in Table 4-3.

4.5 Evaluation of Outcomes

Each combination of government actions and terrorist inclinations provides one of several outcomes with some specified probability. Each outcome can be characterized in terms of eight attributes which are described in this section. These attributes represent both long- and short-term criteria. They are assigned initial weights, and outcomes are given initial scores for illustrative purposes. These scores and weights were not obtained from operational experts and do not represent any official policy. However, the initial Colombian model results were used in the development of some of these scores and weights.

GOVERNMENT ACTION	GROUP ACTION	LIKELY OUTCOME
(1) Violence	Violence	Shootout or Successful C.T. Operation
No Concessions/Wait	Violence	Shootout
Safe Passage Only	Violence	Shootout
Negotiate	Wait/Hold	High Concessions or Shootout
(2) Violence	Violence	Shootout or Successful C.T. Operation
No Concessions/Wait	Violence	Shootout
Safe Passage Only	Wait	High Concessions or Shootout
Negotiate	Wait	High Concessions or Shootout
(3) Violence	Violence	Shootout or Successful C.T. Operation
No Concessions/Wait	Violence	Shootout
Safe Passage Only	Wait	Moderate Concessions or Safe Passage
Negotiate	Reduce Demands	Negotiated Settlement-Moderate Concessions
(4) Violence	Violence	Shootout or Successful C.T. Operation
No Concessions/Wait	Wait	Moderate to Maximum Demands or Shootout
Safe Passage Only	Wait	Moderate to Maximum Demands or Shootout
Negotiate	Wait	Moderate to Maximum Demands or Shootout
(5) Violence	Violence	Shootout or Successful C.T. Operation
No Concessions/Wait	Wait	Shootout or Moderate Concessions
Safe Passage Only	Wait	Moderate Concessions
Negotiate	Reduce Demands	Negotiated Settlement-Moderate Concessions
(6) Violence	Violence	Shootout or Successful C.T. Operation
No Concessions/Wait	Wait	Minor Concessions or Safe Passage
Safe Passage Only	Reduce Demands	Negotiated Settlement-Minor Concessions or Safe Passage
Negotiate	Reduce Demands	Negotiated Settlement-Moderate Concessions

Table 4-3

POSSIBLE OUTCOMES RELATED TO
GOVERNMENT ACTION AND GROUP RESPONSE

GOVERNMENT	GROUP ACTION	LIKELY OUTCOME
(7) Violence	Violence	Shootout or Successful C.T. Operation
No Concessions/Wait	Reduce Demands	Negotiated Settlement-Minor Concessions
Safe Passage Only	Reduce Demands	Negotiated Settlement-Minor Concessions
Negotiate	Reduce Demands	Negotiated Settlement-Moderate Concessions
(8) Violence	Surrender	No Concessions
No Concessions/Wait	Wait	Minor Concessions or Safe Passage
Safe Passage Only	Wait	Minor Concessions or Safe Passage
Negotiate	Reduce Demands	Moderate Concessions or Minor Concessions
(9) Violence	Surrender	No Concessions
No Concessions/Wait	Wait	Minor Concessions or Safe Passage
Safe Passage Only	Reduce Demands	Minor Concessions or Safe Passage
Negotiate	Reduce Demands	Minor or Moderate Concessions
(10) Violence	Surrender	No Concessions
No Concessions/Wait	Reduce Demands	Minor Concessions or Safe Passage
Safe Passage Only	Reduce Demands	Minor Concessions or Safe Passage
Negotiate	Reduce Demands	Minor Concessions

Table 4-3

POSSIBLE OUTCOMES RELATED TO
GOVERNMENT ACTION AND GROUP RESPONSE (Continued)

4.5.1 Evaluation of criteria - Outcomes are evaluated in terms of eight attributes. Each attribute is scaled from 0 to 100 where 0 represents the worst possible situations and 100 the best. The eight attributes and scale definitions are:

(1) Hostage Safety -

0 - All Hostages Killed.
25 - Majority of Hostages Killed.
50 - Small Percentage of Hostages Killed.
75 - Hostages Severely Beaten.
100 - Hostages Completely Safe.

(2) Internal Political Implications - This attribute deals with the internal political implications of outcomes for the government responsible for the action. Political implications could involve impacts in elections or government stability due to public feeling about government action.

0 - Government Perceived as Very Weak and Disorganized.
50 - Government Perceived as Somewhat Hesitant and Without Strong Conviction.
100 - Government Perceived as Acting Decisively With Organization.

(3) International Political Implications - This attribute deals with the international implications of the incident. For example, other countries can be angered if ambassadors or other hostages, e.g., Israeli olympic team, are injured or killed. Also, the general international perception of the government's actions is covered here.

0 - Major Negative International Impact, With Lasting Implications.

50 - No Net International Impact.

100 - Very Favorable International Implications. Outcome Enhances Overall Perception of Government.

(4) Counter-Terrorist Force Safety -

0 - Almost Entire Force Killed.

25 - Major Casualties, Many Deaths--Up to 50% of Force.

50 - Several Deaths, Moderate Casualties.

75 - One or Two Deaths, Light Casualties.

100 - No Casualties.

(5) Counter-Terrorist Force Morale -

0 - Force Morale Undermined. Once Again Not Used When Should Have Been. All Training Wasted.

50 - Force Morale Negatively Impacted. Feeling That They are Pawns in Ridiculous Situation. Feelings of Professionalism Affected.

100 - Force Morale Uplifted. Allowed to do Their Job in Their Own Way.

(6) Facility Damage -

0 - High - Over $100,000.

50 - Moderate - $25,000 - $100,000.

75 - Low - Less Than $25,000.

100 - None.

(7) Terrorist Resources - What additional resources do the terrorists have as a result of the incident. For example, do they have the services of released prisoners, money, etc.?

0 - Major Resources. Weapons, Money, and Fairly Large Number of Released Prisoners.
25 - Fairly Large Resource. Money and Several Released Prisoners.
50 - Moderate Resources. One or Two Released Prisoners.
75 - Small Resources. Safe Passage for the Group.
100 - Loss of Resources. Group all Captured.

(8) Terrorist Ideology - This attribute refers to the positive impact of the incident outcome on the terrorist ideology campaign. Positive impacts include major ideological boost due to confronting major government powers, victory, enhanced recruitment, and martyrdom effects. Negative effects include loss of respect due to apparent disorganization, surrender, meaningless deaths or casualties.

0 - Major Victory for Terrorists. Government Gives In.
25 - Safe Passage and Government Makes Statement.
50 - Moderate Victory. Safe Passage.
75 - Martyrdom for Some Terrorists. No Other Implication.
100 - Terrorists Perceived as Ineffective.

4.5.2 Importance weights - A set of importance weights indicating the relative importances of the 100-point ranges follows. These weights are illustrative only and do not reflect any specific expert judgment. Different scenarios are likely to dictate different sets of weights, and a necessary capability of an aid is the ability to display the decision as a function of different weighting policies.

	WEIGHTS	NORMALIZED WEIGHTS
Hostage Safety	80	16
Internal Political Implications	80	16
International Political Implications	60	12
Counter-Terrorist Force Safety	40	8
Counter-Terrorist Force Morale	50	10
Facility Damage	10	2
Terrorist Resources	100	20
Terrorist Ideology	80	16
		100

4.5.3 Utilities of outcomes - Each different action/group disposition combination can result in one or more outcomes. Probabilities of these outcomes must be assessed. Also, the utility of the outcome must be assessed. It is assumed here that the utility of an outcome is the same for all act/disposition combinations that can lead to that outcome. This may not be strictly correct in that the outcomes may take slightly different forms for different act/disposition combinations.

The utility of each outcome is obtained by scoring the outcome on each of the eight attributes and then combining these scores using attribute importance weights. Illustrative assessments appear in Tables 4-4 through 4-11.

OUTCOME: MAXIMUM CONCESSIONS

ATTRIBUTE	SCORE	x WEIGHT	= WEIGHTED SCORE
HOSTAGE SAFETY	100	16	16
INTERNAL POLITICAL	0	16	0
INTERNATIONAL POLITICAL	80	12	10
C.T. FORCE SAFETY	100	8	8
C.T. FORCE MORALE	30	10	3
FACILITY DAMAGE	100	2	2
TERRORIST RESOURCES	0	20	0
TERRORIST IDEOLOGY	0	16	0
TOTAL			39

Outcome independent of terrorist state

Table 4-4
UTILITY OF OUTCOME FOR MAXIMUM CONCESSIONS

OUTCOME: SHOOTOUT--GOVERNMENT HIT, TERRORISTS VIOLENT

Shootout -

Assume 50% Hostages Killed
Heavy C.T. Force Casualties
All Terrorists Killed
Heavy Facility Damage

ATTRIBUTE	SCORE	x WEIGHT	= WEIGHTED SCORE
HOSTAGE SAFETY	25	16	4
INTERNAL POLITICAL	90	16	14
INTERNATIONAL POLITICAL	10	12	1
C.T. FORCE SAFETY	25	8	2
C.T. FORCE MORALE	100	10	10
FACILITY DAMAGE	0	2	0
TERRORIST RESOURCES	100	20	20
TERRORIST IDEOLOGY	75	16	12
TOTAL			63

Table 4-5

UTILITY OF OUTCOME FOR SHOOTOUT--GOVERNMENT HIT, TERRORISTS VIOLENT

OUTCOME: GOVERNMENT HIT--OPERATION SUCCESSFUL

ATTRIBUTE	SCORE	x WEIGHT	= WEIGHTED SCORE
HOSTAGE SAFETY	100	16	16
INTERNAL POLITICAL	100	16	16
INTERNATIONAL POLITICAL	90	12	11
C.T. FORCE SAFETY	100	8	8
C.T. FORCE MORALE	100	10	10
FACILITY DAMAGE	80	2	2
TERRORIST RESOURCES	100	20	20
TERRORIST IDEOLOGY	100	16	16
TOTAL			99

Table 4-6

UTILITY OF OUTCOME FOR GOVERNMENT
HIT--OPERATION SUCCESSFUL

OUTCOME: TERRORISTS SURRENDER

ATTRIBUTE	SCORE	x WEIGHT	= WEIGHTED SCORE
HOSTAGE SAFETY	100	16	16
INTERNAL POLITICAL	100	16	16
INTERNATIONAL POLITICAL	100	12	12
C.T. FORCE SAFETY	100	8	8
C.T. FORCE MORALE	100	10	10
FACILITY DAMAGE	50	2	1
TERRORIST RESOURCES	100	20	20
TERRORIST IDEOLOGY	100	16	16
TOTAL			99

Assume Some Facility Damage if Hit

Table 4-7

UTILITY OF OUTCOME FOR TERRORISTS SURRENDER

OUTCOME: NEGOTIATED SETTLEMENT, MODERATE CONCESSIONS

ATTRIBUTE	SCORE	x WEIGHT	= WEIGHTED SCORE
HOSTAGE SAFETY	100	16	16
INTERNAL POLITICAL	40	16	6
INTERNATIONAL POLITICAL	70	12	8
C.T. FORCE SAFETY	100	8	8
C.T. FORCE MORALE	20	10	2
FACILITY DAMAGE	100	2	2
TERRORIST RESOURCES	20	20	4
TERRORIST IDEOLOGY	20	16	3
TOTAL			49

Table 4-8

UTILITY OF OUTCOME FOR NEGOTIATED SETTLEMENT, MODERATE CONCESSIONS

OUTCOME: NEGOTIATED SETTLEMENT, SAFE PASSAGE

ATTRIBUTE	SCORE	x WEIGHT	= WEIGHTED SCORE
HOSTAGE SAFETY	100	16	16
INTERNAL POLITICAL	70	16	11
INTERNATIONAL POLITICAL	80	12	10
C.T. FORCE SAFETY	100	8	8
C.T. FORCE MORALE	60	10	6
FACILITY DAMAGE	100	2	2
TERRORIST RESOURCES	75	20	15
TERRORIST IDEOLOGY	50	16	8
TOTAL			76

Table 4-9

UTILITY OF OUTCOME FOR NEGOTIATED SETTLEMENT, SAFE PASSAGE

OUTCOME: HOSTAGES KILLED/DESTROY TERRORISTS

ATTRIBUTE	SCORE	x WEIGHT	= WEIGHTED SCORE
HOSTAGE SAFETY	0	16	0
INTERNAL POLITICAL	50	16	11
INTERNATIONAL POLITICAL	0	12	0
C.T. FORCE SAFETY	90	8	7.2
C.T. FORCE MORALE	50	3	1.5
FACILITY DAMAGE	0	2	0
TERRORIST RESOURCES	100	20	20
TERRORIST IDEOLOGY	75	16	12
TOTAL			49

Table 4-10

UTILITY OF OUTCOME FOR HOSTAGES
KILLED/DESTROY TERRORISTS

ATTRIBUTES	WEIGHT	MAXIMUM CONCESSIONS	SHOOTOUT	GOV'T HIT OPERATION SUCCESSFUL	TERRORISTS SURRENDER	NEGOTIATED MODERATE CONCESSIONS	SAFE PASSAGE ONLY	HOSTAGES KILLED
HOSTAGE SAFETY	16	100	25	100	100	100	100	0
INTERNAL POLITICAL	16	0	90	100	100	40	70	50
INTERNATIONAL POLITICAL	12	80	10	90	100	70	80	0
C.T. FORCE SAFETY	8	100	25	100	100	100	100	90
C.T. FORCE MORALE	10	30	100	100	100	20	60	50
FACILITY DAMAGE	2	100	0	80	50	100	100	0
TERRORIST RESOURCES	20	0	100	100	100	20	75	100
TERRORIST IDEOLOGY	16	0	75	100	100	20	50	75
TOTAL WEIGHTED	100	39	63	99	99	49	76	49

Table 4-11

SUMMARY OF UTILITIES OF OUTCOMES

5.0 DECISION AID STRATEGIES

The basic model elements for a general Hostage and Barricade incident can be combined in a number of ways to produce decision aids with any of a variety of features. In particular, decision aids could be built for the general Hostage and Barricade incident based on HIVAL, OPINT, ITREE, some other methodology, or a combination of methods. Mathematically, the methods could be completely isomorphic. The aids must be distinguished, then, on how well they interact with the user.

Several factors help determine the quality of the interactions between the decision aid and its user. Primary among these factors is the extent to which the model representation of the situation corresponds to that of the user and is easily understood by him. In addition, the aid must be able to draw relevant information from the TRAP data base and display the information and its important implications on the user's decision. Other factors which enhance user interaction are the ability to investigate critical assumptions with sensitivity analysis, and the freedom from long and cumbersome assessment of parameters. These factors represent the major considerations in assessing the quality of decision aids.

The three analyst aids OPINT, HIVAL, and ITREE were used as bases of a prototype counter-terrorist decision aid for the Hostage and Barricade scenario described in Section 4.0. The prototype aids are all mathematically equivalent, but differ significantly in form, representation, and flexibility. Some of the differences between the aids depend on the methodology embodied by the aid, while others depend on the particular implementation of the methodology as a computer program. Attempts will be made to specify which differences are critical in comparing these aids.

5.1 The OPINT Analysis

The OPINT approach to the problem is illustrated in Figure 5-1. Each of the set of available counter-terrorist force actions is evaluated conditional on each of a set of potential terrorist tendencies. These demeanors represent a group personality variable that exists independently of the government action taken. Contributing to the group tendency is a set of variables displayed in the influence diagram in Figure 5-2. These variables reflect the group identity and doctrine, as well as the potential effect on the group due to the perception of the government. That perception is influenced both by past behavior and current policy. The other determinant of group tendencies is the health/morale of the group. If the group has been shot up and is disorganized, it should be more likely that it will settle for lower demands; this may enhance the probability of a successful counter-terrorist force operation. This probability analysis is kept fairly small here, although the possibility for expansion exists. The probability of each event in the diagram must be assessed conditional on all combinations of the events directly influencing the specific event in question. Examples of the assessments used in this evaluation appear in Table 5-1.

The ability to pre-assess many of these probabilities greatly increases the value of this approach to an aid for two reasons. First, the assessments are available for inspection and possible modification prior to use. This greatly reduces implementation time. Second, the wisdom of the experienced analysts who made the judgments is made available to the decision maker who may be less experienced with the particular group or situation, or who may not have the time to think through all aspects of the problem.

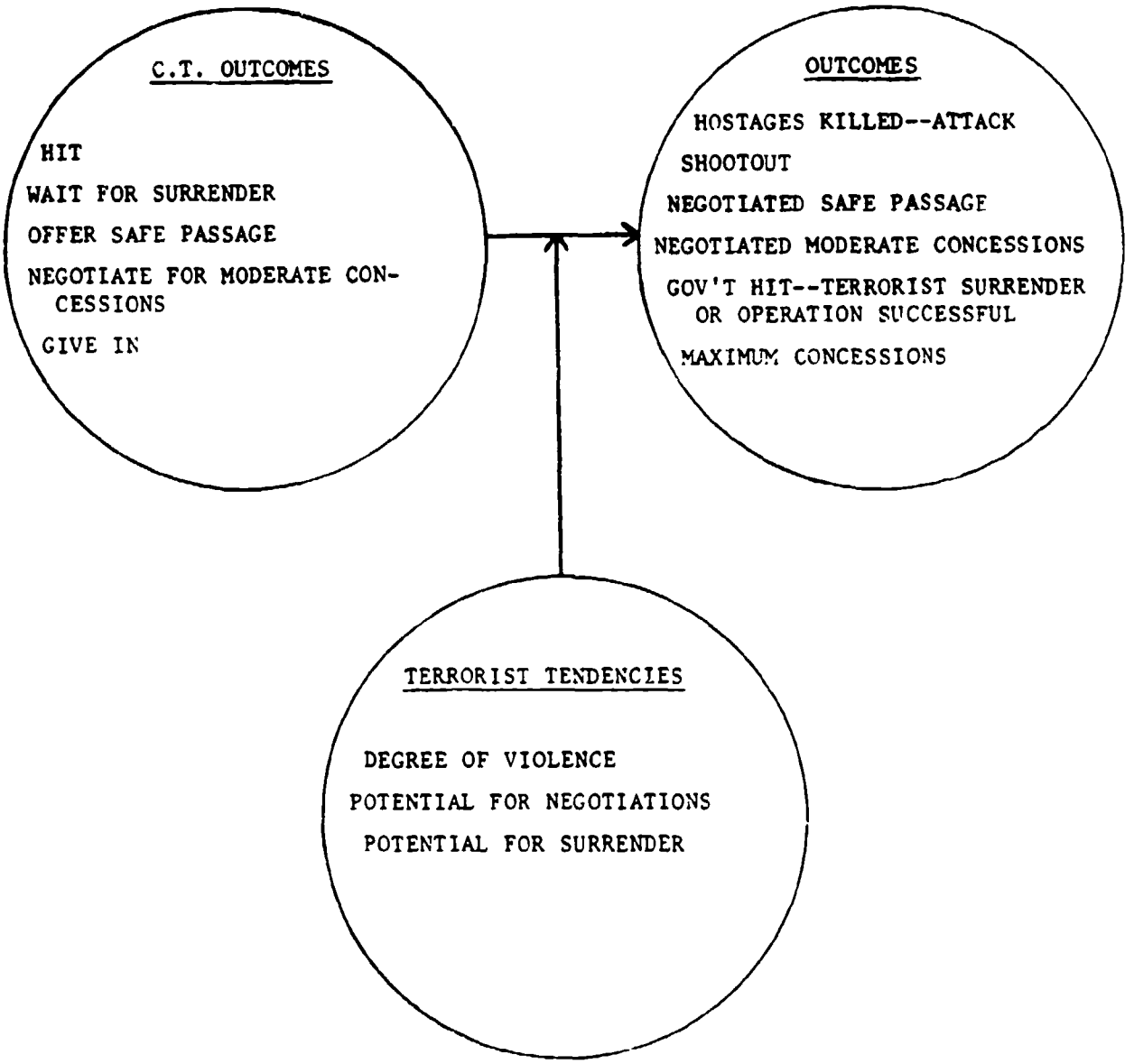


Figure 5-1

REPRESENTATION OF POTENTIAL ACTIONS, TERRORIST TENDENCIES, AND OUTCOMES

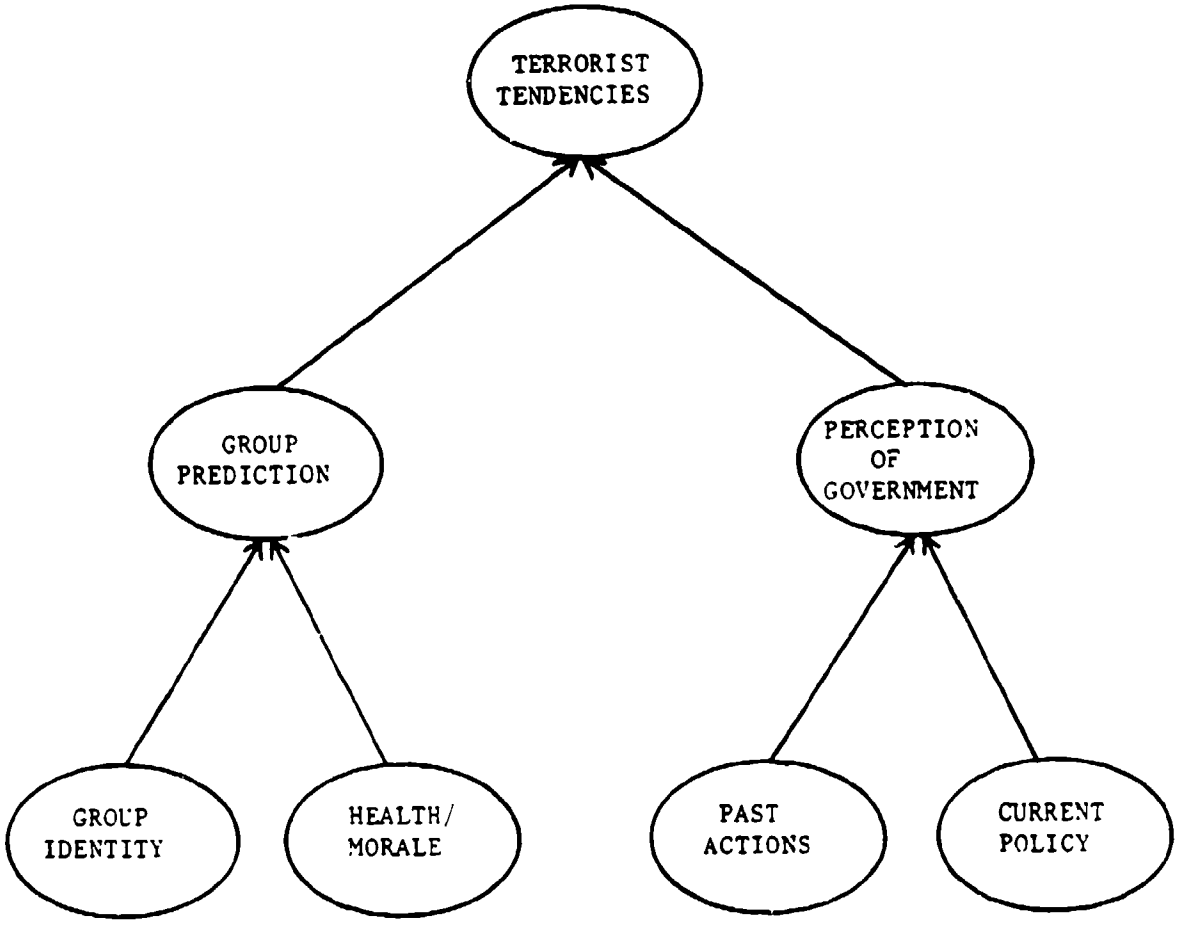


Figure 5-2

INFLUENCE DIAGRAM FOR ASSESSMENT
OF PROBABLE TERRORIST TENDENCIES

GRP PREDCT	PRC OF GVT		TERR TENDC: TENDCS 1&2	TENDCS 4&5	TND 8,9,10		
			TENDENCY 3	TENDCS 6&7			
TENDCS 1&2	INC VILNCE	(1)	100	0	0	0	0
TENDCS 1&2	NO EFFECT	(5)	100	0	0	0	0
TENDCS 1&2	DEC VILNCE	(1)	90	10	0	0	0
TENDENCY 3	INC VILNCE	(4)	20	80	0	0	0
TENDENCY 3	NO EFFECT	(16)	0	100	0	0	0
TENDENCY 3	DEC VILNCE	(4)	0	85	15	0	0
TENDCS 4&5	INC VILNCE	(7)	0	20	80	0	0
TENDCS 4&5	NO EFFECT	(26)	0	0	100	0	0
TENDCS 4&5	DEC VILNCE	(6)	0	0	80	20	0
TENDCS 6&7	INC VILNCE	(4)	0	0	20	80	0
TENDCS 6&7	NO EFFECT	(17)	0	0	0	100	0
TENDCS 6&7	DEC VILNCE	(4)	0	0	0	80	20
TND 8,9,10	INC VILNCE	(1)	0	0	0	20	80
TND 8,9,10	NO EFFECT	(3)	0	0	0	0	100
TND 8,9,10	DEC VILNCE	(1)	0	0	0	0	100
MARGINAL TOTALS:			9	23	38	25	4

GROUP NAME	HLTH/MORAL		GRP PREDCT: TENDCS 1&2	TENDCS 4&5	TND 8,9,10		
			TENDENCY 3	TENDCS 6&7			
BSO	STRONG	(13)	20	40	35	5	0
BSO	WEAK	(13)	15	30	45	10	0
FSLN	STRONG	(13)	0	15	45	40	0
FSLN	WEAK	(13)	0	10	40	40	10
PLFP	STRONG	(13)	0	15	45	40	0
PLFP	WEAK	(13)	10	25	45	20	0
MLG	STRONG	(13)	15	25	30	25	5
MLG	WEAK	(13)	5	25	30	25	15
MARGINAL TOTALS:			8	23	39	26	4

Table 5-1

ASSESSMENTS OF CONDITIONAL PROBABILITIES FOR INFLUENCE DIAGRAM WITH RESULTANT MARGINAL TOTAL PROBABILITIES

GROUP NAME			
BSO	FSLN	PLFP	MLG
25	25	25	25

HLTH/MORAL	
STRONG	WEAK
50	50

PAST ACTS	CURRNT POL		PRC OF GVT INC VILNCE	DEC VILNCE	NO EFFECT
NO CNCESSN	HARD LINE	(11)	0	60	40
NO CNCESSN	NO EFFECT	(11)	0	75	25
NO CNCESSN	INC CNCESS	(11)	15	60	25
SAFE PASSG	HARD LINE	(11)	10	70	20
SAFE PASSG	NO EFFECT	(11)	10	80	10
SAFE PASSG	INC CNCESS	(11)	20	70	10
CONCESSION	HARD LINE	(11)	25	70	5
CONCESSION	NO EFFECT	(11)	30	60	10
CONCESSION	INC CNCESS	(11)	40	60	0
MARGINAL TOTALS			17	67	16

PAST ACTS		
NO CNCESSN	CONCESSION	SAFE PASSG
33	33	33

CURRNT POL		
HARD LINE	INC CNCESS	NO EFFECT
33	33	33

Table 5-1

ASSESSMENTS OF CONDITIONAL PROBABILITIES FOR INFLUENCE DIAGRAM WITH RESULTANT MARGINAL TOTAL PROBABILITIES (Continued)

The other assessments in the OPINT model are the value assessments for the act/tendency combinations. For each act, each of several tendency states is possible, and values must be assessed for these. "If the counter-terrorist force hits and the terrorists are maximally violent, what is the relative value?" This kind of question requires the decision maker to mentally aggregate across several alternative outcomes, and this is a difficult task. Rather, it is desirable to assign a value to the potential outcomes of the act/tendency combinations such as shootout, terrorists surrender, hostages killed, etc. The OPINT software as currently configured does not provide for such a step. Currently, the values of the act/tendency combinations must be directly assessed with respect to the attributes.

An alternative approach was used in this application. The potential outcomes of the act/tendency combinations shown in Figure 5-1 were used as attributes, and the probabilities of these outcomes for each act/tendency combination were used as the scores on the "outcome attribute." The weight or benefit swing for the outcome then corresponded to the relative utility associated with that outcome. Assessed benefits for the possible outcomes were discussed in Section 4.5.3.

The probabilities of outcomes appear in Table 5-2. Note that the terrorists surrendering in response to an attack and the government achieving a successful counter-terrorist operation are slightly different outcomes, but the utilities summarized in Table 4-11 are very similar. Therefore, these outcomes were combined into a single outcome (as shown in Table 5-2) to reduce the size of the model.

The approach described here yields expected utilities of acts in a way that is mathematically correct. However, the judgments required are somewhat unintuitive in the form

HOSTGS KILLD/ATTACK WEIGHT: 13

	TERR TENDC SCENRS 1&2 SCENARIO 3	SCENRS 4&5	SCN 8,9,10 SCENRS 6&7		
HIT	0	0	0	0	0
WAIT	60	40	5	0	0
OFR SAF PS	50	0	5	0	0
NEGOTIATE	40	0	0	0	0
GIVE IN	0	0	0	0	0

SHOOTOUT WEIGHT: 17

	TERR TENDC TENDCS 1&2 TENDENCY 3	TENDCS 4&5	TND 8,9,10 TENDCS 6&7		
HIT	90	80	75	70	20
WAIT	40	60	15	0	0
OFR SAF PS	50	0	5	0	0
NEGOTIATE	40	0	0	0	0
GIVE IN	0	0	0	0	0

NEGOTTED SAFE PASSGE WEIGHT: 20

	TERR TENDC SCENRS 1&2 SCENARIO 3	SCENRS 4&5	SCN 8,9,10 SCENRS 6&7		
HIT	0	0	0	0	0
WAIT	0	0	0	80	80
OFR SAF PS	0	50	0	100	100
NEGOTIATE	0	0	0	0	20
GIVE IN	0	0	0	0	0

Table 5-2

PROBABILITIES OF OUTCOMES FOR EACH ACTION/TENDENCY COMBINATION

NEGOTTED MOD CONCESS WEIGHT: 14

	TERR TENDC SCENRS 1&2 SCENARIO 3	SCENRS 4&5	SCN 8,9,10 SCENRS 6&7		
HIT	0	0	0	0	0
WAIT	0	0	70	20	10
OFR SAF PS	0	50	85	0	0
NEGOTIATE	0	100	100	100	80
GIVE IN	0	0	0	0	0

TERR SURR/SUCSFL HIT WEIGHT: 26

	TERR TENDC TENDCS 1&2 TENDENCY 3	TENDCS 4&5	TND 8,9,10 TENDCS 6&7		
HIT	10	20	25	30	80
WAIT	0	0	0	0	10
OFR SAF PS	0	0	0	0	0
NEGOTIATE	0	0	0	0	0
GIVE IN	0	0	0	0	0

MAXIMUM CONCESSIONS WEIGHT: 10

	TERR TENDC SCENRS 1&2 SCENARIO 3	SCENRS 4&5	SCN 8,9,10 SCENRS 6&7		
HIT	0	0	0	0	0
WAIT	0	0	10	0	0
OFR SAF PS	0	0	5	0	0
NEGOTIATE	20	0	0	0	0
GIVE IN	100	100	100	100	100

Table 5-2

PROBABILITIES OF OUTCOMES FOR EACH ACTION/TENDENCY COMBINATION (Continued)

required in the OPINT software. At the heart of the problem with OPINT is the requirement that the event of interest be independent of the action taken. The problem arises because the event which was constructed to satisfy this requirement does not specify the final outcome of the incident. The somewhat more complex version of OPINT described below would be required if OPINT were to be the basis of an aid.

The modification is illustrated in Figure 5-3. The major difference is that all values, weights, and probabilities are represented in the model. All the probabilities in the influence diagram are available for sensitivity analyses. These are assessed at point B in Figure 5-3. The probabilities could also be directly manipulated at the terrorist tendency level of the influence diagram at point B; this provides direct sensitivity analyses. Thus, the capabilities of OPINT to manipulate probability assessments are maintained in the modified version.

The major enhancement is shown at point C of Figure 5-3. Probabilities of outcomes are assessed for each act/tendency combination. These could be assessed in advance by experts and modified by the user during the incident. Similarly, these probabilities are available for sensitivity analyses.

At point D, the outcomes are evaluated with respect to the attributes such as hostage safety, terrorist resources, internal political considerations, and the like. This evaluation would be assessed in advance, and sensitivity analyses on the importance weights of the attributes would be conducted. These are very important sensitivity analyses because the recommended course of action is very sensitive to the relative importance of hostage safety, political considerations, and terrorist resources, as well as other attributes. Therefore, it is desirable to be able to do this

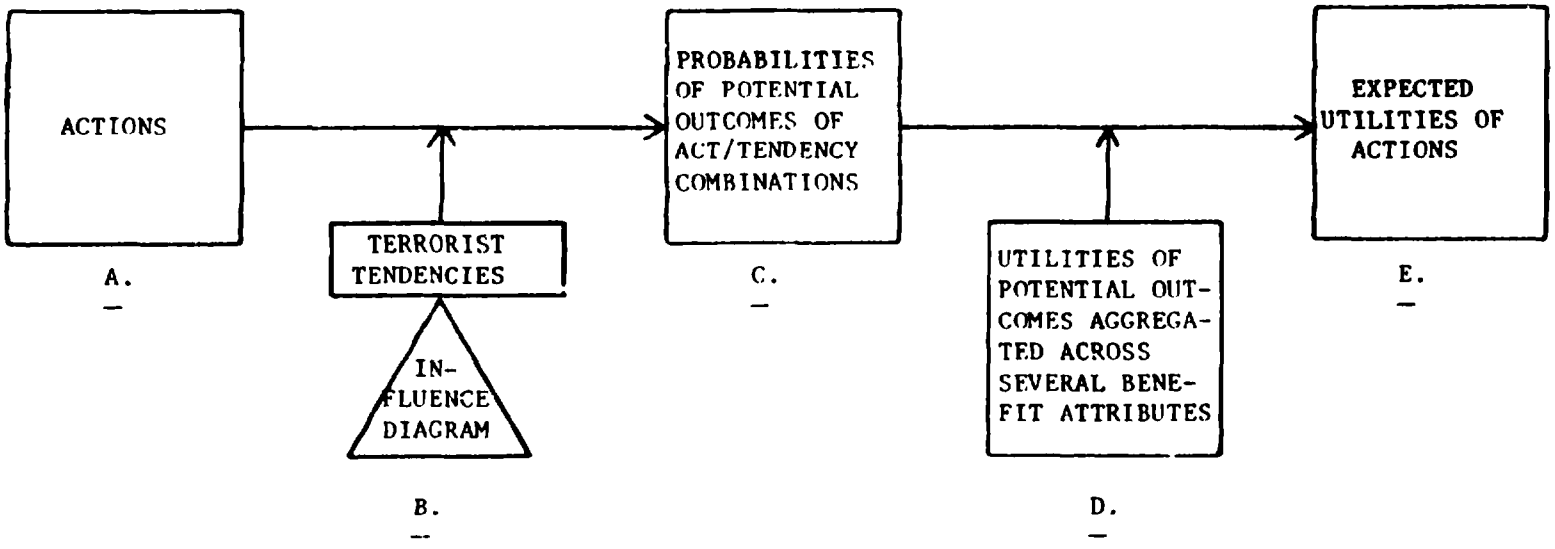


Figure 5-3

THE MODIFIED OPINT APPROACH

directly and easily, and it cannot be done if the attribute weights are not available for sensitivity analyses.

At point E, the expected values of the actions are displayed. This would be a display similar to that in Table 5-3.

For many reasons this OPINT approach is a good one. The modifications described would alleviate some of the problems encountered in this trial application. Before discussing the relative merits of this approach, it is desirable to describe the HIVAL and ITREE applications.

5.2 The HIVAL Analysis

The HIVAL analysis used the same scenario and the same assessments as the OPINT analysis. Since it is possible to have the same mathematical structure with HIVAL as it is with OPINT, the important question is which is better from a user viewpoint.

The HIVAL hierarchy is illustrated in Figure 5-4. Each node at a higher level contains all nodes below it. Thus, there are 240 branches in the HIVAL structure.

An abbreviated version of the results appears in Table 5-4. At the highest level of the hierarchy are the five actions evaluated for each of the five group personality types. Scores for action/personality combinations are combined using the weights in the WT column. Note that these weights are the probabilities obtained from the OPINT influence diagram analysis illustrated in Figure 5-2 and Table 5-1. If these influencing events were included in the HIVAL model, the resulting structure would have 259,200 branches. The OPINT analysis has a distinct advantage here in that it

COMBINED VALUE

ACTIONS	PR	9	23	38	25	4	EXPECTED VALUE
		TERR TENDC TENDCS 1&2 TENDCY 3	TENDCS 4&5	TND 8,9,10 TENDCS 6&7			
HIT		18	19	19	20	24	19
WAIT		15	15	14	19	20	16
OFR SAF PS		15	17	14	20	20	16
NEGOTIATE		14	14	14	14	15	14
GIVE IN		10	10	10	10	10	10

Table 5-3

EXPECTED VALUE OF ACTIONS

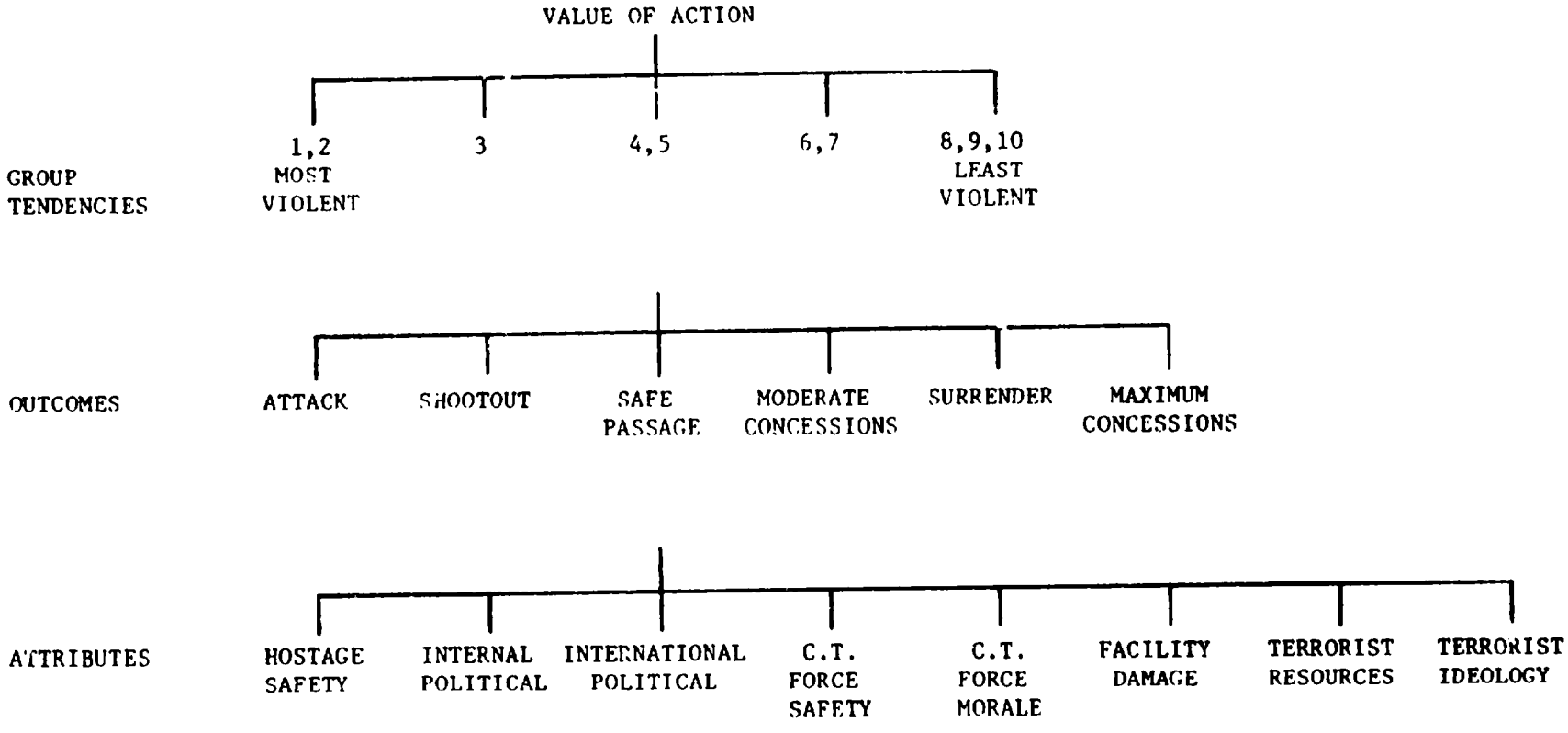


Figure 5-4

THE HIVAL STRUCTURE

provides an economical way to represent probabilistic relationships among events.

Each tendency such as MOST VIOLENT 1,2 (which corresponds to dispositions 1 and 2 of Table 4-2) is decomposed into six attributes, the potential outcomes (again combining surrender with successful operation). As with OPINT, the weights on the outcomes represent the benefit scores for those outcomes, and the attribute scores represent the outcome probabilities. This unintuitive representation is necessitated by the fact that weights in a MAUA model are independent of the action being evaluated.

The next level of the hierarchy under each tendency/outcome combination is the set of attributes upon which an outcome is to be evaluated. The incorporation of attributes presents significant problems for an additive MAUA model. Specifically, the fact that outcome probabilities depend on the action chosen forces the score/weight reversal described in the previous paragraph. To make this reversal, outcome branches must be at the lowest level of the hierarchy; otherwise the score would be a weighted average of other attributes. However, the value of an outcome (represented in the model as a weight) depends on the evaluation attributes. Thus, the attributes must be lower in the hierarchy than the outcomes; furthermore, the average attribute value should feed into the outcome weight rather than the outcome score.

The above problem could be solved if outcome value and outcome probability were the two factors under each outcome. Value could be further subdivided to consider the evaluation attributes. However, the value of each outcome would be the product of its probability and the weighted average attribute score rather than the weighted sum. Thus, the problem

may be solved by using a nonlinear MAUA in a way which restores the intuitive meaning of all model parameters.

It is also possible to retain the additive form of the analysis, but only at the cost of further confusion in interpretation. One way to maintain an additive model is to consider the actions as the highest level factors in the evaluation. In this way it would be possible to represent the probability of an outcome as a weight which was different for different action/tendency combinations. Confusion is added because the role in the model of actions is now filled by a fictitious system which does not correspond to any action available to the government. The capability to do sensitivity analyses is also seriously impaired.

HIVAL provides for a sensitivity analysis on the importance of any attribute in the model. This is done by varying the total relative importance of that attribute as compared to all others in the model. The CUMWT listed in Table 5-4 indicates the amount of importance assigned an attribute. By varying the CUMWT through a range, the sensitivity of the results to the attribute importance can be observed. Although sensitivity analysis is desirable and is used in many evaluations, it becomes a problem with the structure displayed in Figure 5-4 because each of the eight evaluation attributes appears under each tendency/outcome combination for a total of thirty times each. To vary the overall importance of hostage safety, it is necessary to simultaneously vary all thirty attributes labeled hostage safety. To do so is somewhat cumbersome, and it might be best accomplished by adding enhanced capability for sensitivity analyses. However, the general feeling DDI analysts observed was that the sensitivity analyses and representation of the problem achieved by this HIVAL approach do not merit further pursuit.

MAUA HOSTAGE AND BARRICADE MODEL TUESDAY 11/11/1980 10:52

0 - TERR EVAL

	FACTOR		WT	HIT	WT	SP	NEG	GI	DISC4	CUMWT	FLG
1)	TENDCS 1,2	(	9)	18	15	15	14	10	8.37	9.09	
2)	TENDENCY 3	(	23)	19	15	17	14	10	22.54	23.23	
3)	TENDCS 4,5	(	38)	19	14	14	14	10	38.20	38.38	
4)	TENDCS 6,7	(	25)	20	19	20	14	10	25.76	25.25	
5)	TND 8,9,10	(	4)	24	20	20	15	10	5.13	4.04	
	TOTAL			19	16	16	14	10	100.00	100.00	

1 - TERR EVAL - TENDCS 1,2

	FACTOR		WT	HIT	WT	SP	NEG	GI	DISC4	CUMWT	FLG
1)	ATTACK	*(	13)	0	60	50	40	0	.00	1.19	A
2)	SHOOTOUT	*(	17)	90	40	50	40	0	7.12	1.53	B
3)	SAFE PASSG	*(	20)	0	0	0	0	0	.00	1.84	C
4)	MOD CONCES	*(	14)	0	0	0	0	0	.00	1.24	D
5)	HIT/SURREN	*(	26)	10	0	0	0	0	1.24	2.40	E
6)	MAX CNCESS	*(	10)	0	0	0	20	100	.00	.90	F
	TOTAL			18	15	15	14	10	8.37	9.09	

2 - TERR EVAL - TENDENCY 3

	FACTOR		WT	HIT	WT	SP	NEG	GI	DISC4	CUMWT	FLG
1)	ATTACK	*(	13)	0	40	0	0	0	.00	3.04	A
2)	SHOOTOUT	*(	17)	80	60	0	0	0	16.18	3.90	B
3)	SAFE PASSG	*(	20)	0	0	50	0	0	.00	4.71	C
4)	MOD CONCES	*(	14)	0	0	50	100	0	.00	3.16	D
5)	HIT/SURREN	*(	26)	20	0	0	0	0	6.36	6.13	E
6)	MAX CNCESS	*(	10)	0	0	0	0	100	.00	2.29	F
	TOTAL			19	15	17	14	10	22.54	23.23	

3 - TERR EVAL - TENDCS 4,5

	FACTOR		WT	HIT	WT	SP	NEG	GI	DISC4	CUMWT	FLG
1)	ATTACK	*(	13)	0	5	5	0	0	.00	5.02	A
2)	SHOOTOUT	*(	17)	75	15	5	0	0	25.07	6.45	B
3)	SAFE PASSG	*(	20)	0	0	0	0	0	.00	7.78	C
4)	MOD CONCES	*(	14)	0	70	85	100	0	.00	5.22	D
5)	HIT/SURREN	*(	26)	25	0	0	0	0	13.13	10.13	E
6)	MAX CNCESS	*(	10)	0	10	5	0	100	.00	3.79	F
	TOTAL			19	14	14	14	10	38.20	38.38	

Table 5-4

RESULTS OF THE HIVAL EVALUATION

4 - TERR EVAL - TENDCS 6,7

	FACTOR		WT	HIT	WT	SP	NEG	GI	DISC4	CUMWT	FLG
1)	ATTACK	*(	13)	0	0	0	0	0	.00	3.30	A
2)	SHOOTOUT	*(	17)	70	0	0	0	0	15.39	4.24	B
3)	SAFE PASSG	*(	20)	0	80	100	0	0	.00	5.12	C
4)	MOD CONCES	*(	14)	0	20	0	100	0	.00	3.43	D
5)	HIT/SURREN	*(	26)	30	0	0	0	0	10.37	6.67	E
6)	MAX CNCESS	*(	10)	0	0	6	0	100	.00	2.49	F
	TOTAL			20	19	20	14	10	25.76	25.25	

5 - TERR EVAL - TND 8,9,10

	FACTOR		WT	HIT	WT	SP	NEG	GI	DISC4	CUMWT	FLG
1)	ATTACK	*(	13)	0	0	0	0	0	.00	.53	A
2)	SHOOTOUT	*(	17)	20	0	0	0	0	.70	.68	B
3)	SAFE PASSG	*(	20)	0	80	100	20	0	.00	.82	C
4)	MOD CONCES	*(	14)	0	10	0	80	0	.00	.55	D
5)	HIT/SURREN	*(	26)	80	10	0	0	0	4.42	1.07	E
6)	MAX CNCESS	*(	10)	0	0	0	0	100	.00	.40	F
	TOTAL			24	20	20	15	10	5.13	4.04	

Table 5-4

RESULTS OF THE HIVAL EVALUATION (Continued)

The initial review here indicates that the HIVAL representation is probably the least valuable of the three, mainly mainly due to the failure of this approach to address uncertainty and the sequential dependencies that are a natural part of OPINT and ITREE. Although modifications can be made to accommodate some uncertainties, the capability provided in influence diagrams and decision trees is not available without vastly increasing the size of the evaluation hierarchy. The HIVAL hierarchy generally does not provide a framework that corresponds to the way the decision maker thinks about the problem. The main HIVAL benefit for this application is ease of use, but the disadvantages are many.

5.3 The ITREE Analysis

As discussed earlier, the ITREE analysis provides for the most natural and most complete representation of the general Hostage and Barricade scenario. However, the completeness and flexibility of the analysis greatly increases the complexity and makes it more cumbersome. The model created, which is mathematically equivalent to the OPINT model, is quite large, consisting of 394 nodes.

Figure 5-5 illustrates the structure of the ITREE model. The nodes in this structure are the same as those for the OPINT model; arrows between nodes indicate the influence relationships between the associated events or actions. The chief difference between this methodology and that of OPINT is that with OPINT, the effects of all uncertain events on the value of an action must be summarized by a single event, while in ITREE any event or action may influence the value or probability of any other node. The restrictions of OPINT allow one to separate the probability analysis from the rest of the decision tree; only the result of the calculations of the influence diagram is used in calculating the expected value of an action. Since ITREE

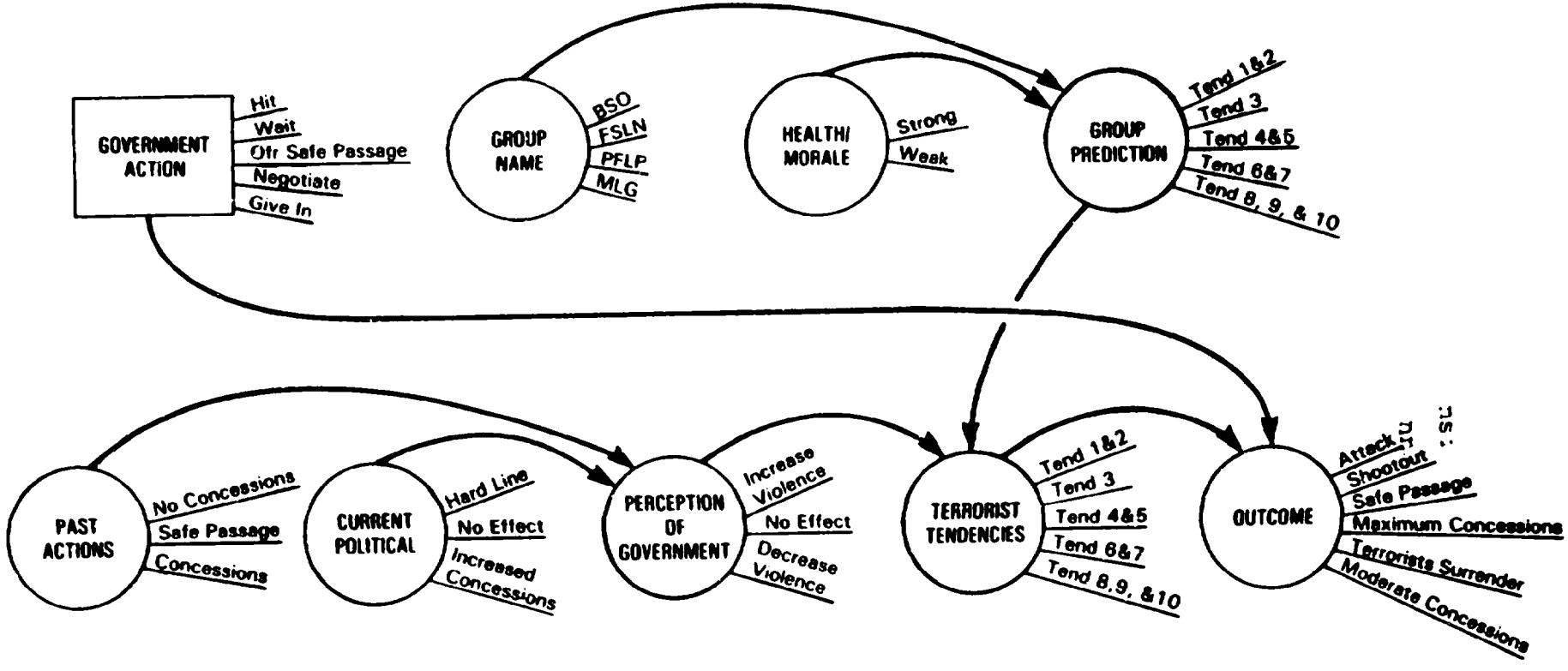


Figure 5-5
ORGANIZATION OF ITREE MODEL

allows arbitrary influences (which must be consistent, of course), probability and value calculations cannot be separated.

Because of the generality of ITREE, the methodology cannot take advantage of the economy provided by a group personality variable such as the terrorist tendency variable in this analysis. Economy in ITREE is obtained by exploiting dependencies existing between nodes. Since the nodes influencing terrorist tendencies are all independent of government action, they must be replicated for each action. Since many of them are independent of each other, they must be replicated even more times.

The large number of nodes in the model makes the model output extremely long and rather difficult to understand. Table 5-5 shows the first one and one-half pages of a 68-page printout of model values. Each block in Table 5-5 shows the scores for the branches of a particular node in the structure. The blocks shown in the table depict a sequence of nodes along a single path from the decision node to an outcome node obtained by choosing the first branch at every node. The entire printout shows all 394 nodes in the structure.

Because the ITREE model accurately represents the problem structure, it is possible to perform sensitivity analyses on attribute weights as well as on the probability of any event in the structure. In fact, the software provides an even more general capability to perform sensitivity analyses; the analysis results may be examined for any node in the structure instead of only for the top node. The ability to perform appropriate sensitivity analyses is a definite advantage of the ITREE model over the other two approaches, but it must be weighted against the disadvantages brought about by increased complexity.

HOSTAGE AND BARRICADE MODEL TUESDAY 11/11/1980 11:42

GVT ACTION [D]

CRIT. WEIGHTS:	16	16	12	8	10	20	16	
BRANCH	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1) HIT →	45	93	34	45	100	100	82	74
2) WAIT	66	59	47	81	54	64	49	59
3) OFR SAF PS	89	55	66	95	44	52	39	61
4) NEGOTIATE	94	42	66	97	24	26	24	50
5) GIVE IN	100	0	80	100	30	0	0	37
NET VALUE	45	93	34	45	100	100	82	74

1-HIT-GROUP NAME [P]

CRIT. WEIGHTS:		16	16	12	8	10	20	16	
BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1) BSO	(25)	41	92	29	41	100	100	80	72
2) FSLN	(25)	47	93	37	47	100	100	82	75
3) PLFP	(25)	44	93	33	44	100	100	81	74
4) MLG	(25)	47	93	36	47	100	100	82	75
EXPECTED VALUE		45	93	34	45	100	100	82	74

1 1-HIT-BSO-HLTH/MORAL [P]

CRIT. WEIGHTS:		16	16	12	8	10	20	16	
BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1) STRONG	(50)	40	92	28	40	100	100	80	72
2) WEAK	(50)	41	92	30	41	100	100	80	73
EXPECTED VALUE		41	92	29	41	100	100	80	72

Table 5-5

SELECTED OUTPUT FROM ITREE ANALYSIS

1 1 1-HIT-BSO-STRONG-GRP PREDCT [P]

	CRIT. WEIGHTS:		16	16	12	8	10	20	16	
	BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1)	TENDCS 1/2	(20)	33	91	19	33	100	100	78	68
2)	TENDENCY 3	(40)	40	92	28	40	100	100	80	72
3)	TENDCS 4/5	(35)	44	92	32	44	100	100	81	74
4)	TENDCS 6/7	(5)	49	93	38	49	100	100	83	76
5)	TND 8/9/10	(0)	84	98	80	84	100	100	95	92
	EXPECTED VALUE		40	92	28	40	100	100	80	72

1 0 0 1-HIT-TENDCS 1/2-PAST ACTS [P]

	CRIT. WEIGHTS:		16	16	12	8	10	20	16	
	BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1)	NO CNCESSN	(33)	33	91	19	33	100	100	78	69
2)	SAFE PASSG	(33)	33	91	19	33	100	100	78	68
3)	CONCESSION	(33)	33	91	19	33	100	100	78	68
	EXPECTED VALUE		33	91	19	33	100	100	78	68

1 0 0 1 1-HIT-TENDCS 1/2-NO CNCESSN-CURRNT POL [P]

	CRIT. WEIGHTS:		16	16	12	8	10	20	16	
	BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1)	HARD LINE	(33)	33	91	19	33	100	100	78	69
2)	NO EFFECT	(33)	33	91	19	33	100	100	78	68
3)	INC CNCESS	(33)	33	91	19	33	100	100	78	68
	EXPECTED VALUE		33	91	19	33	100	100	78	69

Table 5-5

SELECTED OUTPUT FROM ITREE ANALYSIS (Continued)

1 0 0 1 1 1-TENDCS 1/2-NO CNCESSN-HARD LINE-PRC OF CVT [P]

	CRIT. WEIGHTS:		16	16	12	8	10	20	16	
	BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1)	INC VIOLNC	(0)	32	91	19	32	100	100	77	68
2)	NO EFFECT	(60)	32	91	19	32	100	100	77	68
3)	DEC VIOLNC	(40)	33	91	20	33	100	100	78	69
	EXPECTED VALUE		33	91	19	33	100	100	78	69

1 0 0 1 0 0 1-HIT-TENDCS 1/2-INC VIOLNC-TERR TEND [P]

	CRIT. WEIGHTS:		16	16	12	8	10	20	16	
	BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1)	TENDCS 1,2	(100)	32	91	19	32	100	100	77	68
2)	TENDENCY 3	(0)	40	92	28	40	100	100	80	72
3)	TENDCS 4,5	(0)	44	93	33	44	100	100	81	74
4)	TENDCS 6,7	(0)	47	93	37	47	100	100	82	75
5)	TND 8,9,10	(0)	85	98	82	85	100	100	95	93
	EXPECTED VALUE		32	91	19	32	100	100	77	68

1 0 0 0 0 0 0 1-HIT-TENDCS 1,2-OUTCOME [P]

	CRIT. WEIGHTS:		16	16	12	8	10	20	16	
	BRANCH	PROB	HSTAG	IN PL	OUT P	CT SF	CT MR	T RES	IDEOL	TOTAL
1)	ATTACK	*(0)	0	50	0	90	50	100	75	53
2)	SHOOTOUT	*(90)	25	90	10	25	100	100	75	65
3)	SAFE PASSG	*(0)	100	70	80	100	60	75	50	75
4)	MOD CNCESS	*(0)	100	40	70	100	20	20	20	49
5)	TERR SURR	*(10)	100	100	100	100	100	100	100	100
6)	MAX CNCESS	*(0)	100	0	80	100	30	0	0	37
	EXPECTED VALUE		32	91	19	32	100	100	77	68

Table 5-5

SELECTED OUTPUT FROM ITREE ANALYSIS (Continued)

5.4 General Comparison of the Aids

This section provides a brief summary of the advantages and disadvantages of each of the prototype Hostage and Barricade decision aids.

The OPINT version of the aid maintains separate probability and value analyses. This provides for the J2-J3 inputs. The manner in which this is accomplished keeps the problem representation at a manageable size, thus enhancing the value as a user aid. The OPINT version also provides for characterization of the personality of the group. The degree to which this is important will be determined in further applications, but initial discussions indicate that the concept of a group personality could aid the user in appraising the problem.

The use of the personality variable could, however, be a two-edged sword. The assumption that there is some general relation between specific behavior in a situation and general traits--e.g., tendency to be violent--may be invalid. It may be that groups have fairly similar tendencies, and variations are determined by the situation. The personality theory is thus inadequate to characterize the situation, and a more dynamic model is necessary. If this is true, the ITREE version of the aid, with the ability to represent the sequential dependencies involved, will provide the most valid representation of the situation.

Related to this point is the requirement in the OPINT approach to maintain separate probability and utility analyses. As discussed, this can be a benefit for it simplifies the analysis. However, such arbitrary simplification may distort the actual situation through omission of important dependencies.

The ITREE representation does not suffer from potential problems with misrepresentation, and as discussed in Section 5.3, the potential for modeling complex dependencies exists. However, the degree to which such complex relations can be specified in advance is questionable. For a model as complex as that developed for the general Hostage and Barricade incident, it is imperative that nearly all parameter assessments be made in advance.

Another potential problem with the ITREE representation is its complexity. The user can understand any particular node in the tree, but the tree can become so large so quickly that it is difficult to represent in an understandable way. The size of the representation also affects execution time, so that each change or sensitivity analysis takes much longer to perform on ITREE than on HIVAL or OPINT.

Another point involving the ITREE analysis concerns the inability to compare the options at each node in the tree. The same nodes for different options are separated in the tree and difficult to compare. Thus, it could be the case that all options were poor with respect to some set of potential events, and this would be difficult to deduce. Such is not the case with OPINT or HIVAL. The trade-off between ITREE and OPINT is therefore simplicity versus accurate modeling. Which approach is better for a particular application depends on the relative importance of these desirable attributes. As discussed in Section 5.2, the HIVAL representation of the problem does not offer much for the Hostage and Barricade problem, and further discussion of it does not seem merited.

5.5 Other Applications for Decision Aids

The modeling effort described thus far has concentrated on the decision on how to respond to a terrorist incident. Naturally, there are other problems which could be addressed by decision analysis. One such application, which will be illustrated briefly here, provides a way for a decision maker to monitor the severity of a Hostage and Barricade incident. A MAUA model which might provide the basis of such an aid considers a number of factors which indicate a critical situation. The structure of these factors is shown in Figure 5-6, and scale definitions for the factors appear in Table 5-6. This example is meant to illustrate one of several potential uses of decision analysis in counter-terrorism. This general MAUA approach could be expanded to provide an organizing framework for a data base on terrorist behavior. Adding additional sorting capability would provide a data base management system and a potential indications and warning aid as well as aids for monitoring specific situations such as that discussed here.

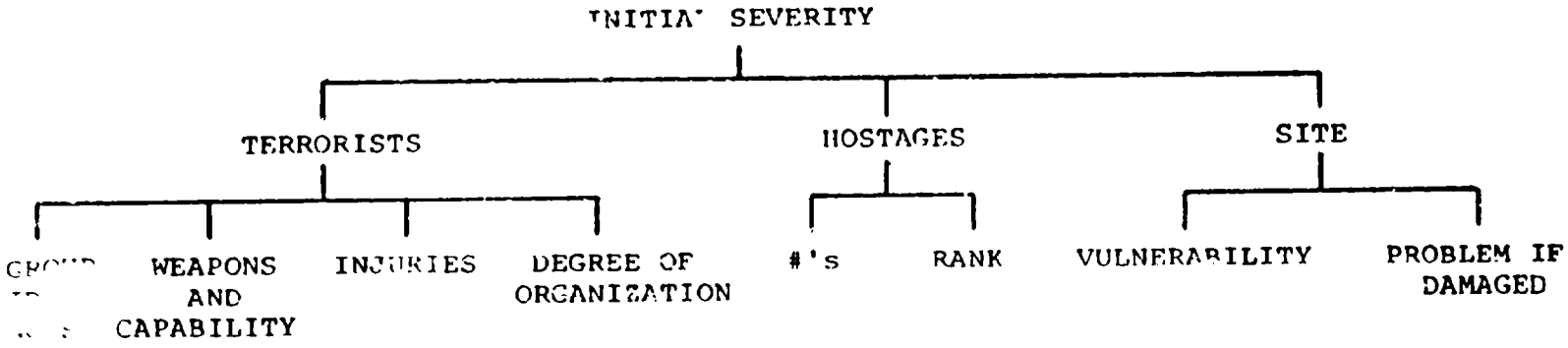


Figure 5-6

SEVERITY INDEX STRUCTURE

Attributes	
Group ID and #'s	0 Low - Group not experienced; small numbers, little doctrine 100 High - Group very experienced, large numbers, strong doctrine
Injuries to Terrorists	0 Several 100 None
Weapons and Capability	Low - Knives or less - 0 Moderate Handguns - 25 High Automatic Weapons, Grenades, Bombs - 100
Site ID and Vulnerability	Low - 0 - easily penetrated; cover available High - 100 - hard to penetrate, cover not available Problem if damaged; cost to site; cost to other facilities
# Hostages	0 Few - easy to resuce 100 Many - high probability of someone being hurt
Hostage Rank	0 Non-diplomats or equivalent 100 All diplomats or equivalent
Apparent Organization	0 - poorly organized 100 - very well organized

Hostages

Table 5-6

ATTRIBUTE SCALES FOR INITIAL SITUATION ASSESSMENT

6.0 RELATION OF THIS AID TO THE GENERAL COUNTER-TERRORISM DECISION SITUATION

The work described in this report has been fairly specific in that it was based on a Hostage and Barricade incident in progress. The decision aid deals with specific actions that can be taken with respect to negotiation, confrontation, or attack on the barricade. A major part of this study has involved exploring of the feasibility of developing a general user decision aid for Hostage and Barricade incidents, and this effort has addressed several of the major trade-offs such as speed and ease of use versus accuracy of representation; generic, preprogrammed aids versus on-line model building, and others. While this effort is far from completion, a plan has been described for an aid that would likely prove useful in a Hostage and Barricade incident. The question of generalizing such an aid to other types of incidents relates to the similarities among different types of terrorist incidents as well as the general issue of types of decision aids for counter-terrorism.

6.1 Incident Generality

The aid described in this report is designed to help the decision maker choose among several responses to a terrorist situation. Thus, it would be primarily applicable for situations developing over a period of hours or days. In addition to Hostage and Barricade incidents, an aid similar to this would be appropriate to kidnappings and hijackings. On the other hand, some incidents develop so quickly, or the response is so obvious that a decision aid of the type developed here would not be very useful. For such situations, exemplified by bombings and assassination, a decision aid would be useful for prediction, prevention, and setting policy to cover many incidents.

The similarities between Hostage and Barricade incidents and other terrorist incidents such as hijackings and kidnappings indicate that a similar decision-analytic structure may be appropriate for all three of these incident types. One area of similarity is the actions available to the government. In all three types of incidents, government actions can be grouped into three classes: military responses, diplomatic responses, and refusals to negotiate. Thus, government responses to terrorist actions are relatively independent of the type of incident, as long as the incident develops over a fairly long period of time.

A similarity more basic to the structure of the analysis is that the utility of an action depends on the tendency of the terrorist group toward violence. A model similar to OPINT, with its group personality variable, would seem appropriate for kidnappings and hijackings, as well as Hostage and Barricade incidents. The effectiveness of the OPINT approach for these new types of incidents depends on the adequacy of the assumption that the behavior of a group can be characterized by a single dispositional variable.

Although the similarities among these types of incidents suggest that a single modeling strategy might be appropriate to all, differences indicate that the approach must be tailored to the specific application. For example, terrorists who hijack airplanes may be different in many respects from those who participate in Hostage and Barricade incidents. They may be at different ends of the scale of violence, or may even require different personality variables to predict their behavior.

In addition, each type of incident has specific features to be considered in evaluating actions. For example, [illegible]ing of an action is much more important in a hijacking than in a Hostage and Barricade incident. It would probably

be necessary to incorporate concerns of timing in a decision aid addressing hijackings. Concerns of timing could be incorporated into the event probabilities or into the utility criteria in any of the analyses described above.

6.2 Roles of Decision Aids in Counter-Terrorism

The decision to allocate resources to a particular type of aid must be based on a knowledge of how that aid would fit into an integrated system for data gathering, data dissemination, indications and warning, analysis of decisions, decision support, and situation monitoring. Such an integrated system would be a desirable result of counter-terrorist research. The system would focus on three important matters:

- transferability of counter-terrorist aids and methods to the field, including training and maintaining proficiency;
- rapidly identifying the chain of command, establishing communications links, and coordinating efforts to provide an unambiguous authority network for decisive response in a crisis; and
- being able to assemble and disseminate timely data about the geographic site of a crisis, the terrorists' identities and histories, the sociopolitical environment, and the tactical resources available for rapid deployment in the area.

A complete system to meet all of the above requirements is a very ambitious goal, but the fact that several of the planned components have already been at least partially developed indicates that the idea is feasible. Furthermore, if the overall design is used as a guiding framework, a

basic core of capabilities could be developed initially, with improvements and additions incorporated on an incremental basis.

One framework for discussing counter-terrorist activity divides such activity into four phases: routine monitoring, "alert" status, crisis management, and aftermath/follow-up. As discussed below, assistance could be rendered during all four phases.

6.2.1 Routine monitoring - During the routine monitoring phase, actions are designed to provide overall readiness to respond to crises and to anticipate such crises as early as possible.

One of the most important ways to assist decision makers in the routine monitoring phase is to provide a complete file of up-to-date information in an easily accessible form. This data base should include the following sorts of information:

- o geographic data - maps of the crisis region and the immediate locality of the crisis, photographs of the immediate area, and architectural plans of buildings, where available;

- o political/social/economic data - a historical account of relevant facts, trends, and events which might serve as a briefing on the issues, the groups, and the sociopolitical environment;

- o terrorist data - a record of terrorists and terrorist groups, their past activities, their goals and methods, and potential methods of influencing them;

- o host government profile - the likely attitude of the host government to the terrorist group, the host government's chain of command and prior jurisdictional agreements, and the probable priorities of the host government in dealing with the crisis; and

- o tactical resources - an inventory of friendly, neutral, and hostile tactical forces, supply sources and routes, and other data which might help determine U.S. options or terrorist capabilities/limitations.

A second way to aid decision making is to institute a general-purpose terrorism indications and warning (I&W) system. This system would operate continuously to provide an overall indication of the likelihood of terrorist activity, by region and time period, and to issue "alerts" when a threshold is reached. In addition, any further data or patterns which might identify specific groups or locations would be provided when an alert is issued.

A third application for decision-analytic methodology would develop and implement an overall strategic planning and policy aid. This aid would contain a generic summary of U.S. policy and strategy for a variety of contingency situations, in the form of pre-canned decision models or policy-capturing routines. By presenting a well-defined set of policies and decision-analytic principles in a straightforward manner, this aid could assist the government decision maker to respond decisively in the event of a crisis, in a manner consistent with established and documented policy.

6.2.2 Alert status - Once an alert has been issued, closer monitoring of events in the troubled area, careful

updating of the data base with respect to that area, and behavioral modeling of the suspected terrorists will maximize readiness to respond to an anticipated crisis. In addition, a decision aid may help to select an appropriate "prepositioning" strategy to deter a confrontation or to minimize its potential impact.

The first requirement of a decision-aiding system is to develop and maintain a situation-specific indications and warning model for the trouble area. While the generic I&W model described in Section 6.2.1 identifies likely areas of terrorist activity, this situation-specific model will focus in more detail on possible targets, time, and methods, as well as on identifying the terrorists involved. It is possible to preprogram generic I&W models, and to develop specific ones to apply to a particular crisis, using available expertise to tailor the model to fit the local situation. Unique problems with terrorist activities may greatly increase the difficulty of this task.

Second, it is necessary to develop a probabilistic behavior model to predict terrorist strategies. Once the identity of a potentially active terrorist group has been established, a generic model of the group's behavioral tendencies may help to predict whether it will strike, and if so, what targets are most likely, what threats may be made, how likely are those threats to be carried out, and what the effect of possible countermeasures would be. This behavioral model would help not only in anticipating a terrorist action, but also in deciding what action to take in the event of such an action.

Finally, it would be beneficial to provide decision assistance to guide "prepositioning." If a planned terrorist activity can be detected or is announced in advance, decision makers have several options which may alter

the likelihood of a terrorist attack, the probability of its succeeding, the potential risk involved to U.S., friendly, and neutral persons and property, and the political impact of potential U.S. responses. Possible actions prior to any incident might include public policy statements, interdiction activities, increased security measures for vulnerable targets, partial or total evacuation, opportunities for non-violent alternatives, and threats of retaliation. These options might be specified and compared using a decision-analytic approach such as influence diagrams (ITREE), or decision trees.

6.2.3 Crisis management - Once an actual crisis has occurred, pre-formed policies and strategies must be quickly re-evaluated in the light of current data, and decisive actions taken. The initial response to the crisis, including all activity before the first contact with the terrorists, will involve rapid and coordinated action; and in the event of either a negotiating strategy or a direct military confrontation, decision assistance may provide help in implementing a successful settlement of the crisis.

The immediate need in a crisis situation is to establish an unambiguous chain of command known to all parties involved, resolving conflicts of jurisdiction and coordinating forces as needed. Using the data base to identify relevant personnel and providing a set of policies and procedures for guidance, the aid could speed up this process and disseminate its results. It could also be used to aid in planning for the efficient and reliable flow of information to relevant personnel, and to apportion and delegate the responsibility for collecting and analyzing new information.

Also required is the ability to specify the most promising tactical options and probable results. Making

available current data about the availability of tactical resources, about the geography and architecture of the crisis site, and about the intentions, strength, and organization of the terrorists, the aid could be of assistance in formulating tactical plans, and in selecting the most promising of those plans for comparison with nontactical alternatives.

With a knowledge of the most promising tactical response as a baseline, the decision maker could now specify and compare alternatives to direct confrontation. These could involve negotiation, unilateral offers, appeals to third parties, threat posturing, or simply waiting. Decision-analytic approaches such as those identified in Section 2.2 could be used to identify specific options, and to compare those options with the direct confrontations to select an appropriate initial response.

If a tactical approach to the crisis has been selected, an implementation aid could help to increase the viability of a plan, to anticipate obstacles or risks, and to minimize loss to tactical forces, hostages, and bystanders. Logistics planning and contingency planning could further improve chances of success.

If the decision is to attempt a negotiated settlement, decision-analytic aids might help to model the conflict between the government's position and the stated demands of the terrorists, in order to identify any possible package which could satisfy both parties. While the negotiation aid might not actually be employed during the negotiation sessions, it could serve as a guide for government negotiators. Furthermore, by providing a closer look at the possibility of a satisfactory negotiated settlement, the negotiation aid could be used to revise the evaluation of

other options, perhaps indicating when to break off negotiations in favor of some alternate approach (tactical action, concessions, waiting).

6.2.4 Aftermath/follow-up - Once the crisis has been resolved, favorably or unfavorably, the aid could be useful in a variety of ways: to update the data base, adding new information collected before and during the crisis; to document the chain of events which led to the crisis and to its ultimate resolution; and to revise strategic policies and behavioral models to reflect current data. Further decision-analytic assistance may be useful in planning any subsequent response to the crisis situation, including possible political actions, public accounts and statements, retaliation, and clean-up activities. Of critical importance in this stage is the need to deter future terrorist activities without jeopardizing our credibility in future negotiation situations.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Section 6.0 described a list of desirable capabilities for a counter-terrorist aid. It is recognized that DARPA-sponsored research is providing some of the capabilities discussed in those sections. Important questions involve what is feasible and what of the feasible capability is cost-beneficial.

The TRAP program implements a data base that will eventually be maintained without DARPA assistance. Similarly, a program is underway to use that data base to aid I&W efforts. The potential degree of sophistication of I&W devices for counter-terrorist uses is uncertain, for specific time-group-target prediction for terrorist activities is even more difficult than I&W work in DoD where targets remain fairly stationary, and the major problem is inference from observable, fairly regular reports.

The potential use of the counter-terrorist decision aids, exemplified by the prototype Hostage and Barricade aid developed in this effort depends mainly on generality, accuracy, and ease/speed of use. The aid must be general enough to be applicable to a reasonable number of situations. Yet it must provide an accurate representation of the actual situation, and it must incorporate the correct decision variables--those that are actually related to potential differences in outcomes. Finally, the aid must be easy to use and must be implemented in a short period of time.

The initial success to date with the decision aid indicates that an aid can be developed for Hostage and Barricade-type situations. An important question involves the development of aids for more complicated situations such as airline

hijackings where jurisdiction can change several times during the crisis.

How useful will be an aid of the type thus far developed? That question must be answered. An attempt was made in this effort to explain the Colombian application to several high-level decision makers, and the response seemed favorable. But it is necessary to compare potential aids with the entire problem in mind. To do this, extensive discussions are necessary with persons or agencies responsible for decisions and policies in the general area of counterterrorism. What are the types of decisions most often faced by the decision maker? Where is the most assistance needed? Perhaps the greatest assistance could be provided by the identification of the line of command in all possible scenarios. Perhaps the data base management capabilities currently offered by the TRAP effort will provide most of the benefit. Decision aids of the type developed here could be used for training, for actual evaluation of decisions, and for communications up the chain of command. Research is necessary to determine whether the benefits to be derived are sufficient for further development.

These questions lead to several recommendations.

- Decision analysts should work with decision makers who are or will be faced with actual counterterrorism decisions. Such meetings will provide a means of evaluating alternative proposed approaches.

- The I&W effort should continue with increased attention to formatting information in such a way to provide for quick, easy access to the answers to specific commander's questions. The interface with decision aids should be an important consideration in the design of this system.

- The decision aid developed during the current effort should be modified as discussed in Section 5.0 and tested with several user groups to determine the usefulness. If useful, expansion to other types of situations should be investigated.

It is recognized that the area of international terrorism is a complicated one, and any counter-terrorist effort potentially involves a large number of decision makers. Also, numerous agencies are pursuing efforts in the general counter-terrorist arena. A final recommendation is that better communications among these efforts be developed to avoid duplication while enhancing the overall counter-terrorist effort by transfer of knowledge.

CONTRACT DISTRIBUTION LIST
(Unclassified Technical Reports)

Director Advanced Research Projects Agency Attention: Program Management Office 1400 Wilson Boulevard Arlington, Virginia 22209	2 copies
Defense Technical Information Center Attention: DDC-TC Cameron Station Alexandria, Virginia 22314	12 copies
DCASMA Baltimore Office Attention: Mrs. Betty L. Driskill 300 East Joppa Road Towson, Maryland 21204	1 copy

SUPPLEMENTAL DISTRIBUTION LIST
(Unclassified Technical Reports)

Director
Defense Advanced Research
Projects Agency
1400 Wilson Boulevard
Arlington, VA 22209

Director
Defense Advanced Research
Projects Agency
Defense Sciences Office
Cybernetics Technology Division
1400 Wilson Boulevard
Arlington, VA 22209

Major Hubert S. Shaw
Headquarters
Department of the Army
ATTN: DAMO-ODO
Washington, DC 20310

Dr. David A. Charvonia
Director
DARPA Regional Office (Europe)
Headquarters, U. S. European Command
APO NY 09128

LTG Edward C. Meyer
Deputy Chief of Staff for
Operations and Plans
Department of the Army
The Pentagon
Washington, DC 20301

Col. Robert Linton
Defense Nuclear Agency
6801 Telegraph Road
Alexandria, VA 22310

Lt. Col. Durham
J-2 Readiness Command
MacDill Air Force Base
Tampa, FL 33608

Mr. James Stinson
CACI, Inc.
301 East Colorado Boulevard
Suite 400
Pasadena, CA 91101

Mr. Steve Harvey
CACI, Inc.
1815 N. Ft. Myer Drive
Arlington, VA 22209

USAF Special Operations School (TAC)
Department of the Air Force
Eglin AF Auxiliary Field No. 9
FL 32544
ATTN: Lt. Col. Dagwell

Mr. Robert Powis
Assistant Director
United States Secret Service
1800 G. Street, N.W., Suite 810
Washington, DC 20006

Col. Robert Nugent
Director of Intelligence
HDQ MAC-IN
Scott Air Force Base
Belleville, IL 62225

Mr. George Weiss
Director of the Office of
Safeguards and Security
and Mr. Thomas H. Issacs
Deputy Director
U. S. Department of Energy
Mail Station A2-1016
Washington, DC 20545

Mr. Troy Wade
Site Manager
U. S. Department of Energy
1753 Highland Drive
Las Vegas, NV 89109

Lt. Col. Chuck Williamson
OJCS-J3
Special Operations Division
Psychological Operations Branch
The Pentagon
Washington, DC 20003

Commander
SFOD-D
P. O. Box #70149
Ft. Bragg, NC 28307
ATTN: Col. Pascal

Commander
SFOD-D
P. O. #70149
Ft. Bragg, NC 28307
ATTN: Major Thomas O'Connell

Col. Moffitt
SOTFE
ECJ3-FE
HQ, EUCOM
APO, NY 09128

Lt. Col. James J. O'Brien
Chief
Indications and Warning Division
DIA/JSW-1
Washington, DC 20301

Major C. G. Johnson
U. S. Army
JFK Center for Military Assistance
Ft. Bragg, NC 28307
ATTN: AFJK-GC-P-SP

Mr. Benny Meyer
Defense Intelligence Agency
Room 1C938B
The Pentagon
Washington, DC 20301

Commanding Officer
SEAL Team One
Naval Amphibious Base
Coronado, CA 92155
ATTN: Lt. Cmdr. Robert Mabry

Lt. Col. Don Gordon
J2 Directorate
Special Operations Command
Ft. Bragg, NC 28307

Mr. Mike Jakubs
Defense Intelligence Agency
The Pentagon, Room 2B527
Washington, DC 20301