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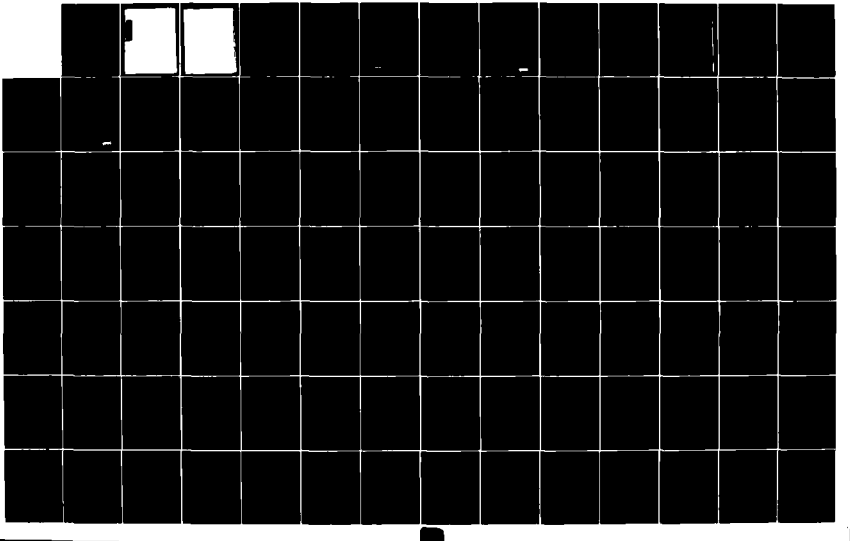

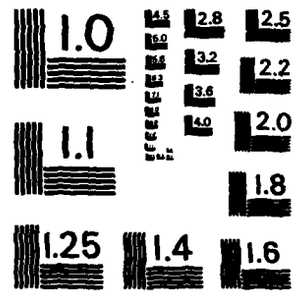

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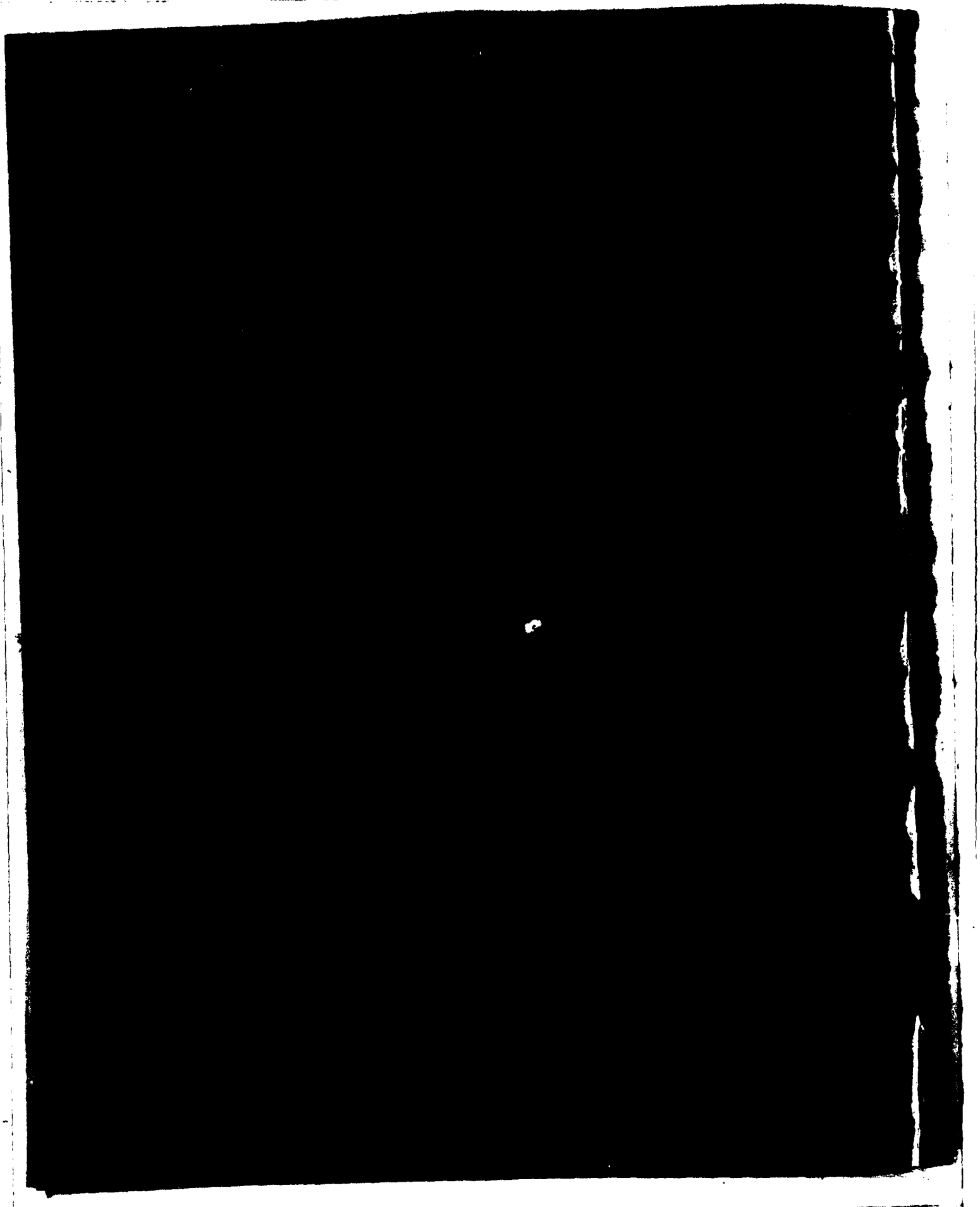

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: N-1838-DNA	2. GOVT ACCESSION NO.: A137300 / 3. RECIPIENT'S CATALOG NUMBER:
4. TITLE (and Subtitle): The Mark II Red and Blue Agenct Control Systems for the Rand Strategy Assessment Center	5. TYPE OF REPORT & PERIOD COVERED: Interim 6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): W. M. Jones, M. L. LaCasse, J. L. LaCasse	8. CONTRACT OR GRANT NUMBER(s): DNA001-80-C-0298
9. PERFORMING ORGANIZATION NAME AND ADDRESS: The Rand Corporation, 1700 Main Street, Santa Monica, CA. 90406	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: Director of Net Assessment, Office of the Secretary of Defense, Washington, D.C. 20301	12. REPORT DATE: June 1983 13. NUMBER OF PAGES: 109
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)

No Restrictions

18. SUPPLEMENTARY NOTES

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

War Games
Model Theory
Strategic Analysis

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

See Reverse Side

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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This Note describes the second-generation "Mark II" version of the Rand Strategy Assessment Center's Red and Blue Agents. These agents are models representing the behavior of the Soviet Union and the United States in an automated political-military game. The Note documents the technical features of the Mark II Red and Blue Agent models; provides a User's Manual; describes model operations with an example from a typical RSAC war game; and explains the relationships between Mark I, II, and III systems. The Note is predominantly technical, and has more to say about the structure of the models than about their basis in political or military science or about the rationale for the variables used or excluded in Mark II analysis.

A RAND NOTE

THE MARK II RED AND BLUE AGENT CONTROL SYSTEMS FOR THE RAND STRATEGY ASSESSMENT CENTER

William M. Jones, Jean L. LaCasse,
Mark L. LaCasse

June 1983

N-1838-DNA

Prepared for

The Defense Nuclear Agency

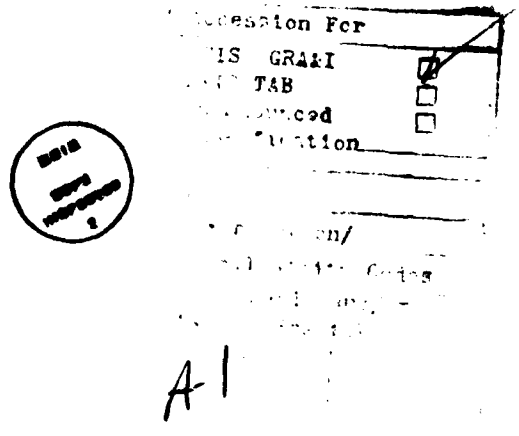
35th Year

Rand
SANTA MONICA, CA. 90406

PREFACE

This Note describes the second-generation "Mark II" version of the Rand Strategy Assessment Center's Red and Blue Agents. These agents are models representing the behavior of the Soviet Union and the United States in an automated political-military game.

The RSAC is an ambitious, high-risk research program sponsored by the Director of Net Assessment in the Office of the Secretary of Defense, and by the Defense Nuclear Agency under DNA contract 001-80-C-0298. Its purpose is to improve the quality of U.S. strategic analysis, with respect to both nuclear and conventional warfare, by finding ways to combine the best features of traditional gaming (e.g., sophisticated treatment of asymmetries and scenario variables) with the best features of analytic modeling. Inquires and comments on this Note are welcomed. They may be made directly to the authors or to Paul K. Davis, Director of the Rand Strategy Assessment Center.



SUMMARY

The Red and Blue Agents[1] of the Rand Strategy Assessment Center (RSAC[2]) are computer models representing the behavior of the Soviet Union and the United States in automated war games. These agents are second-generation models intermediate in complexity between the primitive Mark I system demonstrated in January 1981[3] and the more sophisticated Mark III system currently under design.[4]

This Note has the following objectives: (1) to document the technical features of the Mark II Red and Blue Agent models; (2) to provide a User's Manual; (3) to describe model operations with an example from a typical RSAC war game; and (4) to explain the relationships among Mark I, II and III systems.

The Note is predominantly technical, and has more to say about the structure of the models than about their basis in political or military science, or about the rationale for the variables used or excluded in Mark II analysis. In spite of its limited scope--a consequence of our

[1] As used in this Note, the word "agent" means a major player or actor in a war game. In the RSAC, the Red and Blue "agents" are automated systems playing the role that the Red Team and Blue Team play in traditional war gaming.

[2] An overview of the RSAC is provided in P. Davis and J. Winnefeld, The Rand Strategy Assessment Center: An Overview and Interim Conclusions About Potential Utility and Development Options, The Rand Corporation, R-2945-DNA, March 1983.

[3] For a discussion of the initial RSAC effort and the Mark I system, see M. Graubard and C. Builder, Rand's Strategic Assessment Center: An Overview of the Concept, The Rand Corporation, N-1583-DNA, September 1980.

[4] For discussion of the design for Mark III Red and Blue Agents, see R. Steeb, J. Gillogly, "Design for an Advanced Red Agent for the Rand Strategy Assessment Center," The Rand Corporation, R-2977-DNA forthcoming. For overview material on the RSAC program as of September 1982, see P. Davis and C. Williams, Improving the Military Content of Strategy Analysis Using Automated War Games: A Technical Approach and an Agenda for Research, The Rand Corporation, N-1894-DNA, June 1982.; and P. Davis and J. Winnefeld, op. cit.

desire to provide timely documentation--it should help interested nontechnical readers achieve a "feel" for RSAC war games, and should help them understand how to separate the computer-science aspects of the effort from those involving such matters as Sovietology, strategic decisionmaking, and military analysis.

THE MARK II MAJOR AGENT CONTROL SYSTEMS

The program structures for the Red and Blue Agents are identical, with U.S.-Soviet asymmetries reflected in the different data bases that are inputs to the programs. We refer to the general program as the major agent control system, "major" emphasizing that it pertains to a superpower, and "control system" emphasizing that the program is a device for storing, retrieving, displaying, and manipulating complex data--a device which, by itself, knows nothing about strategy or national behaviors. The "content" of the agents is contained in the data bases.

The Mark II major agent control system is written in general terms that are not even tied to war gaming. The program can build and manipulate data bases of "situations" defined by as many as 5000 qualitative or quantitative descriptors that depend on the application, and can then compare alternative strategies for "closeness." The system is efficient, highly interactive, and portable. It is written in the "C" language on the Unix operating system. It consists of about 4800 lines of code. In the current work for RSAC war games, we use 780 situation descriptors, and run the system on a DEC Vax 11/780 computer.

APPLICATION TO WAR GAMING

The components of an RSAC war game are Red Agent, Blue Agent, Force Agent (which maintains files on worldwide military forces and computes

the results of combat), Scenario Agent (which describes the behavior of countries other than the United States or the Soviet Union), and Systems Monitor (which schedules moves).[5] Given a starting situation with Red having the first move, the sequence is Red, Force, Scenario, Blue, Force, Scenario, and then Red again. The system records all moves (with reasons as well as outcomes), providing a history for the unfolding scenario. The game can be rerun from any point with one or more variables changed, thus providing for the sensitivity analyses that have not previously been conveniently possible in political-military war games.

The major agent control system compares the political-military situation of the Red or Blue Agent at a given point in time with preidentified situations in a data base, consistent with the character of the Red or Blue Agent in question. The control system retrieves and displays the "closest" situations from the data base, along with associated sets of action instructions. The action instructions are usually conditional, with the details of action (e.g., the tactics to use in an invasion, or the force levels to use on a given axis of advance) depending upon situation descriptors that are more fine grained than those used for the initial situation matching. The conditionals may also have actions depend on calculations to be performed by Force Agent or Scenario Agent.

It follows that the situation matching performed by the major-agent control system is a preliminary filter designed to focus on rules (conditional action instructions) applicable to the type of situation in question. The situation matching uses five overview tableaux that define situations in standardized terms. The tableaux are:

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[5] For discussion of Force Agent design, see B. Bennett, C. Williams, and A. Bullock, "Conceptual Design of an Advanced Force Agent for the Rand Strategy Assessment Center," The Rand Corporation, N-1919-DNA, forthcoming; and for documentation of the Mark II Scenario Agent, see W. Schwabe and L. Jamison, A Rule-Based Policy-Level Model of Non-Superpower Behavior in Strategic Conflicts, The Rand Corporation, R-2962-DNA, forthcoming.

- o Scenario Situation (for each nation or faction: orientation, cooperation with Red or Blue, military preparedness, and combat involvement).
- o Sea Situation (for each sea region: types of Red and Blue Naval forces, and state of combat).
- o Theater Combat (for each theater: locations and combat status of ground and air forces).
- o Combat Conditions (types of weapons in use, and types of targets under fire).
- o Long-Range Nuclear Forces (alert and activity status).

In principle, we could use any of several algorithms to correlate situations in the data base with the one in question. The Mark I system used a generalized Euclidean metric that weighted the distance in each "dimension". A similar approach can be used with the Mark II system. For our initial Mark II work, we have chosen a simpler scheme that focuses on the location of conflict, but otherwise weights equally the various descriptors. The closest situation is considered to be the one differing from the situation in question in the fewest descriptors. This simplified approach is possible because the Mark II state-of-the-world description is relatively detailed and because, in current work, we are restricting somewhat the types of conflict we consider. The Mark II system has now been expanded to include the weighting capability present in the Mark I system, although this capability has only been used experimentally.

ALTERNATIVE BEHAVIOR SETS

From its inception, the RSAC has emphasized having alternative models of Red and Blue behavior (alternative "Ivans" and "Sams") to reflect the enormous uncertainty about potential behaviors. In Mark II

as in Mark I, different Ivans and Sams are represented by different data bases, and the action instructions corresponding to a given situation differ from data base to data base. The Mark II world-state descriptors are more sophisticated than in the RSAC's earlier work. In particular, they include more elements critical to real-world escalation and termination decisions, elements suggestive of intentions, will, and alliance cohesion. In addition, it is part of the characters of alternative Ivans and Sams to interpret the descriptors differently--with some being more contemptuous of ambiguous indicators of adversary resolve than others. Although we have barely begun to exploit the potential of the system for dealing with such matters, we have laid a technical foundation that will permit the agents to be far more realistic and intelligent than if they depended solely on calculations of expected war outcomes for decisionmaking.[6]

There is no limit to the number of alternative Ivans and Sams we can consider. In practice, however, we are currently focusing on two stylized Ivans and two stylized Sams. Ivan 1 is somewhat adventurous, somewhat risk-taking, and somewhat contemptuous of Blue. Ivan 2 is opportunistic, but less willing to participate in adventures that bring risks, and less contemptuous of Blue. Ivan 2 may approximate a "best estimate" and Ivan 1 may approximate a plausible bad (but not worst) case. Either Ivan would adopt strategies and tactics in war that would be very Russian, and--in many cases--very different from American style. Sam 1 and Sam 2 are less well described at present, but Sam 1 is generally more willing to react quickly and decisively to protect his perceived interests.

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[6] See J. Winnefeld, A Simple Experiment with the Use of Automated Gaming in Strategic Analysis, The Rand Corporation, forthcoming, for discussion of recent RSAC war games explaining possible applications of and illuminating design requirements for a Mark II system.

LOOK-AHEAD CAPABILITY

It is essential in automated war games that the Red and Blue Agents be able to "look-ahead" to estimate the likely consequences of a given action. The looks ahead (projections) are often required in the conditional action instructions mentioned above. In the current Mark II system, the projections are accomplished with both Red and Blue using the same models in Force and Scenario Agents (e.g., both would use the same equations to estimate how quickly the United States could deploy forces from the United States to the Middle East). However, an agent's projection may be quite inaccurate (with respect to what happens in the game if he actually makes the move), because he may make incorrect assumptions in applying the models. For example, consider a war game in which Ivan 1 is fighting Sam 1. In projecting the consequences of a possible invasion, Ivan 1 may assume he is fighting Sam 2 (characteristic of his contempt for the United States); he may also assume that the NATO allies will be reluctant to cooperate with the United States; and he may be mistaken in his assessment of what forces the United States already has in the combat region. After his look-ahead, he may go ahead with his invasion and be surprised to see that the results are quite different from those expected. Such mistakes are, in our view, fundamental to the understanding of real-world conflicts. The Mark III Red and Blue Agents will have even more flexibility and complexity in dealing with such projections. Red will have his model of Blue and his own way of modeling the results of combat; similarly for Blue. The Mark III system will also allow explicitly for stochastic treatment of some uncertainties. In the meantime, however, the Mark II system represents a substantial advance in the state of the art, and allows for a wide range of sensitivities.

STATUS OF EFFORT

In summary, the Mark II Red and Blue Agents are sophisticated enough to reflect considerable military detail and to make projections that consider both political and military events, with the projections depending on each agent's assessment of the other's likely behavior. Although the agents are by no means an appropriate basis for a mature automated system, and frequently require considerable human intervention, they represent major progress toward politically and militarily realistic "chess-playing" automatons. Indeed, we have already reached the point at which our analysis of strategy issues is limited as much by the state of force modeling and Sovietology as by the Red and Blue Agents.

CONTENTS

I. INTRODUCTION

The Rand Strategy Assessment Center (RSAC)[1] is currently developing an automated political-military war game to use in strategic analysis. The initial phase of the project, conducted in 1980 and 1981, demonstrated the feasibility of such a project. In the automated game, U.S. and Soviet behavior is represented by the Blue and Red Agents[2], respectively. The games also include the Scenario Agent, simulating the behavior of nations or factions other than the United States or Soviet Union; and the Force Agent, which transmits military information and calculates the results of battles. There is also a Systems Monitor, which keeps track of moves and records the game.

The automated game begins with the description of a crisis to one of the "major" agents (Red or Blue). That agent responds by selecting a set of diplomatic and military actions. The Systems Monitor then advances game time and passes the play to the Force Agent, who makes the directed military moves and assesses the course of combat. The Scenario Agent then assesses and reports any significant changes in non-superpower political and military alignments. A description of the new situation is passed to the other major agent, who then formulates and directs his move. The game sequence continues in this way as long as the analytic purpose of the game is served. Because a complete and detailed record is automatically maintained, an analyst can return the action to any previous game point and change one or more variables to explore the different course of events so triggered.

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[1] An overview of the RSAC is provided in P. Davis and J. Winnefeld, The Rand Strategy Assessment Center: An Overview and Interim Conclusions about Potential Utility and Development Options, The Rand Corporation, R-2945-DNA, March 1983.

[2] As used in this paper, the word "agent" means a major player or actor in a war game. In the RSAC, the Red and Blue "agents" are automated systems playing the roles of the Red Team and Blue Team in traditional war gaming.

We refer to the original bread-board system as Mark I. We are now designing an advanced system to be completed in 1983, the Mark III. In the meantime, we have developed an interim, Mark II, system that allows us to examine possible applications, and to better understand the issues involved in building the Mark III system.

The Mark I Red Agent was basically a "production rule"[3] system. (There was no automated Blue Agent in Phase I.) The IF conditions were specified using 15 elementary descriptors of the crisis situation, with each element selected from a list of choices. The Red Agent data base held several hundred such situation descriptions with action instructions associated with each one. Thus, at each Red move, the Red operator would enter a description of the situation Red faced. Then the control system would identify the four closest data base "fits" (a process called pattern matching) taking into account the element and choice weights. The associated action instructions of these "fits" were then displayed, along with a metric indicating their relative degrees of "closeness". Normally the Red operator would implement the action instructions associated with the closest fit. If they were inappropriate, new action instructions were formulated on-line (either a new set was devised or instructions for one of the other "fits" were used) and the exercise continued with this new situation and its action instructions "archived" as an additional data base entry. This procedure worked very well in dealing with categorically described game situations. It permitted the use of a few hundred situation/action pairs to cover the very large number of possible game situations.

The design objectives of the Mark II system led to a somewhat different approach, including use of a simpler form of pattern matching. One of these objectives was to treat nations, ocean areas, and attack

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[3] A "production rule" is an IF <condition> THEN <action> logical structure. The rule is assumed to be one of many similar rules, all tested in sequence. This form is commonly used in computer language parsing, and artificial intelligence decisionmaking applications.

axes (in theater ground and air warfare) in specific named terms (also a Mark III system objective). Another objective was to move toward multi-level control operations, distinguishing national-level from tactical-level decisions. A third objective was to incorporate greater military specificity into the branched scripts.

Section II presents the format of the Mark II major agent situation descriptions. It also defines terms and describes the protocol followed in data base development.

Section III describes action instructions and discusses: (1) items that must be included in each action instruction, (2) additional situation data that can be used for fine-tuning actions, (3) procedures for allowing the Red or Blue Agent to make projections (i.e. "looks ahead"), (4) protocols for assessing intangibles when necessary, and (5) message handling procedures.

Section IV presents examples of situation descriptions and their associated action instructions, and explains the rationale leading from one to the other. For the ongoing applications experiments, two Red control data bases were developed. One represents a "most likely" pattern of Soviet behavior, called Ivan 2. The other represents a more aggressive Red, called Ivan 1. In the same fashion, two Blue data bases were developed. One represents a conservative risk-averse Blue, called Sam 2. The other is somewhat more aggressive (Sam 1). These data bases are described in this section.

Section V describes the setting of the major agent control system within the RSAC. It also discusses: the choices made in software development; the program's pattern matching algorithm; and its operating environment. It then touches on other applications of the Mark II major agent system, and discusses the connection between the Mark II and Mark III major agent systems. Appendix A is an operators manual for the Mark II system.

II. THE MARK II MAJOR AGENT SITUATION DESCRIPTION FORMAT

The Mark II major agent control system permits the description of a large family of situations. These situations are described by 780 dimensions or state variables. These can each take on any of a predetermined set of numeric or nonnumeric values. Comments or instructions can be associated with each situation so described. The program can accept a situation description, search its data base of prestored situations, and retrieve and display those situations closely resembling the input situation. The comments or instructions that are associated with the similar situations in the data base are then available for examination. (See Section 4 for a more complete technical description of the process of describing situations and formulating action instructions.)

The Mark II system specifies and controls the actions of the Red and Blue Agents at every move in the game. A major agent move is accomplished by the system operator who enters a description of the situation faced and then executes the action instructions that are retrieved and displayed.

The Mark II system was designed to support initial applications experiments. For this reason it was made area-specific, covering war in the Middle East, war in Europe, war at sea in connection with these theaters, and general nuclear war. The situation, or "state of the world" is described in five tableaux: the scenario situation, sea situation, theater combat situation, combat conditions (weapons/targeting), and long-range nuclear forces status. In the subsections below, we will outline the types of information covered in each of the five tableaux. Then we will explain the allowable entries in each tableau and define the terms used.

The Scenario Situation

The types of information covered in each tableau are as follows:

1. Location of conflict.
2. National orientations.
3. Cooperation of any relevant nations with either superpower.
4. Acceptance by a nation of Soviet or U.S. military forces on the homeland, and the nature of those forces.
5. National military and economic preparedness of relevant nations.
6. National involvement in any Middle Eastern conflict.
7. National involvement in any European conflict.

The Sea Situation

1. Location of conflict at sea.
2. The location of any Blue launch sites at sea for long-range attacks on Red or Red affiliate forces and assets, and the same for Red. A "known unknown" can be entered covering the situation in which Red or Blue knows that certain forces of the other are at sea, but do not know where.
3. The nature of the Soviet naval forces present, and their current activities.
4. The nature of the U.S. naval and allied forces present, and their current activities.

The Theater Combat Situation (Land and Air)

1. The status of the Soviet and allied forces deployed on or committed to each attack axis.
2. The status of Soviet or allied reenforcements for Red forces deployed on or committed to each axis.

3. The status of U.S. and allied forces deployed on or committed to each attack axis.
4. The status of U.S. and allied reenforcements for Blue forces deployed on or committed to an axis.
5. The position of the main Red ground force spearhead on the attack axis.
6. The position of special Red combat operations in advance of the main spearhead.
7. The position of the main Blue ground force spearhead on the attack axis.
8. The position of special Blue combat operations in advance of the main spearhead.

The Combat Conditions (Weapons/Targeting)

This tableau is organized by target types. It covers nuclear forces bases; ground forces; air bases; seaports; land lines of communication; sea forces; industry; cities; and command, control, communication, and intelligence (C3I). These targets are treated separately for Blue and aligned targets, Red and aligned targets, and unaligned targets. For each category, the highest class of weapons currently directed against them is given. These weapons classes range from selective conventional weapons, through chemical/biological/radiological weapons, to nuclear weapons.

Long Range Nuclear Forces

This tableau shows the status of Red and Blue intercontinental ballistic missiles (ICBMs), nuclear submarines (SSBNs), Long Range Aviation (LRA) cruise carriers, and MR/IR forces. This status might be either normal, alerted, dispersing, penetrating, or launched as appropriate. This tableau also reports the status of Red and Blue civil defense procedures.

Possible Entries and Definition of Terms

This subsection fully enumerates all possible entries in each tableau of the "world situation." Entries are often a shorthand for a complex relationship. In these cases, the terms used in the entries are defined.

The Scenario Situation

An example of the tableau called the "Scenario Situation" is given in Figure 1. Possible entries are described below:

Col. 1: CONFLICT LOCATION: Designate with X.
Combat operations are being conducted in or against that nation's territory.

Col. 2: ORIENTATION:

- R. Firm (Red Firm) - Has coincidence of interest with the USSR in relation to conflict and is very unlikely to change this orientation under current conditions.
- R. Mod (Red Moderate) - Has coincidence of interest with the USSR in relation to conflict and is relatively unlikely to change this orientation under current conditions.
- R.Soft (Red Soft) - Has coincidence of interest with the USSR in relation to conflict but is relatively likely to change this orientation if current conditions persist.
- White - Has no coincidence of interest with either the United States or the USSR.

Figure 1 - Example of the Scenario Tableau

SCENARIO SITUATION

Country	Conflict	Orient	Cooperatn	Super Power Presence	Military Prep	Mid-East Invlvmnt	European Invlvmnt
Afghanis	X	White	Noncoord	R.Major_Pres	Mobilzd	Combatant	Noncombat
Algeria		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Austria		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Bahrain	X	B.Firm	Cobellig	B.U.Trip_Wire	Mobilzd	Combatant	Noncombat
Belgium		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Bulgaria		R.Firm	Coordin.	No_Presence	Normal	Noncombat	Alerted
Canada		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Cuba		White	Noncoord	R.A.Trip_Wire	Normal	Noncombat	Noncombat
Czech		R.Firm	Coordin.	R.Major_Pres	Normal	Noncombat	Alerted
Denmark		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Djibouti		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Egypt	X	B.Firm	Cobellig	B.Major_Pres	Mobilzd	Combatant	Noncombat
Finland		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
France		White	Noncoord	No_Presence	Call_Up	Noncombat	Noncombat
FRG		B.Firm	Coordin.	B.Major_Pres	Normal	Noncombat	Noncombat
GDR		R.Firm	Coordin.	R.Major_Pres	Normal	Noncombat	Alerted
Greece		B.Firm	Coordin.	B.U.Trip_Wire	Call_Up	Noncombat	Noncombat
Hungary		R.Firm	Coordin.	R.Major_Pres	Normal	Noncombat	Alerted
Iceland		White	Noncoord	B.U.Trip_Wire	Normal	Noncombat	Noncombat
Iran	X	White	Noncoord	R.Major_Pres	Normal	Noncombat	Noncombat
Iraq		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Israel		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Italy		B.Firm	Coordin.	B.U.Trip_Wire	Normal	Noncombat	Noncombat
Japan		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Jordan		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Kuwait	X	B.Firm	Cobellig	B.Major_Pres	Mobilzd	Combatant	Noncombat
Lebanon		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Libya		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Luxembrg		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Mongolia		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat

Figure 1 - Example of the Scenario Tableau, Continued

SCENARIO SITUATION

Country	Conflict	Orient	Cooperatn	Super Power Presence	Military Prep	Mid-East Invlvmnt	European Invlvmnt
Morocco		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
N.Korea		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
N.Yemen		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Netherld		White	Noncoord	B.U.Trip_Wire	Normal	Noncombat	Noncombat
Norway		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Oman	X	B.Firm	Cobellig	B.Major_Pres	Mobilzd	Combatant	Noncombat
Pakistan		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Poland		R.Firm	Coordin.	R.Major_Pres	Normal	Noncombat	Alerted
Portugal		B.Firm	Coordin.	B.U.Trip_Wire	Normal	Noncombat	Noncombat
PRC		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Qatar	X	B.Firm	Cobellig	B.U.Trip_Wire	Mobilzd	Combatant	Noncombat
Rumania		R.Firm	Coordin.	No_Presence	Normal	Noncombat	Alerted
S.Korea		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
S.Yemen		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Saudi Ar	X	B.Firm	Cobellig	B.Major_Pres	Mobilzd	Combatant	Noncombat
Spain		B.Firm	Coordin.	B.A.Trip_Wire	Normal	Noncombat	Noncombat
Sweden		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Syria		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Turkey		B.Mod.	Coordin.	No_Presence	Call_Up	Noncombat	Noncombat
UAE	X	B.Firm	Cobellig	B.Major_Pres	Mobilzd	Combatant	Noncombat
UK		B.Firm	Coordin.	B.Major_Pres	Normal	Noncombat	Noncombat
US		B.Firm	Coordin.	B.Major_Pres	Normal	Combatant	Noncombat
USSR		R.Firm	Cobellig	R.Major_Pres	Normal	Combatant	Alerted
Yugoslav		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Rfaction	X	R.Firm	Coordin.	R.Major_Pres	Mobilzd	Combatant	Noncombat
Wfaction		White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Bfaction	X	B.Firm	Cobellig	B.Major_Pres	Mobilzd	Combatant	Noncombat

B.Soft (Blue Soft) - Has coincidence of interest with the United States in relation to conflict but is relatively likely to change this orientation if current conditions persist.

B.Mod (Blue Moderate) - Has coincidence of interest with the United States in relation to conflict and is relatively unlikely to change this orientation under current conditions.

B.Firm (Blue Firm) - Has coincidence of interest with the United States in relation to conflict and is very unlikely to change this orientation under current conditions.

Col. 3: COOPERATION:

Noncoord (Noncoordinate) - Not granting land, sea, or air transit rights for the military forces of either superpower.

Coordin. (Coordinate) - Allowing land, sea, or air transit rights for the military forces of the affiliated superpower.

Cobellig (Cobelligerent) - Allowing the use of its territory by the combat forces of its superpower affiliate as a launch area for attacks.

Nuc.Rels (Nuclear Releaser) - Cooperating to the maximum extent with its superpower ally including agreeing on the use of nuclear weapons.

Col. 4: SUPER POWER PRESENCE:

R.Major-Pres (Red Major Presence) - Major Soviet line combat units are deployed in the nation's territory. They are of sufficient size to make a major contribution to the defense of that nation against an attack, or to control a large-scale threat to its internal security. An attack against the nation's territory would almost certainly involve these forces and could be regarded as an act of war against the USSR.

R.U.Trip-Wire (Red Unambiguous Trip-Wire) - Soviet line combat forces are deployed in the nation's territory and are so configured and postured that an attack on the host country would probably involve attacks on them.

R.A.Trip-Wire (Red Ambiguous Trip-Wire) - Soviet military forces are deployed in the nation's territory and are so configured and postured that an attack could be made on the host country without a high probability of their becoming involved.

No_Presence - No superpower presence.

B.A.Trip-Wire (Blue Ambiguous Trip-Wire) - U.S. military forces are deployed in the nation's territory and are so configured and postured that an attack could be made on the host country without a high probability of their becoming involved.

B.U.Trip-Wire (Blue Unambiguous Trip-Wire) - U.S. line combat forces are deployed in the nation's territory and are so configured and postured that an attack on the host country would probably involve attacks on them.

B.Major-Pres (Blue Major Presence) - Major U.S. line combat units are deployed in the nation's territory. They are of sufficient size to make a major contribution to the defense of that nation against an attack, or to control a large-scale threat to its internal security. An attack against the nation's territory would almost certainly involve these forces and could be regarded as an act of war against the United States.

Col. 5: NATIONAL MILITARY PREPAREDNESS:

Normal - Not mobilized for war.

Indus.M (Industrial Mobilization) - Shifting industries to war support.

Call-Up - Mobilizing or has mobilized ready reserve components of armed forces.

Mobilized - Mobilizing or has mobilized all reserve components of armed forces. Conscripting at wartime levels.

Col. 6: MID-EAST INVOLVEMENT:

Noncombatant	-	Not engaged in conflict in specified region.
On-Call	-	Has agreed to become a combatant if asked by its superpower affiliate.
Alerted	-	Preparing for combat operations in specified region.
Poised	-	Forces deployed to combat initiating positions.
Mobilizing	-	Mobilizing reenforcements.
Combatant	-	Forces engaged in combat.

Col. 7: EUROPEAN INVOLVEMENT:

Noncombatant	-	Not engaged in conflict.
On-call	-	Has agreed to become a combatant if asked by its superpower affiliate.
Alerted	-	Preparing for combat operations.
Poised	-	Forces deployed to combat initiating positions.
Mobilizing	-	Mobilizing reenforcements.
Combatant	-	Forces engaged in combat.

The Sea Situation

Figure 2 shows the format of the Sea Situation by example. The list of seas and ocean areas in the Figure are self explanatory, with the exception of "Unknown". This "area" is used when forces as described are know to be at sea, but the location is not yet known. The possible entries for the Sea Situation are described below:

Col. 1: CONFLICT: Military combat operations are in progress in the area. Designate with X.

Col. 2: LAUNCH AREA: (In the Red Agent) Red forces or assets located out of this area are being attacked by missiles or aircraft launched from this sea area.

Figure 2 - Example of the Sea Tableau

SEA SITUATION

Ocean Area	Conflict Launch Area		Red Presence				Blue Presence		
			SAG/BG	Anti CV	Kiev GP	SSBN	BG	MAU	SSBN
Barents Sea			Poised	Poised	Poised	Poised			
Norwegian S						Poised			Poised
Baltic Sea									
North Sea									
E.Atlantic						Poised			Poised
W.Atlantic							Poised		Poised
Caribbean								Poised	
Gibraltar									
W.Mediter.			Poised	Poised			Poised	Poised	
E.Mediter.			Poised	Poised	Poised		Poised		
Black Sea									
Arabian Sea	X	X	Combatnt	Combatnt	Combatnt		Combatnt		
Persian Glf									
Indian Ocen	X		Combatnt	Combatnt	Combatnt		Combatnt		
S.China Sea			Poised	Poised				Poised	
W.Pacific						Poised		Poised	Poised
Japan Sea									
Hawaiian									Poised
E.Pacific									Poised
Unknown									

(In the Blue Agent) Blue forces or assets located out of this area are being attacked by missiles or aircraft launched from this sea area.

Col. 3: RED SAG/BG: Surface action group/battle group configured for maintenance control of the area, presumed to have an amphibious assault capability.

Present - Present in the area.
Poised - Prepared and positioned for combat initiation.
Withdraw - Withdrawing from the area.
Reenforce - One or more additional SAG/BGs are en route to the area. (Reenforcing)
Combatant - In combat.

Col. 4: RED ANTI CV: A surface and subsurface combatant group configured for the purpose of attacks on carrier task forces.

Present - Present in the area.
Poised - Prepared and positioned for combat initiation.
Withdraw - Withdrawing from the area.
Reenforce - One or more additional Anti CVs are en route to the area. (Reenforcing)

Col. 5: RED KIEV GROUP: A naval group configured for ASW (anti-submarine warfare), with additional sea area control and amphibious assault capabilities, especially when used in coordination with a SAG/BG.

Present - Present in the area.
Poised - Prepared and positioned for combat initiation.
Withdraw - Withdrawing from the area.
Reenforce - One or more additional Kiev Groups are en route to the area. (Reenforcing)
Combatant - In combat.

Col. 6: SSBN (RED SSBNs):

Present - Present in the area.
Poised - Prepared and positioned for combat initiation.
Withdraw - Withdrawing from the area.
Reenforce - One or more additional SSBNs are en route to the area. (Reenforcing)
Combatant - In combat.

Col. 7: BG (Blue Carrier Task Force--Battle Group):

Present - Present in the area.
Poised - Prepared and positioned for combat initiation.
Withdraw - Withdrawing from the area.
Reenforce - One or more additional BGs are en route to the area. (Reenforcing)
Combatant - In combat.

Col. 8: MAU (Blue Marine Amphibious Assault Unit):

Present - Present in the area
Poised - Prepared and positioned for combat initiation.
Withdraw - Withdrawing from the area.
Reenforce - One or more additional MAUs are en route to the area. (Reenforcing)
Combatant - In combat.

Col. 9: SSBNs (Blue SSBNs):

Present - Present in the area.
Poised - Prepared and positioned for combat initiation.
Withdraw - Withdrawing from the area.
Reenforce - One or more additional SSBNs are en route to the area. (Reenforcing)
Combatant - In combat.

The Theater Combat Situation (Land and Air)

Figure 3 gives an example of the Theater Combat Situation. This tableau is used to describe the activity status and location of forces (in statute miles) relative to the initial attack advance position.

Figure 3 - Example of the Theater Combat Tableau

THEATER COMBAT SITUATION

Theater	Red Forces	Red Reenf.	Blue Forces	Blue Reenf.	Red Main Position	Red Adv Position	Blu Main Position	Blu Adv Position
Axis 4	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 1	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 2	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 3	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 5	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 6	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 7	In_Combat	Deploy	In_Combat	Deploy	+50-200		+200-800	
Axis 8	In_Combat	Deploy	In_Combat	Deploy	+50-200		+200-800	
Axis 9	In_Combat	Deploy	In_Combat	Deploy	+50-200		+200-800	
Axis 10	In_Combat	Deploy	In_Combat	Deploy	+50-200		+200-800	
Axis 11								
Axis 12								

This position is usually an international border with the main, initial concentrations of attacking and defending ground forces. These forces are generally supported by tactical air forces in a theater ground/air war. During pre-D Day mobilizations and deployments, the Red position is shown as 0.

The possible entries for the theater combat situation are described below:

Attack Axis, Europe 4

From Northwestern USSR to Narvik, Norway.

Attack Axis, Europe 1

From Northern GDR across the North German plains, the Lowlands, and France along the North Sea and English Channel coasts.

Attack Axis, Europe 2

Extending from the central GDR/FRG border through the Fulda Gap across the Rhine in the Frankfort area and into north central France.

Attack Axis, Europe 3

Extending out of Czechoslovakia, through the Munich and Black Forest areas into north central France.

Attack Axis, Europe 5

Extending from the Bulgarian border with Greece and Turkey to Istanbul and across The Bosporus (with a branch into the Athens area).

Attack Axis, Europe 6

Extending from the USSR Turkish border area to the Turkish Mediterranean coast.

Attack Axis, Europe 7

Extending from the Transcaucasus/Iranian border through western Iran to Shatt-el-Arab with a possible extension across Kuwait and eastern Saudi Arabia into Oman.

Attack Axis, Mid-East 8

From the Transcaucasus to Tehran and south to the Iranian coast on the Persian Gulf.

Attack Axis, Mid-East 9

From Turkmen through Mashhad to Tehran area and south to the Strait of Hormuz.

Attack Axis, Mid-East 10

From Afghanistan south to the Indian Ocean. (Red forces permanently based in USSR or WP territories contiguous to the originating points of these axes are treated as being in the related Red theater of operations and, except in unusual situations, are committable to that theater only.)

Col. 1: RED FORCES: Red land and air combat units deployed and postured for combat along the axis.

- Normal - Normal peacetime posture.
- Alerted - Alerted.
- Poised - Deployed out of normal postures into positions from which attacks can be initiated.
- Withdrawing - Withdrawing.
- In_Combat - In combat.
- Not_Present - Not present.

Col. 2: RED REENFORCEMENTS: Soviet land and air combat units based in the USSR and available as reenforcements to the Red forces committed to the axis. (Note: When reenforcements deploy to the axis they become a part of the Red forces committed to the axis.)

- Normal - Normal peacetime posture.
- Mobile - Mobilizing or mobilized.
- Deploy - Deploying.

Col. 3: BLUE FORCES: Blue land and air combat units deployed and postured for combat along the axis.

- Normal - Normal peacetime posture.
- Alerted - Alerted.
- Poised - Deployed out of normal postures into positions from which attacks can be initiated.

Withdrawing - Withdrawing.

In_Combat - In combat.

Not_Present - Not present.

Col. 4: BLUE REENFORCEMENTS: U.S. land and air combat units based in the United States and available as reenforcements to the U.S. forces committed to the axis. (Note: When reenforcements deploy to the axis they become a part of the U.S. forces committed to the axis.)

Normal - Normal peacetime posture.

Mobile - Mobilizing/mobilized.

Deploy - Deploying.

Col. 5: RED MAIN POSITION: Location of the spearhead of the main Red ground force units on the axis.

-over800 - Over 800 statute miles behind of the 0 point on the axis in Red territory.

-200-800 - Between 200 and 800 statute miles behind the 0 point on the axis.

-50-200 - Between 50 and 200 statute miles behind the 0 point on the axis.

-1-50 - Between 1 and 50 statute miles behind the 0 point on the axis. This is the location used when Red forces committed to this axis are not in combat.

+0-50 - Between 0 and 50 statute miles into territory hostile (or potentially hostile) to Red.

+50-200 - Between 50 and 200 statute miles into territory hostile to Red.

+200-800 - Between 200 and 800 statute miles into territory hostile to Red.

+over800 - More than 800 statute miles into territory hostile to Red.

Col. 6: RED ADVANCED POSITION: Location of Soviet naval, infantry, or airborne forces deployed ahead of the main forces to seize and control key points or facilities (may be behind Blue main position).

-over800 - Over 800 statute miles behind the 0 point on the axis in Red territory.

-200-800 - Between 200 and 800 statute miles behind the 0 point on the axis.

-50-200 - Between 50 and 200 statute miles behind the 0 point on the axis.

-1-50 - Between 1 and 50 statute miles behind the 0 point on the axis. This is the location used when Red forces committed to this axis are not in combat.

+0-50 - Between 1 and 50 statute miles into territory hostile (or potentially hostile) to Red.

+50-200 - Between 50 and 200 statute miles into territory hostile to Red.

+200-800 - Between 200 and 800 statute miles into territory hostile to Red.

+over800 - More than 800 statute miles into territory hostile to Red.

Col. 7: BLUE MAIN POSITION: Location of the main Blue ground forces on an axis.

-over800 - Over 800 statute miles behind the 0 point on the axis in Blue territory.

-200-800 - Between 200 and 800 statute miles behind the 0 point on the axis.

-50-200 - Between 50 and 200 statute miles behind the 0 point on the axis.

-1-50 - Between 1 and 50 statute miles behind the 0 point on the axis. This is the location used when Blue forces committed to this axis are not in combat.

+0-50 - Between 0 and 50 statute miles into territory hostile (or potentially hostile) to Blue.

+50-200 - Between 50 and 200 statute miles into territory hostile to Blue.

+200-800 - Between 200 and 800 statute miles into territory hostile to Blue.

+over800 - More than 800 statute miles into territory hostile to Blue.

Col. 8: BLUE ADVANCED POSITION: The location of U.S. airborne or marine amphibious assault forces deployed ahead of the U.S. main forces on the axis (which may be behind the Red main position) to seize and control key points and facilities.

-over800 - Over 800 statute miles behind the 0 point on the axis in Blue territory.

-200-800 - Between 200 and 800 statute miles behind the 0 point on the axis.

-50-200 - Between 50 and 200 statute miles behind the 0 point on the axis.

-1-50 - Between 1 and 50 statute miles behind the 0 point on the axis. This is the location to be used when Blue forces committed to this axis are not in combat.

+0-50 - Between 0 and 50 statute miles into territory hostile (or potentially hostile) to Blue territory.

+50-200 - Between 50 and 200 statute miles into territory hostile to Blue.

+200-800 - Between 200 and 800 statute miles into territory hostile to Blue.

+over800 - More than 800 statute miles into territory hostile to Blue.

The Combat Conditions

Figure 4 below gives an example of the format of the Combat Conditions tableau. This tableau covers both sides of the combat

Figure 4 - Example of the *Combat* Conditions Tableau

COMBAT CONDITIONS (WEAPONS/TARGETS)

Targets	Mid-East	Europe	Sea	Homeland
Red Untargeted				
Red Nuclear Forces				
Red Ground Forces	Unlim.Conven.			
Red Airbases	Unlim.Conven.			
Red Seaports				
Red Land LOCs	Unlim.Conven.			
Red Sea Forces			Unlim.Conven.	
Red Industry				
Red Cities				
Red C3I				
White Untargeted				
White Nuclear Force				
White Ground Forces				
White Airbases				
White Seaports				
White Land LOCs				
White Sea Forces				
White Industry				
White Cities				
White C3I				
Blue Untargeted				
Blue Nuclear Forces				
Blue Ground Forces	Unlim.Conven.			
Blue Airbases	Unlim.Conven.			
Blue Seaports	Unlim.Conven.			
Blue Land LOCs	Unlim.Conven.			
Blue Sea Forces	Unlim.Conven.		Unlim.Conven.	
Blue Industry				
Blue Cities				
Blue C3I				

situation. Entries with both Red and White targets describe a conflict in which a White scenario entity is targeting the assets of the USSR or a Red affiliate, and a Red entity is targeting against a White entity; and similarly with Blue and White, or Red and Blue. Entries with all three (Red, White, and Blue) types of targets are barred, since a Blue attack on a Red entity who had previously been engaged with a White entity automatically (but possibly temporarily) makes the previously White entity become a Blue affiliate.

The possible entries for the combat conditions are described below:

Col. 1: MIDDLE EAST:

Select.Conven. - Selective conventional: Characterizes an attack with conventional weapons against one (or a very few) targets of the indicated class for punitive or coercive purposes. Usually used to underline a verbal threat or demand.

Unlim.Conven. - Unlimited conventional: Characterizes an attack with conventional weapons in which the attacker's intent is to damage or destroy as much of the target type as possible.

Selective_CBR - Selective attack using chemical, biological, or radiation weapons.

Unlimited_CBR - Unlimited attack using chemical, biological, or radiation weapons.

Select.Nuclear - Selective nuclear weapons use.

Unlim.Nuclear - Unlimited nuclear weapons use.

Col. 2: EUROPE:

Select.Conven. - Selective conventional: Characterizes an attack with conventional weapons against one (or a very few) targets of the indicated class for punitive or coercive purposes. Usually used to underline a verbal threat or demand.

Unlim.Conven. - Unlimited conventional: Characterizes an attack with conventional weapons in which the attacker's intent is to damage or destroy as much of the target type as possible.

Selective_CBR - Selective attack using chemical, biological, or radiation weapons.

Unlimited_CBR - Unlimited attack using chemical, biological, or radiation weapons.

Select.Nuclear - Selective nuclear weapons use.

Unlim.Nuclear - Unlimited nuclear weapons use.

Col. 3: SEA (Forces at Sea):

Select.Conven. - Selective conventional: Characterizes an attack with conventional weapons against one (or a very few) targets of the indicated class for punitive or coercive purposes. Usually used to underline a verbal threat or demand.

Unlim.Conven. - Unlimited conventional: Characterizes an attack with conventional weapons in which the attacker's intent is to damage or destroy as much of the target type as possible.

Selective_CBR - Selective attack using chemical, biological, or radiation weapons.

Unlimited_CBR - Unlimited attack using chemical, biological, or radiation weapons.

Select.Nuclear - Selective nuclear weapons use.

Unlim.Nuclear - Unlimited nuclear weapons use.

Col. 4: HOMELAND:

Select.Conven. - Selective conventional: Characterizes an attack with conventional weapons against one (or a very few) targets of the indicated class for punitive or coercive purposes. Usually used to underline a verbal threat or demand.

Unlim.Conven. - *Unlimited conventional: Characterizes an attack with conventional weapons in which the attacker's intent is to damage or destroy as much of the target type as possible.*

Selective_CBR - Selective attack using chemical, biological, or radiation weapons.

Unlimited_CBR - Unlimited attack using chemical, biological, or radiation weapons.

Select.Nuclear - Selective nuclear weapons use.

Unlim.Nuclear - Unlimited nuclear weapons use.

Long Range Nuclear Forces

Figure 5 gives an example of the format of the Long Range Nuclear Forces tableau. This tableau covers both the activation of the named weapons against the target types, and civil defense status. The only legal entry is a "check mark", or the lack of one. The target types are self-explanatory.

Obviously, such stylized situation descriptions may omit other data, nuances, details and anticipations that are important to the formulation of detailed agent action instructions. As will be covered in more detail in the next section, the operator action instructions evoked may instruct the operator to search for such additional data or information, and condition the directed action on the results of the search. In effect, a stylized situation description format is used to bound an approximate situation in which attention can be focused on the additional data required to make an intelligent move.

A Simple Example of a Situation Description: War in Iran

Figures 1 through 5 above depict a situation that was faced by Red in one of the RSAC exercises. It captures a moment in the course of a widespread, conventional war in the Middle East. Associated naval

Figure 5 - Example of the Long Range Nuclear Forces Tableau

LONG RANGE NUCLEAR FORCES STATUS
(plus civil defense)

Force	Status Description	Status	
Red:	ICBMs	Launched	
Red:	SSBNs	Launched	
Red:	LRA/Cruise Carriers	Launched	
Red:	MR/IR Forces	Launched	
Red:	Civil Defense	Activated	
Red:	LRA/Cruise (US)	Penetrating	
Red:	MR/IR Forces (in theater)	Penetrating	
Red:	SSBNs	Dispersing	
Red:	LRA/Cruise Carriers	Dispersing	
Red:	MR/IR Forces (in theater)	Dispersing	
Red:	ICBMs	Alerted	X
Red:	SSBNs	Alerted	X
Red:	LRA/Cruise Carriers	Alerted	X
Red:	MR/IR Forces	Alerted	X
Blue:	MR/IR Forces	Alerted	X
Blue:	LRA/Cruise Carriers	Alerted	X
Blue:	SSBNs	Alerted	X
Blue:	ICBMs	Alerted	X
Blue:	MR/IR Forces (in theater)	Dispersing	
Blue:	Bombers/Cruise Carriers	Dispersing	
Blue:	SSBNs	Dispersing	
Blue:	MR/IR Forces (in theater)	Penetrating	
Blue:	Bombers/Cruise Carriers	Penetrating	
Blue:	Civil Defense	Activated	
Blue:	MR/IR Forces	Launched	
Blue:	LRA/Cruise Carriers	Launched	
Blue:	SSBNs	Launched	
Blue:	ICBMs	Launched	

combat, at the moment, is confined to the Indian Ocean and the Arabian Sea. The locations of conflict include Afghanistan, Bahrain, Egypt, Iran, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates, and the territories held by a Red-oriented faction and a Blue-oriented faction in Iran. The list of active combatants includes all of the above plus the USSR and the United States. Blue long-range weapons (air) attacks on Red positions in Iran are being launched from Bahrain, Egypt, Kuwait, Oman, Saudi Arabia, the UAE, and the territory held by the Blue Iranian faction. Red long-range weapons (air) attacks on Blue are being launched from the USSR.

Figure 2, showing the Sea Situation, indicates that Red and Blue naval forces are in combat in the Indian Ocean and the Arabian Sea. Their forces in all other areas are in the highest degree of alert. Blue long-range weapons (air) from the Arabian Sea are attacking Red forces in Iran.

Figure 3, showing the Theater Combat Situation, indicates that Red and Blue ground forces are engaged on all four major axes of the Red advance somewhere between 50 and 200 miles from the points of Red's initial entry into Iran.

Figure 4, showing Combat Conditions (Weapons/Targets), indicates that Red ground forces, air bases, and land LOCs are under unlimited conventional weapons attack. It also shows that Blue ground forces, air bases, seaports, land LOCs, and sea forces are under Red unlimited conventional weapons attack.

Figure 5, Long Range Nuclear Force Status, indicates that all of the listed forces of both Red and Blue are on alert.

III. MARK II ACTION INSTRUCTIONS

Preliminary Comments

In this section, we will discuss preparation of action instructions and the use of these instructions during game exercises. Each situation description (discussed above) in the systems data base has an associated set of action instructions. In an RSAC exercise, the current situation is entered into the major agent program, a "best match" is found, and the associated actions are implemented by the operator. Thus the system's data base should reflect a diverse set of situations and action instructions to maximize the probability that any situation that may arise in RSAC exercises will be "similar" enough to at least one data base entry to evoke an appropriate action instruction. This may seem to impose a stringent requirement for near perfect foresight on the data base developer. In practice, however, any situation that arises in an exercise and does not find a close match in the data base is handled by writing (and implementing) an appropriate set of instructions at that time. The situations and instructions so developed are then entered into the system's data base, thus eliminating the detected gap.

Several considerations must be kept in mind when preparing action instructions for entry in the major agent data bases. The directed actions and procedures required of the operator should be stated clearly and precisely so that operator errors are avoided. Any directive to search for and use data or information of a sort that is not to be found in the RSAC game system should be avoided. No action instruction directing forces of the other major opponent or those of any foreign nation other than those that have previously agreed to be de facto or de jure combat allies can be issued. The same is true for changes in political alignments: foreign nations can be requested or demanded to alter their political stances, but they will not neccessarily do so. Finally, the instructions must produce realistic actions. The

situation-related action instructions in the data base are the only means of characterizing the political and military force related behavior patterns of Red and Blue. This is probably the most difficult requirement to satisfy. The future behavior of any nation in a variety of postulated situations can only be an informed assumption, normally stated by scholars in terms of probabilities and improbabilities. The data base developer should make every effort to insure that his assumptions agree with those of scholars of Soviet diplomatic and military affairs, and that these assumptions are explicitly stated.

In theory, there are no particular required formats or presentational constraints on the writers of major agent action instructions. The action instructions are in no way involved in the pattern matching processes of the control system. Procedurally, the control system's output is a simple directive to the operator to execute a particular set of instructions. Practically, however, some kind of informal format or checklist is required, not only to assist the developers of action instructions in "covering" all the necessary "bases", but also to help the system operator perform his functions. The format suggested below is one we have found to best accomplish these two minimal requirements.

The Basic Concepts Involved

The basic pattern of operation of the major agent control system is the "IF <condition> THEN <action>" production rule[1] format. In this system, the "IF <condition>" is the situation description, which can thus be read as "If this pattern describing a situation arises in an

[1] A "production rule" is an IF <condition> THEN <action> logical structure. The rule is assumed to be one of many similar rules, all tested in sequence. This form is commonly used in computer language parsing, and artificial intelligence decisionmaking applications.

RSAC exercise, then..." The "THEN <action>" thus becomes "Then, operator, take the following action." Like most production rule programs, the "THEN <action>" can be made to be conditional with sequential defaults, which can themselves be conditional. Thus, the major agent control process can be stylized as:

```
IF <pattern match>
THEN
<
    IF <condition>
    THEN <action instruction>
    ELSE
    <
        IF <condition>
        THEN <action instruction>
        ELSE
        <
            IF <condition>
            THEN <action instruction>
        >
        ELSE <ask the Analyst of Record for instructions>
    >
>
```

This is not as complicated a procedure as it appears. It simply means that in developing action instructions, the writer can direct the operator to use critical pieces of information not covered in the basic description, and apply specified criteria in the process of determining which branch to take. The specific bits of additional information required can vary from situation to situation, as can the decision criteria.

The variety of additional information that is available or can be developed may be viewed by the action instruction writer as essentially that array of specifics and generalizations that would probably be available to the top-level and theater functional-level command echelons simulated in the control system.

The listing of available situation data given below is not intended to limit the data base developers. It is provided rather for instructional purposes. Necessary departures from this list, however, do require prior arrangements, and in system operations may entail ad hoc and judgment calls. The available additional information can be specific and numerical, generalizations or combinations of selected specifics, general qualitative assessments of force or systems status, or such intangibles as adversary "will". The information can be "as of the moment", or can represent what is to be anticipated using the "look-ahead" procedure. In many cases during an exercise, a request by Red or Blue for information may be unsatisfied if it is judged that Moscow or Washington (or their respective theater/functional commanders) would in real life not have that information available. In cases where the developer of action instructions can foresee this possibility, his instructions should cover the contingency, with a set of instructions to be followed if certain desired information proves to be unknown.

Information Available from the Systems Monitor and Analyst of Record

Current Time

This can be specified in "game date and clock time" or in plus or minus days, hours, or minutes relative to a discrete "benchmark" event, such as a Red initiation of combat in a theater or ocean area. Note that in specifying time relative to a future benchmark event, such as Red D-Day in Europe (Red DE-Day minus X), provisions should be made to cover the situation in which Red has not yet established a firm DE-Day. Action instructions may have to be formulated for such "undecided" cases. Time per se in some situations makes little difference to an action decision. If, for example, Red decides to launch an assault on a neighbor and sets a tentative D-Day and begins mobilizing and deploying

its forces, Blue's action instructions might include a precautionary mobilization as a reaction, without any knowledge of the date of Red's D-Day to come. If time will significantly affect Blue's decisions in a later move, but before Red D-Day, time can be shown as Blue mobilization day plus X. As a general rule it is better to make Red and Blue decisions conditional on critical events or a few critical elements of a situation rather than on relative time.

Critical Intelligence Assessments

In some experiments, the purposes of the analysis may dictate a particular branching decision as an alternative, or the formulator of the action rules may perceive the choice as delicately balanced and may wish to throw the choice to the Analyst of Record[2] during the exercise. In such cases, the action rules can be made conditional on the introduction of a specific "critical intelligence assessment" with one branch to be selected if it is introduced and another if not. When that action instruction is evoked in an exercise, the major agent operator will refer the question to the Analyst of Record. Care should be exercised in using this decision determinate to insure that the other situation descriptors do not refute the accuracy of the assessment.

Force Operations

In RSAC exercises, the Force Agent plays several roles. Force keeps abreast of the location and status of the relevant military forces, and assesses the results of combat interactions. In the role of

[2] "Analyst of Record" is the RSAC's term for the person in charge of a game exercise. This is generally the person who set the starting conditions, and who will analyze the results of the exercise.

"current military intelligence" for Red and Blue it can, when required, describe the forces and current combat conditions. In doing so, Force must filter out those real situation data that the major agent being served is not likely to be able to see. In this role, Force can predict the future state of a contemplated or ongoing conflict using the appropriate filtered data base, and whatever assumptions about the future behaviors of the adversaries that the major agent being served provides. Major agent decisions (or plan branch selections) based on such look-aheads are to be predesignated in the relevant action instructions. These decisions are to be based on specified criteria applied to a subset of the data listed below as being available in the "current military intelligence" role. Currently available data are also available in the products of a look-ahead.

In its current military intelligence role, the Force Agent can provide the following information for both sides of a conflict:

Land/Air Combat

1. The ground and air units involved.
2. The attrition experienced, up to the moment, in ground and air units. This can be in numbers of units or percentages of the initially committed and reenforcing units.
3. The effectiveness to date of any special advanced or isolated force commitments, such as forward use of airborne forces or amphibious assaults.
4. The targets attacked by long range weapons and the damage done to date.
5. The locations and specific natures of the forces involved or likely to be involved in the near future.
6. The sizes and characteristics of reenforcements being mobilized or deployed.

Sea Warfare

1. The nature and sizes of the sea force in any named area.
2. The current combat effects on forces in a combatant sea area.
3. The nature and sizes of any sea reenforcements being committed.

Theater and Intercontinental Nuclear Forces

1. The number of long range nuclear weapons delivery systems by type, as of the moment.
2. The number of long range nuclear delivery systems on both sides expressed in terms of prompt, accurate systems; nonprompt, accurate systems; prompt, inaccurate systems, nonprompt inaccurate systems; systems targetable by the adversary; systems not targetable by the adversary; readily retargetable systems; non-retargetable systems, etc. Note that the use of these kinds of system designators permits the formulation of action instructions that are applicable across a range of alternative force structures. The use of specific named systems makes the action instructions force structure specific.
3. The current surviving numbers of nuclear targets by system types on both sides, namely: ICBM launchers, bomber/air-launched cruise missiles (ALCMs), carrier bases, SSBN ports, C3I sites, airfields, air defenses, missile warning sites, nuclear storage sites, naval bases, ground troops, military recovery/support facilities, other military bases, industry, and populations. The European component of the C3I sites, defenses, nuclear storage sites, naval bases, ground forces, military recovery/support sites, and other military data are available separately if required.

4. Summary data.
    a. Deliverable warheads (all forces on alert only) by numbers on both sides or ratios.
    b. Equivalent megatonnages (all forces on alert only) by numbers on both sides or ratios.
    c. Countersilo potential (all forces on alert only) by numbers on both sides or ratios.

Relevant Generalizations Available

1. Surviving general purpose forces, theater or worldwide.
2. Surviving leadership with essential C3I.
3. Surviving populations.
4. Surviving homeland based intercontinental forces.
5. Surviving power projection forces.
6. Surviving homeland defenses.
7. Surviving non-superpower European leadership and C3I.
8. Surviving European populations.
9. Surviving IR/MR nuclear forces

Scenario Agent

The Scenario Agent's major role is to keep a record of the conflict-related status of all relevant nations, and to change such statuses as a function of situation-related rules. An additional role of Scenario is to provide current political intelligence and future political estimates to the major agents. In its current political intelligence role it provides the status information suggested in the "Scenario Situation" part of the Red and Blue situation description. In its look-ahead process, which requires a prior look-ahead by Force, it predicts Red or Blue future status changes.

Red's Model of Blue and Blue's Model of Red

At some critical juncture in the exercise, Red's action decision may depend not only on anticipated combat outcomes, and the anticipated world political alignments, but also on Red's projection of Blue's response to a Red action being contemplated. At such junctures the Blue Agent temporarily steps out of its role as major adversary and assumes the role of a predictive model of Blue behavior for Red. This full systems look-ahead process, when called for in the Red action instructions, entails a Force look-ahead, a Scenario look-ahead, and a Blue model look-ahead, in that order. It must be accompanied by a specification of those specific Blue response actions that would influence Red's choices of action. This does not give Red a completely accurate forecast of Blue's action because Red must specify which model of Blue is to be used. (See "Alternative Ivans and Sams" below.) Similarly, Blue can have the counterpart full systems look-ahead.

Nation-to-Nation Communications in the Action Instructions

By *handling* communications between major agents in the conditionals of their action instructions, the absolute need for using a stylized vocabulary no longer applies as it did in the Mark I system. Such communication can be realistic and, more important, *can influence* the recipient's move decisions. As a general rule, however, such communication should be confined to important junctures and, where possible, worded in a way that no verbal answer is absolutely required.

Communications to Scenario entities are a different matter. The substance of a Red or Blue message can directly influence the future status and behavior of a recipient nation. Messages to Scenario entities are by convention worded using the following vocabulary:

TO: (Name of addressee)

	(	Demand (I demand that you....)
	(	Suggest (I suggest that you....)
	(	Request (I request that you....)
Pick one	(	Agree (I agree to....)
	(	Intend (I intend to....)
	(	Refuse (I refuse to....)
	(	Remain as (Remain as....)
Pick one	(	No change (No change by you to....)
	(	Change you (Change your status to....)
	(	Red
Pick one	(	Blue
	(	White
Pick one	(	NATO
or none	(	WP
Pick one	(	Red trip-wired
or none	(	Blue trip-wired
	(	Noncoordinate
Pick one	(	Coordinate
or none	(	Cobelligerent
	(	Nuclear releasor
Pick one	(	Noncombatant
or none	(	Combatant-on-call
	(	Combatant
Pick one	(	In Middle Eastern conflict
or none	(	In European conflict

A Format and Rationale for Formulating Major Agent Action Instructions

To support the Task 2 applications experiments, the major agents play a closely connected set of roles. For conflict in any particular theater, the major agent, following his data base decision criteria, must make the war initiation decision, pick the basic war plan and possibly the contingency branches, and set the objectives. The action instructions related to a particular land campaign should include action instructions (and decision criteria) for the operations of naval forces in ocean areas related to the combat theater.

Finally, for the sake of post exercise analysis, the formulator of agent action rules should include a short rationale for the move selected. This rationale should be appropriate to the situation, and consistent with the character of Red or Blue being "played".

The specifications of the additional pieces of information to be considered (or developed in a look-ahead and considered) in the process of deciding on an action are so variable that a formal guide is impossible to suggest. At best one can suggest a checklist of a general nature:

1. Time, if relevant.
2. Critical intelligence assessment, if relevant.
3. Additional current information required and related action decision criteria.
4. Look-aheads as required and related action decision criteria.

An example of an action instruction is given in Figure 6 below. It is coupled to the situation description given in Figures 1 through 5 above. It illustrates several special procedures on instruction preparation that have proved to be useful. One is the inclusion of a verbal description of the salient features of the situation which is defined in much more detail in the situation description tableaux that are used in the search for the most similar situation in the data base. Notice that this verbal description is appended as a part of the data base of situations and associated instructions. In RSAC exercises this verbal description may not precisely describe the game situation that was close enough to this particular data base entry to cause it to be retrieved as a close match. But by including this outline, the exercise record, which contains a complete listing of every situation experienced and action instruction implemented, gives an easy-to-grasp picture of what is going on. The improvement in game record readability justifies the additional effort required in adding such verbal descriptions while developing data base entries.

The general instructions section is included as a kind of checklist. It reminds the preparer of action instructions that instructions to his forces in quiescent areas may be appropriate. This is usually used to change the alert status of forces in these areas. If complex or detailed instructions are required, they are normally covered in the special instructions section.

The special instructions section is used to convey detailed and possibly conditional action instructions. The special instructions section of our example illustrates several features we have developed. It shows a conditional instruction with fall-back and default actions if the first conditional's acceptance criteria are not satisfied. It shows the use of multiple acceptance criteria (IF< [this] OR [this] OR [this] > THEN [do this] ELSE, etc.). This usage permits the writer of action instructions to cover multiple contingencies in one instruction. The example also shows the use of the "look-ahead" procedure as a decision supporting device. In this example the operator is told to enlist the

Figure 6 - Example of an Action Instruction

ID: R12w IVAN(1) ADVENTUROUS/OPPORTUNISTIC D+17b2

SITUATION:

Lead elements of RED forces in Iran have made contact with lead elements of BLUE forces in the Zagros mountains. RED versus BLUE naval combat is confined to the I/O. RED and BLUE continue an exchange of air attacks against each other's forces and bases (not to include any BLUE air attacks on RED homeland). RED attacks against BLUE air bases involve most of the Persian Gulf nations that have provided combat base rights to BLUE.

GENERAL INSTRUCTIONS:

(a) NORTH SCANDINAVIA:
(b) CENTRAL EUROPE: see below
(c) SOUTHERN EUROPE
(d) MIDDLE EAST: see below
(e) SINO-SOVIET BORDER:
(f) FAR EAST:
(g) NAVAL FORCES: see below
(h) LONG RANGE NUCLEAR FORCES:

SPECIAL INSTRUCTIONS:

IF
< [The US has started to deploy reenforcements to Europe (more than 1 division)
]
OR
[US military forces have attacked Soviet naval forces outside the Indian Ocean area
]
OR
[A force operations look-ahead in Iran (assuming the continuation of current rules of engagement and the commitment of any deploying RED or BLUE reenforcements) indicates that RED forces on attack axes 7 and 8 will not reach their objectives by D+35 or that RED forces on attack axes 7, 8 and 9 will not attain their objectives by D+60
]
>

Figure 6 - Example of an Action Instruction, continued

```
THEN
<   [   Mobilize the WP in readiness to execute RED plan D, 15 days
        from today
    ]
    IF
    [   The US is using Turkish air bases to attack Soviet
        forces in Iran (more than 1 TFW)
    ]
    THEN
    [   Initiate air attacks on military air bases throughout
        Turkey
    ]
>
ELSE
<   [   Continue campaign in Iran ]
    AND
    [   Do not mobilize the WP ]
    AND
    <   IF
        [   The US is using Turkish air bases to attack Soviet
            forces in Iran (more than 1 TFW)
        ]
        THEN
        [   Send a message to Turkey: "The use of your bases for
            US combat operations justifies a RED retaliation."
        ]
    >
>
```

RATIONALE:

IVAN(1) is committed to the attainment of his original objective in Iran on or near the original schedule. The mobilization of the WP in Europe is designed to draw off further US reenforcing of BLUE forces in Southwest Asia, and is not an irreversible commitment to attack. That decision can be deferred to the final days of WP mobilization. The conditional decision to attack Turkey is justified by Turkey's allowing the use of its bases for US combat operations.

HOUSEKEEPING:

If the RED decision is to mobilize the WP, suggest a 2 day time advance to the next BLUE move and ask for a RED move on today + 13 days. Otherwise, suggest a 5 day time advance to BLUE move.

aid of the Force operations models to check on the anticipated future combat outcome. The action instruction specifies the minimum acceptable conditions required to trigger the move. Also exemplified is the use of nested conditionals in the THEN part of the IF-THEN statement. Finally, it illustrates another usage that gives additional power to the system. In the situation description tableaux to which this instruction is appended, Turkey is clearly indicated as not being a base for Blue air attacks. In recognition of the possibility that this data base entry might prove to be the closest pattern match to a situation arising in an RSAC exercise in which Turkey was indeed involved, conditional instructions have been added to cover this contingency.

A rationale section has been used in which the developer of action instructions is to give a brief exposition of the reasoning behind the instructions. This should include how these actions fit the basic behavioral character of the Red or Blue being used. This rationale has proven to be useful in making the game records more understandable.

The section entitled housekeeping is used to instruct the operator to take certain RSAC systems-related actions to insure overall efficiency or exercise effectiveness. An instruction to the Red operator to recommend a specific time advance to the next Blue move (or vice versa) is the most common example. The comparison of two or more game histories for analytic purposes demands consistency in the play-to-play time advances. The housekeeping section of the operator instruction format contributes to this and similar ends.

Alternative Ivans and Sams

Throughout the development of the RSAC automated game, it has been apparent that such a fully automated and controlled model would be uniquely fitted to the purposes of comparative analysis, by exploring the differences in outcomes produced by repeated runs in which important assumptions are varied. Force structure, equipment and unit

performances, and third party/alliance behaviors are among the list of candidate variables. But among the most important assumptions that can alter the outcomes of simulated campaigns are those made about the behavior of the major antagonists. To allow for the specific treatment of this variable, and to insure that the assumptions made are recorded, the Mark II major agent system was designed to allow the development and use of two Red (Ivan) and two Blue (Sam) control system data bases.

The two Ivans are significantly different. One is "adventuristic/risk-taking" and the other "opportunistic/conservative". They represent a deliberate attempt to depict future (turn of the decade) Soviet behavior. Ivan 1 operates in a band between opportunism and fairly cautious adventurism. Ivan 2 operates between conservatism and opportunism. A conservative Ivan represents a turn of the decade Soviet leadership that is slightly less hawkish than the current leaders. Thus Ivan 2 (conservative/opportunistic) represents the most likely case, and the Ivan 1 (adventuristic/risk-taking) a not-too-implausible "bad case." The table below compares and contrasts the two Ivans in terms of their imputed propensities:

Characteristic	Adventurist ↓ Ivan 1	Opportunist ↓ Ivan 2	Conservative
Expansionist ambitions	High	High	Moderate
Risk acceptance	Moderate	Low	Low
Insistence on preserving existing imperial control	Adamant	Adamant	Adamant
Patience and optimism about natural course of events in absence of Soviet action	Low	Moderate	High
Flexibility of objectives once committed	Moderate	High	High
Tactical and strategic daring	Moderate	Moderate	Low
Willing to accept major losses to achieve objective	Moderate	Low	Low
View of adversary intentions	Neutral	Neutral	Alarmist
View of adversary will (when capability exists to assess it)	Contemptuous[a]	Neutral[a]	Conservative

[a] Both Ivans use look-ahead before commitment, and assume a cautious, risk-averse Blue. However, Ivan 2 has more stringent commitment decision criteria than the adventuristic Ivan 1.

Further derived propensities of the Ivans are that the opportunistic/conservative Ivan 2 prefers to use political and deniable/covert means to pursue his territorial ambitions, but will reluctantly use surrogate military means. The adventuristic/opportunistic Ivan prefers to use surrogates, but will use Soviet military means if necessary, and the threat of immediate escalation is not too great. Either may use the means preferred by the other, but their commitment decision criteria differ. The criteria of the opportunistic/conservative Ivan 2 are more stringent than those of Ivan 1. Both are adamantly committed to the preservation of the existing "empire", but Ivan 2 defines that as comprising Eastern Europe and Mongolia, with Afghanistan and Yemen on the margin. Ivan 1 includes Angola, Ethiopia, Vietnam, and Cuba. Neither of the Ivans wants to fight a major war in Europe. But Ivan 1 is more willing to risk actions that may lead in that direction. Ivan 1 is more confident in his ability to control and limit escalation than Ivan 2. Either may at some juncture face the prospect of such a European war due to unforeseen events including some foreign "mistake". In such a case, Ivan 1 is inclined toward preempting the initiative and going for a quick victory as a matter of military "good sense". Ivan 2 is not as prone to preemption, but once committed will go for a quick victory because of a belief that protracted conflict can lead to a collapse of his alliance, and possibly to nuclear war. The significant difference between the two is not in the way they would fight a European war, but rather in their willingness to threaten its initiation as a coercive move.

Neither Ivan entertains any illusions about the enormous costs, in terms of casualties and social and industrial destruction, that would be entailed in a major nuclear war involving attacks on the USSR. But the adventuristic/opportunistic Ivan 1 believes victory, by some metric, is possible. Ivan 2 is postured between being unsure, and pessimistic about the prospects. Again, these differences evince themselves as differences between the willingness of the Ivans to approach the threshold for coercive purposes.

The alternative Blue control data bases (Sams) are not as elaborately formulated as the Ivans. The two Sams are differentiated by the following four characteristics: 1) the promptness with which they are willing to commit forces when Blue's national or alliance interests are threatened, 2) the amount of time devoted to attempts to secure alliance approval before such a commitment is made, 3) the degree of willingness to risk a direct confrontation with Red (to pay the cost in casualties to defend its interests if necessary), and 4) the degree of willingness to approach serious vertical or horizontal escalation. Clearly, no plausible Blue would consider the prospect of a major war in Europe or a major nuclear war as being other than disastrous. But reasonable people can disagree about whether a cautious or a decisive approach is more likely to result in such an undesired result. Sam 1 takes the cautious and calculated approach. Sam 2 prefers expeditious steps designed to to convince the adversary that Blue's will to defend its interests is strong.

IV. ILLUSTRATIVE EXAMPLES OF SITUATIONS AND ACTION INSTRUCTIONS (With Explanatory Comments)

The following example illustrates the process of describing situations and formulating action instructions. No particular effort has been made to depict any situation that might arise in the applications experiments. The situation is posited from the Red point of view. The example uses the adventuristic, "bad case" Ivan, with some side comments on how the most likely case Ivan might differ.

Hypothetical Situation -- Imminent Fall of Iran

The demise of Khomeini resulted in the collapse of the Iranian government. A merger of leftist elements, and groups hostile to the Shai Mullahs formed a new government. This government finds itself experiencing severe dissidence and political violence. In spite of its receiving recognition, and political and arms support from Moscow, its legitimacy is threatened. Even its existence as a presumptive government cannot last for more than a few months. The situation is characterized for Red in the following system situation descriptions (Figures 7 through 11).

Our adventuristic Ivan is now presented with the issue of what, if anything, to do about the situation. There are four basic courses of action available for consideration:

1. Do nothing and let the Red client fall. This is out of character for any Ivan that had come to feel that Iran was becoming a part of the Soviet "empire" in the political sense.
2. Commit the minimum Soviet forces required to insure the survival of its client, but do not put down all effective dissident resistance by any particular date. This is also out of character for the adventuristic Ivan unless this is the only reasonably safe and low-cost option available.

Figure 7 - Scenario Tableau - Imminent Fall of Iran

SCENARIO SITUATION

Country	Conflict Orient	Cooperatn	Super Power Presence	Military Prep	Mid-East Invlvmnt	European Invlvmnt
Afghanis	White	Noncoord	R.Major_Pres	Normal	Noncombat	Noncombat
Algeria	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Austria	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Bahrain	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Belgium	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Bulgaria	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Canada	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Cuba	White	Noncoord	R.A.Trip_Wire	Normal	Noncombat	Noncombat
Czech	White	Noncoord	R.Major_Pres	Normal	Noncombat	Noncombat
Denmark	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Djibouti	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Egypt	White	Noncoord	B.A.Trip_Wire	Normal	Noncombat	Noncombat
Finland	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
France	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
FRG	White	Noncoord	B.Major_Pres	Normal	Noncombat	Noncombat
GDR	White	Noncoord	R.Major_Pres	Normal	Noncombat	Noncombat
Greece	White	Noncoord	B.U.Trip_Wire	Normal	Noncombat	Noncombat
Hungary	White	Noncoord	R.Major_Pres	Normal	Noncombat	Noncombat
Iceland	White	Noncoord	B.U.Trip_Wire	Normal	Noncombat	Noncombat
Iran X	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Iraq	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Israel	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Italy	White	Noncoord	B.U.Trip_Wire	Normal	Noncombat	Noncombat
Japan	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Jordan	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Kuwait	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Lebanon	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Libya	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Luxembrg	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Mongolia	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat

Figure 7 - Scenario Tableau - Imminent Fall of Iran, continued

SCENARIO SITUATION

Country	Conflict Orient	Cooperatn	Super Power Presence	Military Prep	Mid-East Invlvmnt	European Invlvmnt
Morocco	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
N.Korea	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
N.Yemen	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Netherld	White	Noncoord	B.U.Trip_Wire	Normal	Noncombat	Noncombat
Norway	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Oman	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Pakistan	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Poland	White	Noncoord	R.Major_Pres	Normal	Noncombat	Noncombat
Portugal	White	Noncoord	B.U.Trip_Wire	Normal	Noncombat	Noncombat
PRC	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Qatar	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Rumania	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
S.Korea	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
S.Yemen	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Saudi Ar	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Spain	White	Noncoord	B.A.Trip_Wire	Normal	Noncombat	Noncombat
Sweden	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Syria	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Turkey	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
UAE	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
UK	White	Noncoord	B.Major_Pres	Normal	Noncombat	Noncombat
US	B.Firm	Noncoord	B.Major_Pres	Normal	Noncombat	Noncombat
USSR	R.Firm	Coordin.	R.Major_Pres	Normal	Noncombat	Noncombat
Yugoslav	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat
Rfaction X	R.Mod.	Coordin.	No_Presence	Mobilzd	Combatant	Noncombat
Wfaction X	White	Noncoord	No_Presence	Mobilzd	Combatant	Noncombat
Bfaction	White	Noncoord	No_Presence	Normal	Noncombat	Noncombat

Figure 8 - Sea Tableau - Imminent Fall of Iran

SEA SITUATION

Ocean Area	Conflict Launch Area	Red Presence				Blue Presence		
		SAG/BG	Anti CV	Kiev GP	SSBN	BG	MAU	SSBN
Barents Sea		Present	Present	Present	Present			
Norwegian S					Present			Present
Baltic Sea								
North Sea								
E.Atlantic					Present			Present
W.Atlantic						Present		Present
Caribbean							Present	
Gibraltar								
W.Mediter.		Present	Present			Present	Present	
E.Mediter.		Present	Present	Present		Present		
Black Sea								
Arabian Sea						Present		
Persian Glf								
Indian Ocen		Present	Present	Present		Present		
S.China Sea		Present	Present				Present	
W.Pacific					Present		Present	Present
Japan Sea		Present	Present	Present	Present	Present		
Hawaiian						Present		
E.Pacific						Present		Present
Unknown								

Figure 9 - Theater Combat Tableau - Imminent Fall of Iran

THEATER COMBAT SITUATION

Theater	Red Forces	Red Reenf.	Blue Forces	Blue Reenf.	Red Main Position	Red Adv Position	Blu Main Position	Blu Adv Position
Axis 4	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 1	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 2	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 3	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 5	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 6	Normal	Normal	Normal	Normal	-1-50		+0-50	
Axis 7	Normal	Normal	Not_Presnt		-1-50			
Axis 8	Normal	Normal	Not_Presnt		-1-50			
Axis 9	Normal	Normal	Not_Presnt		-1-50			
Axis 10	Normal	Normal	Not_Presnt		-1-50			
Axis 11								
Axis 12								

Figure 10 - Combat Conditions Tableau - *Imminent Fall of Iran*

COMBAT CONDITIONS (WEAPONS/TARGETS)

Targets	Mid-East	Europe	Sea	Homeland
Red Untargeted				
Red Nuclear Forces				
Red Ground Forces	Unlim.Conven.			
Red Airbases				
Red Seaports				
Red Land LOCs	Unlim.Conven.			
Red Sea Forces				
Red Industry				
Red Cities				
Red C3I				
White Untargeted				
White Nuclear Force				
White Ground Forces	Unlim.Conven.			
White Airbases				
White Seaports				
White Land LOCs				
White Sea Forces				
White Industry				
White Cities				
White C3I				
Blue Untargeted				
Blue Nuclear Forces				
Blue Ground Forces				
Blue Airbases				
Blue Seaports				
Blue Land LOCs				
Blue Sea Forces				
Blue Industry				
Blue Cities				
Blue C3I				

Figure 11 - Long Range Nuclear Forces Tableau - Imminent Fall of Iran

LONG RANGE NUCLEAR FORCES STATUS
(plus civil defense)

Force	Status Description	Status
Red:	ICBMs	Launched
Red:	SSBNs	Launched
Red:	LRA/Cruise Carriers	Launched
Red:	MR/IR Forces	Launched
Red:	Civil Defense	Activated
Red:	LRA/Cruise (US)	Penetrating
Red:	MR/IR Forces (in theater)	Penetrating
Red:	SSBNs	Dispersing
Red:	LRA/Cruise Carriers	Dispersing
Red:	MR/IR Forces (in theater)	Dispersing
Red:	ICBMs	Alerted
Red:	SSBNs	Alerted
Red:	LRA/Cruise Carriers	Alerted
Red:	MR/IR Forces	Alerted
Blue:	MR/IR Forces	Alerted
Blue:	LRA/Cruise Carriers	Alerted
Blue:	SSBNs	Alerted
Blue:	ICBMs	Alerted
Blue:	MR/IR Forces (in theater)	Dispersing
Blue:	Bombers/Cruise Carriers	Dispersing
Blue:	SSBNs	Dispersing
Blue:	MR/IR Forces (in theater)	Penetrating
Blue:	Bombers/Cruise Carriers	Penetrating
Blue:	Civil Defense	Activated
Blue:	MR/IR Forces	Launched
Blue:	LRA/Cruise Carriers	Launched
Blue:	SSBNs	Launched
Blue:	ICBMs	Launched

3. Commit sufficient Soviet forces to gain full control of the client state and bring it into the "empire."
4. Under the guise of executing Option 3, commit forces with the intent of gaining even greater control in the area.

Naturally, any choice made other than the "do nothing" option will take some time to prepare for and implement. Extensive preparations are not likely to go unnoticed by the West. A contingent decision can be made to settle for a lesser objective if future developments make that a prudent thing to do. No Ivan would have any illusions about the sensitivities of Western Europe and the United States to the prospects of a permanent Soviet military presence on the Persian Gulf littoral. The greater the Red objective suggested by their preparations, the greater the resulting Western concern is likely to be. The adventuristic/opportunistic Ivan 1 expects adverse reactions from any such preparations. But looking back to the period following the Afghanistan exercise, he is confident that if whatever objective he picks is expeditiously and inexpensively attained, the predictably adverse Western and Japanese verbal reactions will be relatively short-lived. Further, European and Japanese criticisms will tend to be somewhat muted with USSR military forces permanently present in the Persian Gulf area.[1] Although he anticipates a high level of alarm among the nations of SWA, this too will abate, especially with some skillful Red manipulations of the numerous factional and international controversies that are endemic to the area. Few of the local nations have indigenous military capabilities that could present major difficulties to intruding Soviet forces.

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[1] No Russian leader or leadership group, having successfully negotiated the post-Brezhnev power struggle, is likely to place as high a premium on being liked as on being respected. Respect promotes security. Any affection is certain to be transitory.

Thus, the Red action decision hinges on his anticipations of the character and timing of Blue's military moves. This in turn depends on a combination of the following factors: 1) the size and character of Blue's intervention forces, 2) the cooperation or noncooperation of certain key nations in allowing staging and transiting of Blue's forces, 3) the timing of that cooperation (if cooperation for Blue is forthcoming), and 4) the prompt willingness (or nonwillingness) of certain key local nations to allow their territories and bases to be used by Blue as combat launch sites. In short, Blue is not a potential problem to Red if its intervention forces are limited to a relatively small group of deployable air and land forces, plus possibly a Blue carrier group and marine amphibious unit in the Indian Ocean. In this case a rational Blue (by Red's standards) would not be so quixotic as to attempt a doomed effort at interfering. If Blue has an effective deployable force, but does not receive the needed foreign cooperation, the effect is the same. And if Blue has a capable force and foreign cooperation, but not the will to commit its forces to defend its interests, the effect remains essentially the same.

If Blue has the capability to effectively intervene, and the will, but does not receive foreign cooperation and support until days or weeks after Red's move into the area, Red can probably achieve its intermediate objective and leave Blue poised but unengaged in other Middle East nations. A Blue capability to roll back an essentially completed invasion of Iran is most unlikely. A rational Blue probably would not make the attempt. The same conclusion is reached if Blue is slow to commit for reasons of reluctance.

If, however, Blue is positioned in the area with a ready air capability to attack Red forces in northern Iran, and is introducing significant forces into southern Iran by D-Day, the cost of the Red operation could be high and successful achievement dangerously delayed.

Red thus has the problems of assessing Blue's capabilities (a function of the character of the Blue intervention forces and the cooperativeness of certain critical nations) and Blue's will--over time.

Under these circumstances, the Red action instructions should be written along the lines given in Figure 12.

The action instructions of Figure 12 illustrate the use of a full systems look-ahead in the process of making a commitment and selecting a plan and objective. Many of the decision criteria to be applied to the projected situation are general and political.

Another example (Figures 13) illustrates the way decision criteria must sometimes be stated in terms that can be applied to markedly different force structure alternatives.

Notice that the use of the ratio of hard target killers is sensitive to selective reductions or additions of specific weapons types on either or both sides, to postulated or proposed new offensive weapons types, and to the introduction of ABMs.

Figure 12 - Example of Action Instructions - Imminent Fall of Iran

IVAN(1):Adventuristic/Opportunistic D?-a

ID:R1/1c

SITUATION:

A Moscow oriented Iranian government finds itself seriously threatened by violent dissidence, with most of its armed forces in active opposition to the government. While the dissidents are not (at the moment) receiving external aid, they are known to be Western oriented. The fall of their client is apparently imminent; a prospect that no Soviet Government can face without making all reasonable (but not rash) efforts to prevent it.

GENERAL INSTRUCTIONS:

(a)SCANDINAVIAN AREA:none
(b)CENTRAL EUROPEAN AREA:none
(c)SOUTHERN EUROPEAN AREA:none
(d)CASPIAN SEA/MIDDLE EAST AREA:Conditional-see below
(e)SINO BORDER AREA:none
(f)FAR EAST AREA:none
(g)NAVAL FORCES:conditional-see below
(h)LONG RANGE NUCLEAR FORCES:none

SPECIAL INSTRUCTIONS:

Conduct a Force Operations look-ahead in Europe, assuming the execution of Red Plan/script D2 following a 15 day mobilization and deployment of the WP forces starting today, with NATO assumed to initiate mobilization and deployment of reenforcements starting 5 days from today and further assuming that conventional weapons only will be use by both sides.

IF
[Red is projected as occupying and controlling Western European territory as far as France in less than 30 days of combat operations (penetration along 2 or more major axes of Red attack)
]
THEN
[Initiate the process of selecting which of Red SWA Plans/scripts (A, B, or C) is to be executed starting today (Decision procedure given below)
]
ELSE IF
[European look-ahead projects Red control objectives as being achieved in more than 30 days but less than 60 days
]

Figure 12 - Example of Action Instructions - Imminent Fall of Iran, cont.

```
THEN
[ Initiate the process of selecting which of Red SWA Plans/scripts
  (with allowable choices limited to A plan/script, B plan/script
  or abort) is to be executed starting today (Decision procedure
  given below)
]
ELSE IF
[ European look-ahead projects Red control objectives as NOT being
  attainable in 60 days or less and no successful Blue defense
  within 50 miles of the FRG eastern border on 2 or more major
  Red attack axes
]
THEN
[ Initiate the process of deciding whether to execute Red Plan/
  script A starting today or to take no action in SWA (Decision
  procedure given below)
]
ELSE IF
[ European look-ahead projects a successful Blue defense within
  50 miles of the FRG border on 2 or more major Red attack axes
]
THEN [ Take no Red military action in SWA ]

IF
[ One or more Red SWA intervention options is still open for
  consideration
]
THEN
[ Conduct a full system look-ahead in SWA using SAM(2) and Red
  Plan/script B2 following a 30 day (from today) force
  mobilization/deployment period (look ahead to D+11)
]

IF
<
    [ The SWA look-ahead projects no significant Iranian resistance ]
    AND
    [ No significant US ground and air forces (less than .4 ADEs) are
      in the SWA area (due to a lack of US resolve or capability or the
      refusals of nations in the theater to permit the use of their
      territories as a Blue staging/combat base area)on D+11
    ]
    AND
    [ Red in control of Northern Iran by D+8 ]
>
```

Figure 12 - Example of Action Instructions - Imminent Fall of Iran, cont.

```
THEN
<
    [ Set todays date as D-30 ]
    AND
    [ Initiate mobilization and deployment for Plan C ]
    AND
    [ reenforce Red Naval forces in the Indian Ocean ]
    AND
    [ announce (on D-27) an upcoming large scale military exercise
      to be conducted in the Transcaucusus/Turkman area
    ]
    IF
    [ You have a message from the Red Iranian faction requesting
      Soviet combat assistance
    ]
    THEN
    [ send a message to the Red faction, "I agree to provide
      the requested combat aid."
    ]
    ELSE [ send message "I intend to send Soviet forces to aid you." ]

    ( Red Operator:  Note that you are now executing Plan C and
      should ignore any subsequent action instructions relating
      to any other Plan unless instructed to do so )
>
ELSE IF
<
    [ The SWA look-ahead projects Blue will have forces in Iran on
      D+11 (but less than 1.2 ADEs and more than .4 ADEs)
    ]
    AND
    [ Red controls Northern Iran by D+8 ]
    AND
    [ Turkey remains a noncombatant (denying Blue's use of its
      bases for SWA combat operations)
    ]
>
THEN
<
    [ Set todays date as D-30 ]
    AND
    [ Begin mobilizing/deploying for Plan B ]
    AND
    [ Reenforce Red naval forces in the Indian Ocean ]
    AND
    [ Announce (on D-27) an upcoming large scale military exercise
      in the Transcaucusus/Turkman area
    ]
    IF
    [ If you have a request from the Red Iranian faction for
      Soviet combat aid
    ]
    THEN
    [ Send message to Red faction "I agree to send Soviet
      forces to your assistance."
    ]
```

Figure 12 - Example of Action Instructions - Imminent Fall of Iran, cont.

```
        ELSE
        [ Send to Red faction "I intend to send Soviet forces
          to assist you."
        ]
         ( Red Operator:  Note that you are now implementing Red
           Plan B.  Ignore any subsequent instructions relating to
           any other Plan unless otherwise instructed. )
    >
    ELSE IF
    <
        [ The SWA look-ahead projects between 1.2 and 2 Blue ADEs
          in Iran by D+11
        ]
        AND
        [ Red's projected losses do not exceed 5 ADEs ]
        AND
        [ Red control of Northern Iran can be gained before D+14 ]
    THEN
    <
        [ Set todays date to D-30 ]
        AND
        [ Begin mobilizing/deploying for Red Plan A ]
        IF
        [ you have a request from the Red Iranian faction for Soviet
          assistance
        ]
        THEN
        [ Send message to Red faction "I agree to send Soviet
          combat forces to your aid."
        ]
        ELSE
        <
          [ Send to Red faction "I intend to send Soviet forces to
            assist you."
          ]
          AND
          [ Announce an upcoming large scale military exercise to be
            held in the Transcaucusus/Turkman area
          ]
           (Red Operator: Note that you are executing Red Plan A.
            Ignore all instructions related to any other Plan unless
            otherwise instructed)
        >
    >
    ELSE IF
    <
         [ Blue is projected as having more than 2 ADEs in Iran by D+11 ]
         OR
         [ Red does not control Northern Iran by D+11 ]
         OR
         [ Red's projected losses exceed 5 ADEs ]
    >
    THEN
    [ Abandon all plans for military intervention in SWA at
      this time
    ]
```

Figure 12 - Example of Action Instructions - Imminent Fall of Iran, cont.

RATIONALE

IVAN(1) will not accept the impending loss of a strategically located client without making every prudent effort to prevent it. Such efforts may include the commitment of Soviet combat forces if less violent measures are deemed inadequate, if the combat outcome is projected as being favorable and the risk and consequences of unanticipated escalation are acceptable.

IVAN(1) has a long standing desire to gain political and military access to the Indian Ocean to extend his influence in region while decreasing the influence of his Western adversaries. IVAN(1) recognizes the importance of the region to the US, Europe, and Japan; and the resulting sensitivities of those nations to any increase in Soviet access and control. The request of a threatened client in the area for Soviet military assistance offers a legitimizing reason and an opportunity to take action in pursuit of longstanding goals.

With this view of the situation as a backdrop, IVAN(1) calculates as follows:

1. The security of the USSR is the primary Red objective.
2. The security of the Soviet empire in eastern and southern Europe is so critically important to the primary objective that it is practically subsumed under it.
3. The security of the contiguous Red empire elsewhere (e.g. the Far East) is IVAN's next most important strategic objective.
4. The control of Southwest Asia (with the concurrent reduction in Western influence) is a reasonable Red objective only if it can be achieved quickly and with an acceptably small risk of provoking an escalatory response that might threaten more important interests and objectives.
5. The West is likely to attempt to resist any Soviet incursion into Southwest Asia they perceive as a blatant move that threatens to place their economic interests in hostage to Red control. The scale and intensity of any such Western resistance is likely to be determined by the force balance in Europe (as the Western Europeans assess it), by the degree of NATO solidarity (which is partially a function of the force balance), and the ability of the US and its allies to move substantial forces to Southwest Asia (which would be influenced by a combination of US and Western will, US force structure and the degree of support that is given by the nations in the Southwestern Asian region).
6. The achievment of Soviet control of Iran (as a less ambitious objective) is worth some military casualties and political/economic penalties to IVAN(1) if Red victory is assured and undesired escalation is deemed unlikely.
7. Gaining control of northern Iran (as an even less ambitious objective) is also worth some casualties and penalties if the Western and US posture is such that an attempt to quickly overrun all Iran exceeds Red capabilities. IVAN(1) does feel obliged to come to the aid of a threatened client unless the risks to more important Red interests are judged to be too great.

Figure 12 - Example of Action Instructions - Imminent Fall of Iran, cont.

8. The control of Iran is not worth a major war that might escalate out of control.

CAVEAT

The use of extensive military look-ahead calculations called for by this rule is *not* to be interpreted as indicating a belief that the Soviets actually make such calculations in contemplating military intervention into South Western Asia (or any other foreign territory). The calculations used here should be viewed as a necessary surrogate for the more general and extensive a priori assessments that they do indeed conduct.

ASSUMPTIONS Underlying the Red look-ahead at the combat outcome prospects in Europe:

(1) Red believes that Blue and the nations of Western Europe will conduct (or will have conducted) similar assessments of the war outcome prospects in Europe, and would therefore be deterred from any serious consideration of horizontally escalating a Southwest Asian conflict to Europe, and would also be inhibited from provoking the USSR by involving their forces in Iran.

(2) Red recognizes the dubious reliability of such a priori assessments of foreign reactions and the possibility of the contemplated Iranian commitment leading to an unexpected and undesired escalation to Europe and therefore uses the look-ahead in Europe to reassure himself that if such a violent happenstance occurred, his military position in Europe would be generally favorable.

HOUSEKEEPING Request a 2 day time advance to the next Blue move.

Figure 13 - Example of Action Instructions - War in Europe

ID: R75 IVAN(1) ADVENTUROUS/OPPORTUNISTIC DE DAY+

SITUATION:

In the context of a nuclear war in Europe (with war also involving much of the Middle East and all open ocean areas) Red M/R, I/R and theater LRA bases in European Russia have been attacked by Blue theater nuclear weapons. Red is considering his response.

GENERAL INSTRUCTIONS:

(a) NORTH SCANDINAVIA: continue nuclear weapons use as necessary
(b) CENTRAL EUROPE: " " " " " "
(c) SOUTHERN EUROPE: " " " " " "
(d) MIDDLE EAST: " " " " " "
(e) SINO-SOVIET BORDER: Maximum alert
(f) FAR EAST: " "
(g) NAVAL FORCES: continue nuclear weapons use as necessary
(h) LONG RANGE NUCLEAR FORCES: Medium range forces continue nuclear weapons use as necessary. Intercontinental forces stand by for possible launch.

SPECIFIC INSTRUCTIONS:

[Conduct a 24 hour force look ahead with a Red CF attack on the US assuming a full US CF response (LUA)
]

IF
[the projected ratio of hard target killers on both sides (ICBMs, SLBMs, BOMBERS, CMs) is 1:1 or worse for Red
]
THEN [continue theater campaigns]
ELSE [Initiate general nuclear war (CF)]

RATIONALE:

IVAN(1) is in a situation that he never intended to get into but he does believe that even undesired wars must be fought and won. Further, he believes that a general nuclear war will probably be protracted with both sides trying to continue attacks until one side is conquered (and that side must not be Red). Thus the Red decision is conditioned on the anticipation of the likely course of such a protracted war. If Blue is projected as having an advantage, this is clearly a war that Red would not want to initiate.

CAVEAT: The look-ahead procedure called for here is not to be interpreted as implying a belief that any such calculation would be made by the USSR in such a situation. Rather it is a systems surrogate for the many prior staff studies that the Red leadership would have received in the prewar period.

HOUSEKEEPING:

If the general nuclear war option was selected, ask for 10 minutes (from Red ICBM/SSBN launch) to the next Blue move. Otherwise, suggest 5 to 10 days time advance.

V. TECHNICAL DESCRIPTION OF THE MARK II CONTROL PROGRAM

The Mark II control program is a general software system for building data bases of qualitative data, and evaluating the "closeness" of one entry to another. Its current application as a Red and Blue decisionmaking program is one specialized use of the software. The Mark II situation and action structures represent our current thinking about the structure of the Mark III system, which is now being designed. In this section, we will describe the technical setting of the Mark II system, its technical strengths and weaknesses, other applications of the same software, and how Mark II connects with Mark III.

The C Programming Language under the Unix Operating System

The Mark II control program runs on the Unix operating system. Unix is a general purpose, multi-user, interactive operating system developed by Bell Laboratories in the early 1970s. It is the program development and the production system[1] of over 1000 universities and commercial sites nationwide. Unix was selected as the basis for major agent development for a number of reasons. It is highly portable, and currently runs on the DEC PDP-11 and Vax; Interdata 8/32 and 9/32; and IBM 360, 370, and 4300 series computers. Unix also runs on the Zilog Z-8000; Intel 8086; and Motorola 68000 microprocessors. Unix is very portable primarily because it is written in a high-level language, "C". ("C" is a block-structured system and applications language that is designed to compile into efficient code.) Unix offers a very flexible hierarchical file system. It has compatible inter-process, device, and file I/O, accomplished through "pipes", "filters", and "I/O redirection". Unix supports asynchronous multi-process communication.

[1] By "production system" we mean a computer system used for text processing, student programs for classes, accounting, and other uses apart from research and development.

Its system command interpreter is a user-process, and can thus be written by the user and specified on a per-user basis. In addition, Unix carries with it the "software tools" development of Bell Labs, and the academic community at large, offering over 100 subsystems and over a dozen programming languages.

We considered several programming languages for Mark II program development. FORTRAN, COBOL, and BASIC are easily ruled out due to their lack of structure and clumsy handling of data structures. Pascal was ruled out due to weak and non-standardized I/O, and inefficiency in its implementations. PL/1 was ruled out because the required code would be much larger and less clear, it is not portable to non-IBM systems, and it does not allow the level of user interactivity we require because its implementations are in "half-duplex". Ada was ruled out because a fully developed version is not yet available. The "C" language was selected because it is highly structured, has a powerful and standardized I/O library, has reasonable data structure capability, is portable, and is efficient.

The major agent control program consists of approximately 6,000 lines of C code and embedded comments. We believe that the same functionality would require at least 25,000 lines of FORTRAN or a similar language. Indeed, some of the program's flexibility and user interactivity with many types of terminals could not have been achieved in FORTRAN within the project's resources. The code attempts a very high level of internal documentation. Specifically, the code is intended to be easily read and understood by a C programmer by its use of long variable names, macros, and a structured architecture. In addition, the comments alongside the code are intended to make the program understandable to a programmer who does not know C. Thus if the comments and code were separated, they are to be understandable standing alone. However, the comment-half of this separation would give only a general idea of what the missing code is doing. Most of the comments are at the C function level, so that the programmer may treat the

function as a "black box". We could not reproduce the code in this document, since it is over 135 pages in length, but the interested reader may contact the authors for a copy.

Operator Interaction with the Program

The Mark I Red Agent control system required the operator or data base builder to input a situation description. This description consisted of from 5 to 30 possible choices for each of 15 data points. The Mark II system also requires such inputs. However, the Mark II system is configured to require some 780 data points. Each of these data points can take on one of a limited set of qualitative values. Although during an exercise some of these data points are provided automatically by Scenario, the Force Tableaux and any changes still must be entered by hand. The data base developers make all the original entries by hand. This required a very efficient data entry and examination system, which the Mark I system did not have. To accomplish this we built into the Mark II system the ability to display whole tableaux on the screen at once, and to enter any valid data point with a single keystroke. The operator uses cursor[2] arrow keys to move his cursor around the tableau. His "cursor" is shown by placing that data point in inverse video or other highlighting appropriate to the terminal. Simultaneously, a menu[3] is shown at the bottom of the screen listing the one key entries for all the possible data values for this data point in the tableau. Optionally, the cursor position can

---

[2] "Cursor" is a computer term meaning pointer or place-marker on the computer terminal screen.

[3] At a restaurant, a "menu" is handed to a person to give the choices available at this time. As a computer term, "menu" refers to a list of optional choices for execution at the current "state" of a computer program. In the Mark II system, the operator is also prompted with menus of possible data values.

advance either vertically or horizontally. If the operator had to type in the actual data values for the 780 data points, this would require approximately 4,000 keystrokes, and would be very error prone. This system requires only 785 keystrokes from a very limited set of possible keys, and has continuous operator feedback and prompting. This gives us a much lower probability of error.[4]

To facilitate the use of the Mark II major agent control program by many different operators and data base builders, a menu driven system was implemented. The menu creation and updating, as well as the interactive data entry system described above, required extensive screen manipulation and the use of dedicated terminal function keys. The program's screen manipulation was implemented through the Unix screen handling routines developed at the University of California at Berkeley.[5] These routines in turn use the Termcap Library from Berkeley. This code is highly portable. Display terminals of different models and by different manufacturers generally have a unique and complex series of codes for addressing the cursor to a point on the screen, clearing the screen, switching to inverse video mode, etc. The characteristics of each terminal are described in a special language in what is called the Termcap Library. This allows the Mark II agent control program to work with some 100 different display terminals.

The Mark II Matching Algorithm

The Mark II major agent control system has two separate matching algorithms, selected by the operator at run time. Only the first of the

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[4] For details of the data entry design, and for sample menus, see Appendix A.

[5] Kenneth Arnold, "Screen Updating and Cursor Movement Optimization: A Library Package," Computer Science Division, Department of Electrical Engineering and Computer Science, University of California at Berkeley, California, 1981.

two algorithms existed during the initial Mark II exercises, so the second algorithm has been experimented with only recently (after January 1983).

The first algorithim is very simple, contrasting sharply with the Mark I Red control system. First the program looks for an exact match. An exact match can sometimes be achieved during the "branched script" mode of operation. If there is no exact match, the program looks for the number of differences between the "current situation" and all the "candidate situations" in the data base being used. The program simply counts the differences. If there are any data base entries with the same locations of conflict (first column of the Scenario Tableau), those are considered first. Other than this, there is no weighting of any kind. In other words, location of conflict differences count more than all other variables combined, and all the other variables count equally. The best four matches, and the number of differences, are displayed by the program.

This simple algorithm served our needs for the preliminary branched script mode of operation with a limited scope of situations. However, a more powerful matching algorithm was occasionally needed. This need, and other applications of the control program discussed below, prompted us to develop a more sophisticated matching algorithm that can be "switched in", when appropriate, to replace the simplistic match algorithm described above. This algorithm assigns weights to each row and column of each tableau. The weight tables are specific to the Ivan or Sam data base. They are determined by the data base developers.

Weights are multiplied for each row and column to determine the product weight for each data point in each tableau. Thus in the first tableau, Algeria might have a weight of 4, and Location of Conflict might have a weight of 100. The product of these is 400. Any difference in this data point would be multiplied by 400. These numbers are added for all data points to achieve a weighted sum. The weighting could thus be called a "least weighted error". This is similar to the "least squared error" used in standard linear regression, with the

exception that we do not square the error, but only take its absolute value. The weights can be either cardinal or ordinal. If they are cardinal, a difference in a data point is considered a full scale error, which is assigned the value ten. If the weight is ordinal, the error is the difference between the actual data point value and that in the data base. For example, cardinal weights have been used on the continuim of Red-Firm, Red-Mod, Red-Soft ... White ... Blue-Firm. If the current situation has that data point as Red-Firm, and the data base candidate situation shows a value of Red-Soft, the difference is two. Two is then multiplied by the weight for this data point, and added to the summed "difference score".

It should be emphasized that this second weighting algorithm has been used only experimentally. The first, simpler algorithm was used in the 1982 exercises.

The Mark II Control Program in RSAC Gaming

The best way to illustrate of the role of the major agent control program in an automated game is to describe a typical move sequence. The analytic question being pursued is first translated to an initial set of world conditions by the Analyst of Record, with the assistance of the Scenario and Force Agents. The Analyst of Record also specifies which Ivan will play against which Sam (data bases), and which major agent will make the first move. In this example, Red will move first. Scenario then automatically generates the Scenario Tableau, which outlines the state of 57 countries and subnational entities. At the same time, Force generates the four Force Tableaux by a combination of automatic modeling and human input. These five tableaux from Scenario and Force are then automatically sent to the Red Agent, and parsed by the major agent control program. This is the only input necessary for Red to run a "match" and find an action instruction. The Red operator then reads any conditionals and implements the move.

The conditionals may involve looks-ahead. The simplest form of look-ahead is a "what if" question to Force. More complex looks-ahead involve all the agents. In this way the major agents can "see into the future". To achieve a look-ahead with "Red's view of Blue" the real Blue operator is actually involved. However, he is instructed to use a special Blue data base, which is, say, Ivan-1's Blue. This data base is developed alongside Ivan 1.

When the Red operator selects the appropriate conditionals, he can implement the move by telling the Systems Monitor what he is doing. Systems Monitor in turn gives Force, Scenario, or Blue any information they should receive. Scenario and Force then update their computer models and send Blue the tableaux for his move, and so forth.

The Mark II Control Program Used for Other Applications

The Mark II control program is a general software system for building data bases of qualitative data, and evaluating the "closeness" of one entry to another. As such, it is useful for capturing expert opinion about many different topics in a clearly defined form that can be critiqued by other experts. This information can then be used without the expert's presence. The program's operation also offers repeatable results.

We have discussed within the project the possibility of using the Mark II control program with different tableaux and data bases to fill in the gaps in the coverage of our Force models. Sample applications might be air interdiction of ground lines of communication, or antisubmarine warfare. The procedure for bringing up such an application might be as follows:

1. Identify experts in this field.
2. Have these experts identify the important features of a situation to be able to predict its outcome.

3. Build a "template file" to set up the Mark II control program to form tableaux that cover the features identified in "2." above. This is done in a simple specification language. This file is read in by the program at start-up time. None of the Red/Blue tableau format is "hard-wired" into the program. If the application requires five or fewer tableaux, the program need not even be recompiled.
4. Go back to the experts with the tableaux. Ask them to describe important "situations". Ask them what the most likely outcome would be from such situations. Start building a data base of these situations. Reverse this and ask what are the major possible outcomes. Then ask what types of situations are likely to lead into each of these outcomes. Put these in the data base.
5. Ask the experts to rank the features of the situation (the tableaux) in order of greatest importance in determination of outcomes. Use this to build a match-weighting table. Use this table to experiment with more sophisticated matching algorithms.
6. Run the program in varied exercises and further refine the data base. Test the program for validity. Subject the program's behavior to review by the original and other experts.

Mark II Sets the Stage for Mark III

The Mark III major agent control system currently under design is a three-level decision making system. The Mark II system automates in a very crude way the top level, national policy and planning. The lower levels of plan implementation and battle management are handled in abbreviated form by the major agent operator, as he implements the action instructions, in conjunction with the Force Agent and system looks-ahead.

The future Mark III system will need a sophisticated user interface, possibly menu-driven. It will need data entry and editing facilities. It will also need data base manipulation, comparison, and management software. Some of the software from the Mark II system that handles these functions should find its way into the Mark III system's "front-end".

The Mark II action instructions were deliberately structured with the Mark III system in mind. Consider the following example:

```
IF
<   [   The United States has started to deploy > 1 division to Europe   ]
    OR
    [   US military forces have attacked Soviet naval forces outside
        the Indian Ocean area
    ]
>
THEN
<   [   Mobilize the WP in readiness to execute RED plan D, 15 days
        from today
    ]
    IF
    [   The United States is using Turkish air bases to attack Soviet
        forces in Iran (more than 1 TFW)
    ]
    THEN [ Initiate air attacks on military air bases throughout Turkey ]
>
ELSE
<   [   Continue campaign in Iran   ]
    AND
    [   Do not mobilize the WP   ]
>
```

The syntax of the Mark II actions was designed to be suitable for machine interpretation. The "white space" (indents, spaces) are not part of the syntax, but are simply to aid human readability. The control structures are designed like a structured programming language. The "angle-brackets", <> , are the logical delimiters (like parentheses in English). These can be "nested" for conditions within conditions. For human readability, these are generally indented by the level of "nesting". The square brackets, [], show that the text contained within is a single logical variable. Many of these variables may be directly available for testing in IF clauses, or setting in THEN clauses in the Mark III system. Some may be TRUE/FALSE, whereas others may have continuous or discrete values. The following are "keywords": IF, THEN, ELSE, AND, OR, TRUE, FALSE. Some of the logical constructs in the Mark II data bases may be translated into the format of Mark III when we are ready to begin building the Mark III rule set.

Appendix A. MARK II RED AND BLUE AGENT OPERATOR'S MANUAL

Introduction

The Mark II Red and Blue Agent Control System is run by a program called "Agent" that was developed using the "C" language under the Unix operating system. It is designed to accomplish two main objectives:

(1) To allow the operator to build up a set of data bases for the various types of Ivans and Sams by:
   (a) entering information into a set of five tableaux that describe a world situation,
   (b) entering a set of action instructions for that situation, and then
   (c) allowing the situation and action instructions to be placed in the desired data base for later use.

(2) To allow search of a data base for a situation like the current one.

These objectives are accomplished by selecting the appropriate operations from the options presented to the user. These options and their functions are covered in the subsequent sections of these instructions.

This set of instructions is organized into several sections. The main topics are as follows:

1. Introduction
2. Invoking the Agent Program
3. Agent Flags
4. Screen Formats

5. Program/User Interaction
6. Main Program Options
7. Entering Situations into the Data Base
8. The Data Base Match Options
9. Formatting Action Instructions
10. Sample Action Instruction
11. Utility Functions
12. The Procedure During a Game
13. Utility Programs

"Introduction" is this set of opening remarks.

"Invoking the Agent Program" tells how to start the Agent program.

"Agent Flags" lists the various options the user has when invoking the Agent program.

"Screen Formats" talks about the different terminal display modes that the operator will see while running the Agent program.

"Program/User Interaction" tells how the operator records his response to the questions asked by the Agent program.

"Main Program Options" describes the main functions of the Agent program, giving their functions and the questions that are asked.

"Entering Situations into the Data Base" gives the steps that are needed to enter a situation into an Ivan or Sam data base. It also discusses how to enter information into the tableaux that are used to describe the *current* world situation.

"The Data Base Match Options" describes the available options after the Agent program has searched a data base for matches.

"Formatting Action Instructions" gives some rules concerning the formatting of action instructions.

"Sample Action Instruction" illustrates the action instruction formatting rules.

"Utility Functions" describes the options that are available as utility functions.

"The Procedure During a Game" gives a series of steps and options that may be used to complete a move during game operations. It attempts to tie together all of the earlier sections, showing how all the pieces fit together.

"Utility Programs" talks about the various utility programs that have been written to support the Agent program.

Invoking the Agent Program

There are certain environment variables that need to be initialized for the Agent program to run properly. This is done for the operator with "Cshell scripts". The operator should invoke the Agent program from the Unix command level using the script names: red or blue, followed by the desired flags.

For example, the operator would type: % red -dbnum 1 to run as the Red Agent using IVAN(1) for the initial data base.

All of the flags listed in the Agent Flags section below work with these Cshell scripts for invoking the program.

If another operator is running Agent, the program will tell the operator he cannot run it at the same time, and terminate. This is true for either Red or Blue. One operator running with the -multi-agent flag occupies both Red and Blue. This is to prevent two operators from writing to the data base at the same time.

If something very unusual happens, like a system crash or program interrupt, the Agent program may "think" another operator is running it, when this is not the case. The system program "w" should be executed. It lists the programs that are running for each person on the system. This way, the operator can verify the accuracy of the program's statement and contact the other operator to ask him to exit the program so it can be used. If the operator finds that no one is running "agent", he may execute another program called "fix," that will eliminate the problem. The operator should be careful not to execute

"fix" unless he is certain no one else is running Agent, as doing so puts the data base in danger of corruption.

Fix is also useful to reset terminal characteristics in the event of a system crash or program interrupt. In these cases, the terminal's characteristics may be left altered where nothing is echoed. The operator's terminal may also be reset by typing "aaa 30" if the terminal is an Ann Arbor Ambassador, or by typing "oldann" if the terminal is one of the older Ann Arbor terminals.

Agent Flags

The Agent program has a number of flags that affect its operation. These flags follow the word "red" or "blue" on the command line. The flags may be entered in either upper or lower case letters. The program uses the minimal number of characters when checking the flags. Thus, for most of the flags, the operator need only type the minus sign followed by the first letter. The exceptions are:

1. The operator must type the first two letters of the data base number (-dbnum) and the dump (-dump) flags, since both of these flags begin with the letter "d".
2. The test (-test) flag must be fully typed out to prevent the program from accidentally being placed in the test mode.

The flags and their meanings are as follows:

Data Base Flags:

-blue:	**Operator is the Blue Agent.**
-red:	**Operator is the Red Agent (default).**

-multi-agent: Operator will run as a "multi-agent," which allows him to WRITE to either the Red or Blue data bases (Ivans or Sams). This flag is used for building the data bases. (The default is off.) Without this flag the operator can still read from both Red and Blue data bases.

-dbnum #: Set the initial data base number to be #, where # is a number in the range 0 through 6.

-auxiliary f: Run the Agent program in an auxiliary mode using "f" as the Agent's tableau template file.

Data Entry Flags:

-vertical: Automatic vertical (down) movement of cursor as data is entered into the tableaux

-horizontal: Automatic horizontal (right) movement of cursor as data is entered into the tableaux

-no-move: No automatic movement of cursor as data is entered into the tableaux (default).

Logging Flags:

-write-log: Record in the log file all changes to current branch, the current move, additions to the data base, and searches of the data base (default).

-logging-off: Do not log any of the above transactions.

Terminal Flags:

-old-annarbor: Operation with the old Ann Arbor terminals of Rand, or any other terminal without Inverse Video or other highlighting.

Special Flags:

-print-tables: Send to the "standard output" blank tableaux suitable for printing. These are useful for recording new situations that are to be entered by an operator at a later time. This option can be used as:

```
% agent -blue -print-tables > printfile
% print -laser printfile
```

This can also be accomplished by executing the Print_tables program. (Refer to the section on Utility Programs for further information.)

-dump #: Dump the specified data base (where # is a number in the range 0 through 6) for either: Red (default) or Blue (by specifying -Blue prior to the -Dump command). This function can be accomplished by selecting the dump data base utility option or by executing the Dump program. (Refer to the sections on Utility Functions and Utility Programs for further information.)

-test: Special program diagnostic mode (not useful to an operator).

Screen Formats

The Agent program uses three different screen formats or terminal display modes. While the Agent program is running, the screen is usually subdivided into one or three main sections. The different display modes and their subdivisions are given below:

1. The option display mode. The screen is subdivided into three sections (called "windows") as follows:
   (a) option list heading (the top 5 to 7 lines).
   (b) The numbered list of options (the middle section of the terminal).
   (c) The prompting area where the program's questions and operator's answers will appear (the bottom 4 lines).
2. The tableau entry mode. The screen is subdivided into three sections as follows:
   (a) The tableau heading (the top 5 lines).
   (b) The tableau data (the middle section of the terminal).
   (c) The list of possible data options for the current row and column of the tableau, or the candidates for the compare table options (the bottom 4 lines).
3. The full screen display mode. This mode is used for displaying action instructions or lists of situation IDs.

Program/User Interaction

The Agent program has three main modes of program/user interaction: option input, responses to questions asked by the Agent program, and changing the tableaux that define the world situation.

In the option input mode, the operator types the number corresponding to the desired option followed by a <RETURN>. The typed input is checked to be sure it falls within the range of specified

option numbers. If it does, then the program performs the specified option, otherwise it prints an error message and waits for further input.

When the Agent program has a question, it expects the user to enter his response followed by a <RETURN>. These questions may ask for a file name, a situation identification, or simply a yes or no response. In the cases where the answer to a question is either a yes or a no, the operator need only type a "y" or an "n". This is true because the program looks only at the first letter. This also means that anything that begins with a "y" is interpreted as a yes response and anything that begins with an "n" is interpreted as a no response.

While working with the tableaux that define the world situation, the user need not type a <RETURN> after his data entries, since the program is looking for a single key response. Thus, he need only type the numbers that indicate the correct data entry for the current row and column within the tableau, or press one of the special function keys. These function keys allow the user to (1) move from one tableau to the next, (2) move the cursor around within the current tableau, or (3) return to the previously displayed list of options.

The user may picture the Agent program as having a hierarchical structure that starts "at the top of the program" and then moves "down in the code" as he selects different options. When the Agent program first begins, it presents the user with the "main program options" (described in a subsequent section). When certain options are selected, such as the Utility Functions, Searching the Data Base for Matches, or the Change Tableau options, the program moves to a lower operation level. The program will remain at the lower operation level until the user indicates that he is finished by: (a) selecting the Quit option or (b) hitting the <Home> function key or typing the letter "h" (when working with the tableaux).

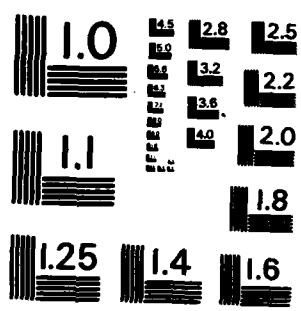
On occasion the screen may become disturbed making certain portions of it unreadable. This may be caused by static electricity, hardware failures, or other occurrences, such as having another Unix user write

AD A107 000 THE MARK II RED AND BLUE AGENT CONTROL SYSTEMS FOR THE RAND STRATEGY ASSESSMENT CENTER(U) RAND CORP SANTA MONICA CA W M JONES ET AL JUN 81 RAND/N-DCR-DNA

UNCLASSIFIED DNA001-80-C-0208

F/G 15/7 NL

22



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

to the screen. In these cases, the operator should select the "Redraw Screen" option (if the "Select Option" prompt was displayed), or he should press the <Replc> function key or type the letter "R" (if he was working with the tableaux). If the operator selects either the Redraw Screen option or the <Replc> function, then the program will redraw the information on the screen.

The values for the Quit and Redraw Screen options are the same for all the option lists.

Main Program Options

Below is a reproduction of the screen the operator sees when the Agent program is first invoked:

```
                    Red Agent 2.1 (12 July 1982)

          1 -> Quit
          2 -> Redraw Screen
          3 -> Utility Functions
          4 -> Change the Current Branch          ( none)
          5 -> Read in a New Base Situation       (      )
          6 -> Change the Current Situation Name  ( none)
          7 -> Change to a Different Ivan         (Ivan0)
          8 -> Change from Ivan to Sam, or Sam to Ivan
          9 -> Read in Tableaux from Another Agent
         10 -> Change Tableau 1:   SCENARIO SITUATION
         11 -> Change Tableau 2: * SEA SITUATION
         12 -> Change Tableau 3:   THEATER COMBAT SITUATION
         13 -> Change Tableau 4: * COMBAT CONDITIONS (WEAPONS/TARGETS)
         14 -> Change Tableau 5: * LONG RANGE NUCLEAR FORCES STATUS
         15 -> Search the Data Base for Matches
         16 -> Edit the New Action Instruction
         17 -> Show the Current Action on the Screen
         18 -> Send Tableaux to Another Agent
         19 -> Log the Current Situation and Action as the Current Move
         20 -> Add the Current Situation and Action to the Data Base

Select Option: _
```

Main Option 1 (Quit) allows the operator to leave the Agent program. The program first asks if the operator is sure he wants to exit. If the response is yes, then all open files are closed and the current state of the situation is saved in a special file. The program then exits, returning the operator to the Unix command level.

Main Option 2 (Redraw Screen) corrects the problems caused by static electricity or other unusual occurrences that might disturb the screen.

Main Option 3 (Utility Functions) provides access to the utilities that may be useful while running the Agent program. These functions include showing all the situation names in a data base, showing all the situation identifications in a data base, and clearing all the data in the tableaux. (See the section on Utilities for further details.)

Main Option 4 (Change Current Branch) enters a new name for the Current Branch in the log file. Main Option line number 4 displays the Current Branch's name in parentheses. During a recorded exercise, this should be done right after starting the program, and at the beginning of each move.

Main Option 5 (Read in a New Base Situation) reads in a situation from the data base. The operator must know the name of a situation before he will be able to read it in. This list can be obtained by selecting the appropriate utility function. (Refer to the section on Utilities for details.) Once the base situation has been read into memory, main option line number 5 will display its name. The Current Situation name will also be changed to the name of the base situation. This is done so the situation name will be accurate if the Print Situation option is selected. This option clears all the tableaux before reading in the data.

Main Option 6 (Change Current Situation Name) names the Current Situation. Main option line number 6 displays the name of the Current Situation in parentheses.

Main Option 7 (Change to a Different Ivan/Sam) changes the number of the data base used (0, 1, 2, ... 6) for the current Ivan or Sam data base. The initial data base number for both Ivan and Sam is 0 unless it is set using the -dbnum # flag when the Agent program was invoked. Main option line number 8 displays the name of the current Data Base in parentheses. (Refer to the section on program invocation for further details.)

Main Option 8 (Change from Ivan to Sam, or Sam to Ivan) changes the operator's data base to the other color. The operator may only READ from the other color's data bases (i.e., Read in a Base Situation, and Search the Data Base for Matches) unless the operator invoked the Agent program with the -multi-agent flag. Thus, the Agent program will not allow the Red Agent to add his current situation and action instructions to any of the Sam (i.e., Blue) data bases, but it will allow him to read situations and use the Match options on the Sam data bases. Main Option 8 displays the name of the current data base in parentheses.

Main Option 9 (Read in Tableaux from Another Agent) allows the operator to read in tableau information from either Scenario, Force, or the other Red or Blue Agent. It asks from whom the operator wants to receive the Tableaux and then asks for a file name. It will then read the appropriate tableaux from that file. This option clears tableau 1 before reading the Scenario tableau, tableaux 2 through 5 before reading tableaux from Force, and tableaux 1 through 5 before reading tableaux from Red or Blue. Scenario usually puts its data in a file that is named as follows: "/r/red-agt/T/<current- branch>". Force, Red and Blue place their tableaux in files that are named: "/r/red-agt/T/<current-branch>" followed by a ".r" or a ".b". The ".r" indicates the file is destined for the Red Agent and the ".b" indicates the file is destined for the Blue Agent. The appropriate default file name is supplied by the program if the operator enters a file name of "/".

Main Options 10 through 14 (the Change Tableau options) enable tableau data entry, and are described in the next section. The asterisks next to the tableau numbers show that the operator has changed data in that tableau since it was last cleared or read in from a data base or the from another agent.

Main Option 15 (Search the Data Base for Matches) searches the current data base for similar situations. The current data base is listed with Option 7 (Change to a Different Ivan/Sam). It then allows the operator to compare and examine the four closest situations and their associated action instructions. The operator may use the various

candidate's action instructions to build an action instruction for the current situation.

Before searching the data base for similar situations, the operator must fill out the tableaux describing the situation and enter a current branch (unless logging was turned off via the -logging-off agent flag). The tableaux data may be entered through a combination of:

1. "Change Tableau" options (Main Options 10-14), that allow changing individual entries within the tableaux.
2. "Read in a New Base Situation" (Main Option 8), that loads in the tableaux and action instructions from a data base.
3. "Read in Tableaux from Another Agent" (Main Option 11), that replaces the contents of tableau 1 with a file from Scenario, or the contents of tableaux 2 through 4 with information from Force, or the contents of tableaux 1 through 5 with information from the other "major agent".

   (See the section on the Data Base Match Options for further details concerning the options available to the operator.)

Main Option 16 (Edit the New Action Instruction) uses the Rand Editor, "e", to create or edit an action instruction for the current situation. This invokes the Rand editor on a special file. The operator should create and edit this file.[1]

Main Option 17 (Show the Current Action on the Screen) uses the system program "more" to show the operator the current action. If the action spans more than one screen, then "more's" prompt will display the

[1] (See Robert Grotz, "The Rand Editor, E", Rand Computation Center, for details on how to use the Rand editor). For further details concerning creating action instructions, refer to the sections "The Data Base Match Options" and "Formatting Action Instructions".

percentage of the file (the action) shown thus far. Useful commands while in "more" are:

```
:p      - goes to top of the action instructions
/exp/   - searches for a string or regular expression (see ed(1))
CTRL-D  - scrolls forward 16 lines
<space> - scrolls forward one screen
<del>   - quit looking at the action.
```

Main Option 18 (Send Tableaux to Another Agent) creates a file of tableaux that is readable by Force, Red, or Blue. This allows the different agents to send information to and from each other. The program asks which agent to send the file to, and then for the file name. The appropriate default file name is supplied by the program if the operator enters a file name of "/".

Main Option 19 (Log the Current Situation and Action as the Current Move) records the current situation and action in the log file. Situation logging occurs whenever the operator searches the data base for matches or adds a situation and action to the data base. Both the tableaux and the action instructions are logged when a situation is added to the data base. However, the program logs only the tableaux when the data base is searched, since the action instructions may not yet be defined. Thus, it is important that the operator log the current move after every move is completed. Otherwise, there may not be a record of the decisions that were made during a session.

When the operator asks for the current move to be logged, the program checks to be sure that logging is enabled. If it is, the logging is performed. Otherwise the program asks the operator if he really wants to log this move. If he does, then only this move is logged. (See the section on Utility Functions for information on how to turn the logging function on or off.)

Main Option 20 (Add the Current Situation and Action to the Data Base) adds a situation to the data base. It is programmed to require a situation name (other than "none"), and a set of action instructions

before it will allow the addition. If the data base already has a situation with the same name, the program will give the operator the option of replacing the situation in the data base with the current situation. If the operator indicates that this is his desire, then the existing situation is saved in a special back-up file and the new situation is added to the end of the data base file. An action instruction may be entered via Option 16 or by using the options available after searching the data base for matches. After a data base addition, the Current Situation name is copied to the place for the Base Situation name. This is done to record the previous situation name in case a new situation will be developed from the existing tableaux and action instruction.

Entering Situations into the Data Base

The operator may enter situations into the data base by using the five steps given below:

1. Update the name of the current branch (only if logging is activated).
2. Specify a situation name for the new situation.
3. Fill in the tableaux that define the situation.
4. Enter an action instruction.
5. Add the situation and action to the desired data base.

Step 1: To update the name of the current branch, the operator selects the Change the Current Branch option (4). He is then asked for the name of the current branch. The current branch is automatically entered into the log file if the logging option was not turned off via the -logging-off flag when the Agent program was invoked. (Refer to the section on program invocation for further details.)

Step 2: To specify a situation name for the new situation, the operator selects the Change the Current Situation Name option (6). He is then asked for a situation name. The operator must enter a unique name since it is checked to be sure it is not already in the data base before it is accepted.

Step 3: To fill in the five tableaux that define a situation, the operator types the Change Tableau option 10-14 for the tableau he wishes to fill in. This brings the operator to another display showing the tableau's current data. The tableaux are initially blank unless the operator has read a situation from the data base, or situation information from another agent. The operator may then enter the appropriate data items in the tableau.

The Agent program prompts the operator at every tableau location by displaying a list of possible data items. The program displays the list of data items at the bottom of the screen. Each of the data items has an associated number. To enter a data item, the operator need only type the number corresponding the the selected data item (no <RETURN> is necessary). The cursor will remain at the same tableau location unless the program has either automatic vertical or horizontal movement activated. (Automatic vertical or downward movement may be accomplished by invoking the Agent program with the -vertical flag. In a similar manner, automatic horizontal or left-to-right movement may be accomplished by invoking the Agent program with the -horizontal flag. Refer to the section on program invocation for details.) These cursor movement flags may also be changed via the "Change Auto-Advance Data Entry Mode" option in the Utility Functions.

The right key pad serves to: (1) move the cursor within the tableau, (2) move the operator to later pages of the current tableaux, (3) move the operator to other tableaux, and (4) move the operator back to the list of program options given in the previous section.

The special keys and their functions in editing the tableaux are as follows:

Ann Arbors	Other Terminals	Function
<Up Arrow>	u	Move up one row.
<Down Arrow>	d	Move down one row.
<Left Arrow>	l	Move left one column.
<Right Arrow>	r	Move right one column.
<+Sch>	N	Next screen of this tableau.
<-Sch>	P	Previous screen of this tableau.
<+Page>	n	Next tableau.
<-Page>	p	Previous tableau.
<Replc>	R	Redraw screen.
<Home>	h	All done. Return to previous option list.

The operator may use standard keyboard letters instead of the function keys to move the cursor around, change tableaux, and so on.

Step 4: To enter a new action instruction, the operator should return to the Agent program's option list using <Home> or "h". The operator is then faced with the choice of:

1. Building an action instruction from existing action instructions within a data base using the Match options. The operator has access to the Match options after selecting the "Search the Data Base for Matches" (Main Option 15). (See the section on "The Data Base Match Options" for further details.) Alternatively, the operator can reach the Match options without searching the data base via "Utility Functions" (Main Option 3).
2. Creating an action instruction using the Rand editor (the Edit the New Action Instruction, Option 16.)

Step 5: The operator may add a situation and action to the data base by selecting Main Option 19. Before the addition request will be accepted, the operator must have entered a Current Branch (if logging), a situation name, and an action instruction.

The Data Base Match Options

Once all the tableaux are complete, the operator may Search the Data Base for Matches (Main Option 15). This loads the tableaux for the four closest situations into memory. The operator is then given the results of the data base search and a list of Match Options. The results from a data base search and the list of Match Options follow.

```
Cand.#   Situation Name   Description
------   --------------   --------------------------------
  0      RB361            Current Situation
* 1      RB533            Is an Exact Match
  2      RB1me            Candidate with a score of   3.161
  3      RB301me          Candidate with a score of   3.164
  4      RB200me          Candidate with a score of   3.371

   1 -> Quit
   2 -> Redraw Screen
   3 -> Utility Functions
   4 -> Change the Current Candidate (RB533)
   5 -> Replace Candidate 4 with any Situation from the Data Base
   6 -> Examine Candidate's Tableau 1: SCENARIO SITUATION
   7 -> Examine Candidate's Tableau 2: SEA SITUATION
   8 -> Examine Candidate's Tableau 3: THEATER COMBAT SITUATION
   9 -> Examine Candidate's Tableau 4: COMBAT CONDITIONS (WEAPONS/TARGETS)
  10 -> Examine Candidate's Tableau 5: LONG RANGE NUCLEAR FORCES STATUS
  11 -> Compare Candidate's Tableau 1: SCENARIO SITUATION
  12 -> Compare Candidate's Tableau 2: SEA SITUATION
  13 -> Compare Candidate's Tableau 3: THEATER COMBAT SITUATION
  14 -> Compare Candidate's Tableau 4: COMBAT CONDITIONS (WEAPONS/TARGETS)
  15 -> Compare Candidate's Tableau 5: LONG RANGE NUCLEAR FORCES STATUS
  16 -> Show an Action on the Screen
  17 -> Replace or Add to the Action for the Current Situation
  18 -> Edit the Action for the Current Situation

Select Option: _
```

Match Option 1 (Quit) returns the operator to the display of the *Main options list*.

Match Option 2 (Redraw Screen) corrects problems caused by static electricity or other occurrences that can occasionally disturb the screen.

Match Option 3 (Utility Functions) provides access to utilities that may be useful while working with the Match options. These functions include showing all the situation names in a data base, showing all the situation identifications in a data base, and clearing all the data in the tableaux. (See the section on Utilities for further details.)

Match Option 4 (Change the Current Candidate) allows the operator to change the "Current Candidate". The program indicates the Current Candidate with an asterisk at the top of the screen. It is also given on Match Option 4. This is the situation that the operator is now working with. It is the implied candidate for the Examine and Compare Tableau options (see below). The Current Candidate is changed by entering the number (0 through 4) that corresponds to the desired candidate as shown at the top of the screen under "Cand.#" (Candidate Number). Zero is not allowed as the Current Candidate for the Compare Tableau options. Zero is also a special case for the Examine Tableau options, since the program allows the operator to change the tableaux for the Current Situation (Cand. # 0).

Match Option 5 (Replace Candidate 4 with any Situation from the Data Base) allows the operator to exchange Candidate 4 for any arbitrary situation. The operator may use the Utility Functions to change the data base before reading in a situation from the data base. He may then use any of the Match options such as: examining the differences, appending it's action instructions to those of the current situation, and so on.

Match Options 6 through 9 (the Examine Tableau options) allow the operator to examine the Current Candidate's tableaux. The Examine Tableau options are almost the same as the Change Tableau options in the main program options. The program allows the operator to move from tableau to tableau and from page to page within the same tableau using the special function keys. The only differences are:

1. The operator can work with 5 different situations.
2. The operator will be allowed to change the information only for the Current Situation (Candidate number 0). Data input while examining the other candidate's tableaux will be ignored.
   The special keys and their functions in examining the tableaux are as follows:

Ann Arbors	Other Terminals	Function
<Up Arrow>	u	Move up one row.
<Down Arrow>	d	Move down one row.
<Left Arrow>	l	Move left one column.
<Right Arrow>	r	Move right one column.
<+Sch>	N	Next screen of this tableau.
<-Sch>	P	Previous screen of this tableau.
<+Page>	n	Next tableau.
<-Page>	p	Previous tableau.
<Replc>	R	Redraw screen.
<Home>	h	All done. Return to match option list.

Match Options 10 through 15 (the Compare Tableau options) perform a tableau comparison between the "Current Candidate" and the "Current Situation". The Current Situation is always Candidate number 0, the situation the operator ran the search on to begin with. The program indicates the Current Candidate with an asterisk at the top of the screen. It is also given on Match Option line 4. The program compares the information given on each line of the specified tableau and displays

the lines that are different. While the program is displaying the differences between the two situations, the operator may move from tableau to tableau using the special function keys (as in the Change and Examine Tableau options). Refer to the special function keys given above. Any data entry will be ignored.

Match Option 16 (Show an Action on the Screen) asks the operator which Candidate's action he wants to see. It then uses the system program "more(1)" to show the operator the candidate's action. If the action spans more than one screen, the prompt from "more" will display the percentage of the file (the action) shown thus far. Useful commands while in "more" are:

```
:p      - goes to top of the action instructions
/exp/   - searches for a string or regular expression (see ed(1))
CTRL-D  - scrolls forward 16 lines
<space> - scrolls forward one screen
<del>   - quit looking at the action.
```

Match Option 17 (Replace or Add to the Action for the Current Situation) builds an action instruction for the current situation. It allows the operator to create the current situation's action instructions from the instructions of one or more match candidates. The operator is asked if he wants to do a replacement or simply add to any existing instructions. If the operator elects to replace the current situation's action instructions, then the program will over-write any existing information with the instructions from the specified match candidate. Adding to the current action causes the program to take a candidate's action instructions and append them to the end of the Current Situation's action instructions. Candidates 1 through 4 may be used in either case. The operator may use this option several times to add several candidate's action instructions to the current set of instructions. The operator may then use Match Option 19 to edit the action instructions and create the Current Situation's action instructions from pieces of several actions.

Match Option 19 (Edit the Action for the Current Situation) uses the Rand Editor, "e", to create or edit an Action Instruction for the current situation. This invokes the Rand editor on a special file. The operator should create respond with a "y" if the editor asks to create this file.

Formatting Action Instructions

The following gives the format rules and a sample set of action instructions. The format rules are defined as follows:

The first line should contain:

1. 2 spaces followed by the situation ID (ID followed by a colon, a space and the identification.
2. The title of the current data base (e.g., SAM(1) FORWARD DEFENSE).
3. The current time/day of the war (e.g., D+37). This is a comment for the convenience of the data base builders. It represents the most likely relative time in a war when this situation might come up.

The Situation section has a heading indented 3 spaces followed by one or more paragraphs of text indented 8 spaces (the first tab stop).

The General Instructions section has a heading indented 3 spaces followed by a list of countries or areas. The country/area name is indented 8 spaces (one tab stop) and prefixed by a letter in parentheses. The actual instructions begin 2 spaces after the colon, lining up 2 spaces after the longest name where possible.

---

[2] See Grotz, op.cit.

The Special Instructions section has a heading indented 3 spaces followed by "structured English" text that is indented 8 spaces (one tab stop). Each new item within the "structured English" text begins 4 spaces in from the last.

Thus the IF, THEN and ELSE words start at column 8, as do their corresponding angle brackets (i.e., '<', '>'). The operator should indent the text 4 spaces from the angle bracket (3 spaces plus the '<') to the 12th column, preceded by an open square bracket (i.e., '[') and 3 spaces. Thus it should line up on the 16th column. Text should be terminated by a closing square bracket (i.e.,]) on the same line (if the text does not span more than one line) or in the same column as the opening square bracket. The operator may find it helpful to set extra tabs at the 12th, 20th and 28th columns by typing "<CMD> tab 13 21 29" (e adds one to the column number). The operator may find it sufficient to set an additional tab stop at only the 12th column (i.e. "<CMD> tab 13"), however, the 20th and 28th columns are useful for IF-statements within IF-statements.

The only exception to the indent 4 rule is when it is possible to fit an entire IF, THEN, or ELSE statement on one line. In these cases, the angle brackets are not necessary. Thus, the operator should place the square bracket that delimits the text four spaces from the IF and two spaces from the THEN or ELSE, and follow it with 1 space. This way the text still lines up in column 16.

If it is necessary to have an IF-THEN-ELSE within an IF statement, then simply indent 4 spaces to where the square bracket would be and then continue.

Refer to the example below.

The Rationale and Housekeeping sections have headings indented 3 spaces followed by one or more paragraphs of text indented 8 spaces (the first tab stop).

Sample Action Instructions

ID: B15 SAM(1) FORWARD DEFENSE D+37

SITUATION:

In the context of a nuclear war in Europe (arising from an escalation of a conventional conflict) BLUE detects the launching of numerous RED ICBMs, SSBNs and strategic LRA.

GENERAL INSTRUCTIONS:

(a) NORTH SCANDINAVIA: Continue nuclear attacks on RED forces
(b) CENTRAL EUROPE: " " " " " "
(c) SOUTHERN EUROPE: " " " " " "
(d) MIDDLE EAST: " " " " " "
(e) SINO-SOVIET BORDER: Conditional (see below)
(f) FAR EAST: Initiate (or continue) nuclear attacks on RED
(g) NAVAL FORCES: Continue nuclear attacks on RED naval forces
(h) LONG RANGE NUCLEAR FORCES: etc.

SPECIAL INSTRUCTIONS:

```
[   Do a Force look-ahead ...edited to save space... ]
IF
<   [   Sufficient time-to-RED-ICBM-impact remains ]
    AND
    [   ABM protection of BLUE ICBMs is inadequate to insure survival]
>
THEN
<   [ Launch BLUE ICBMs immediately (LUA) ]
    IF  [   the USSR is a launch area for nuclear attacks ]
    THEN
    [   attack RED MR/IR bases in Transcaucasus and RED forces in
        SWA
    ]
>
```

```
    ELSE
    [   Ride out the initial RED attack and launch afterward, using
        any "empty hole" information available
    ]
    IF    [ RED asks for cease-fire ]
    THEN  [ accept ]
RATIONALE:
    The conditional nature of the ICBM launch order is designed to fit
    alternative BLUE ICBM basing and protection postures....
HOUSEKEEPING:
    Suggest a time advance of no more than 10 hours to next BLUE move.
```

Utility Functions

If the operator selects Utility Functions (Option 3) from the list of main options or match options, then the Agent program will clear the screen and display the list of utility functions shown below.

```
Red Agent 2.1 (12 July 1982)

Utility Functions

 1 -> Quit
 2 -> Redraw Screen
 3 -> Change to a Different Ivan        (Ivan0)
 4 -> Change from Ivan to Sam, or Sam to Ivan
 5 -> Show all the Situation Names in the Data Base
 6 -> Show a Summary of all Situations in the Data Base
 7 -> Dump all the Situations in the Data Base
 8 -> Change the Auto-Advance Data Entry Mode
 9 -> Turn Logging On or Off
10 -> Clear Data in all Tableaux
11 -> Print the Current Situation and Action
12 -> Restore Saved Situation and Action
13 -> Delete a Situation from the Data Base
14 -> Move to the Match Options without Searching the Data Base

Select Option: _
```

Utility Option 1 (Quit) returns the operator to the list of options that were displayed when the Utility Functions Option was selected.

Utility Option 2 (Redraw Screen) corrects problems caused by static electricity or other occasional disturbances to the screen.

Utility Option 3 (Change to a Different Ivan/Sam) changes the number of data base used (0 through 6) for the current Ivan or Sam data base.

Utility Option 4 (Change from Ivan to Sam, or Sam to Ivan) changes the operator's data base to the other color.

Utility Option 5 (Show all the Situation Names in the Data Base) displays all the situation names in the current data base on the

operator's screen. The operator may find this helpful in determining which situation to read from the data base (using the Read Base Situation option), or when selecting a name for a new situation.

Utility Option 6 (Show a Summary of all Situations in the Data Base) runs a program, lds, that will create two files of situation IDs for the current data base. The current data base is shown on utility option line number 3: "Change to a Different Ivan/Sam". The operator may use Utility Options 3 and 4 to change to the desired data base as needed.

The files created by lds contain: (1) the situation ID, and (2) the first three lines from the associated set of action instructions (if they were not blank). These three lines should give the situation ID as found within the action instructions, the data base name and the time/day. The first file is unsorted and gives the situations as they were added to the data base (useful for showing the most recently added situations). The second file is sorted by the situation ID.

Once these files have been created the program will ask the operator if he wants to see them on his screen, print them at the Rand Computation Center on the laser printer, or send them to the Observer terminal (which is generally a local printer at the RSAC). It is also possible to run the lds program from the Unix command level. (See the section on Utility Programs for details.)

Utility Option 7 (Dump all the Situations in the Data Base) performs a dump of the current data base using the program Dump. (The current data base is given on utility option line number 3: Change to a Different Ivan/Sam. The operator may use Utility Options 3 and 4 to change to the desired data base as needed.)

Dump creates a file of situations in chronological order (i.e., the order they were entered into the data base). The action instructions are given before the tableaux for each situation. The operator is then given the option of printing the file at the RCC on the laser printer and deleting the file. This process takes a long time (especially if the data base is large, as most of them are). It creates a large file

that should usually be deleted. The file is also expensive to print, so this function should be selected with care. It is also possible to dump a data base from the Unix command level. (See the section on Utility Programs for details.)

Utility Option 8 (Change the Auto-Advance Data Entry Mode) allows the operator to change the settings of the flag that controls whether the cursor moves when data is entered into the tableaux. The cursor movement options are as follows:

Vertical:	Automatic vertical (downward) movement of the cursor.
Horizontal:	Automatic horizontal (left-to-right) movement of the cursor.
No-move:	No automatic movement of cursor as data is entered.

Utility Option 9 (Turn Logging On or Off) allows the user to change the logging flag so that logging is either activated or deactivated. The program prints the current state of the logging flag and then asks if the operator wants to change it.

Utility Option 10 (Clear Data in all Tableaux) clears all the data in all the tableaux (changes the data values to blanks). The operator may find this helpful after he has put something in the tableaux (using the Change Tableau options, the Read Base Situation option or the Read in Tableaux from Another Agent option) and wants to start fresh with manual entry. The Read in a New Base Situation option clears all the tableaux before reading in data. The Read in Tableaux from Another Agent option clears tableau 1 before reading the Scenario tableau, tableaux 2 through 5 before reading the Force tableaux, and all tableaux before reading tableaux from the other major agent (Red or Blue).

Utility Option 11 (Print the Current Situation and Action) prints the situation and the associated action. The program prints the situation tableaux in a format similar to what the operator views in the Change Tableau options. The program gives the operator the choice of printing it at the RCC on the laser printer, or on the Observer

terminal. The Observer terminal is generally a local printer at the RSAC.

Utility Option 12 (Restore Saved Situation and Action) allows the operator to resume work on a situation and action instructions. The Agent program saves the current situation and action instructions in a special file whenever the program exits. This is true whether the program exited because the operator asked it to do so, or because there was a fatal error. Thus, the operator may use this function to read in the situation and action as they were the last time the program ran with the current major agent (Red or Blue). There may be occasions when the error was too severe allow the situation and action instructions to be properly saved.

Utility Option 13 (Delete a Situation from the Data Base) allows the operator to delete a situation from the current data base. The program will ask the operator for the name of the situation and then ask for verification before beginning the deletion process. The deleted situation will be saved in a special back-up file in case it needs to be retrieved at a later time.

Utility Option 14 (Move to the Match options without Searching the Data Base) moves the operator directly to the Match options. This allows the user to compare and selectively read situations from the different data bases without having to search through the data base. No logging of the current situation will be performed.

The Procedure During a Game

The following lists the steps that may be used to complete a move during game operations.

Set the Current Branch to the appropriate name using Main Option 4 (Change the Current Branch). The Agent program records any changes to the Current Branch in the session's log unless the operator turned off the logging option.

If this is the first move of a session, or the current tableaux are not accurate, the operator may choose to read in a situation from a data base using Main Option 5 (Read in a New Base Situation). Before reading a situation, the operator may want to change the data base using Main Options 7 or 8 (Change from Ivan to Sam or Sam to Ivan, or Change to a Different Ivan/Sam). The operator may also choose to list the situations in the data base using Utility Function 5 or 6 (Show all the Situation Names in the Data Base, Show a Summary of All Situations in the Data Base).

Set the name for the Current Situation using Main Option 6 (Change the Current Situation Name).

If Scenario or Force has information for the current situation, then read it in using Main Option 9 (Read in Tableaux from Another Agent).

Make whatever changes are necessary to the tableaux that define the current situation using the Change Tableaux options (Main Options 10-14).

Make any necessary changes to the data base name using Main Options 7-8.

Search the data base for matches using Main Option 15

Look at any exact matches (or close matches if there were no exact matches) using the Examine and Compare Tableau options (Match Options 6-10 and 11-15).

1. If a candidate's tableaux look similar to the current situation, then examine it's action instructions using Match Option 16 (Show an Action on the Screen).
2. If the candidate's action instructions are applicable to the current situation, then use them to build the action instructions for the current situation. This is done using Match Options 17-18 (Replace or Add to the Action for the Current Situation, and Edit the Action Instruction for the Current Situation).

3. If the candidate's tableaux are not applicable, create the current situation's action instruction using Match Option 18 (Edit the Action Instruction for the Current Situation).

Interpret and implement the action instructions.

Log the Current Situation and set of action instructions upon return from working with the match options by saying "yes" when the program asks if you want to Log the Current Situation and Action as the Current Move, or by using Main Option 19 (Log the Current Situation and Action as the Current Move).

If you had to create a new action instruction for this move, or if the current situation is well served by the matched action but the match was very distant, you may want to enter the current situation into the data base. Do so by using Main Option 20 (Add the Current Situation and Action to the Data Base). Be sure to make any needed changes to the name and number of the current data base first.

Utility Programs

The following section describes a collection of utility programs that are useful when working with the Agent program. All of these programs are executed from the *Unix command* level.

Dump

The program, Dump, performs the same function as Utility Option 7 (Dump all the Situations in the Data Base). (Refer to the section on Utility Function for details.) Dump is run with flags (like red and blue) that indicate the data base (i.e., Ivan or Sam) and the data base number (i.e., 0-6).

For example, to dump the data base for Sam(2), type: "dump Sam 2" or alternatively "dump blue 2" at the Unix command prompt. The following gives a sample interaction for creating a dump of Sam(2):

```
% dump Sam 2
Creating the Dump of SAM(2).
Blue Agent 2.1 (12 July 1982)
BLUE: Finished Dumping the Requested Database
The Dump of SAM(2) has completed.
Do you want to send the Dump of SAM(2) to the Laser Printer? y
Do you want to Delete the Dump of SAM(2)? y
```

Ids

The program "ids" is run when Utility Option 6 (Show a Summary of all the Situations in the Data Base) is selected. (Refer to the section on Utility Functions for details.) It may also be run from the Unix command level. Ids is run with flags (like red and blue) that indicate the data base (i.e., Ivan or Sam) and the data base number (i.e., 0-6).

For example, to obtain a list of IDs for Sam(2), type: "ids Sam 2" or alternatively "ids blue 2" at the Unix command prompt. The following gives a sample interaction for creating the IDs list for Sam(2):

```
% ids Sam 2
Creating the ID files for SAM(2).
The ID files for SAM(2) have been created.
Do you want to see the sorted and unsorted ID files for SAM(2) ? y
Do you want to send the ID files for SAM(2) to the Laser Printer? y
Do you want to print the ID files for SAM(2) on the Observer Terminal? n
```

Fix

The program, "fix", should be used only if something very unusual happens, like a system crash or program interrupt. In these cases the system may leave the terminal's characteristics in an altered state so that nothing echoes when the user types at the terminal. It is also possible for the program to "think" another operator is running it, when this is not the case. If another operator is running Agent, the program will tell the operator he cannot run it at the same time, and terminate. This is true for either Red or Blue. (One operator running with the -multi-agent flag occupies both Red and Blue.) The program performs this check for other Agent operators to prevent multiple operators from simultaneously writing to the same data base. The system program "w" (or, "who") should be executed. It lists the programs that are running for each person on the system. This way, the operator can verify the accuracy of the program's statement and contact the other operator to ask him to exit the program so it can be used.

If the operator finds that no one is running the program, he may execute "fix", that will straighten these problems out. The operator should be careful not to execute "fix" unless he is certain no one else is running "Agent", as doing so puts the data base in danger of corruption.

The operator may also correct the altered terminal state problem by typing "oldann" or "aaa 30" depending on the type of terminal being used. The operator should use "oldann" when working on an old Ann Arbor terminal, and "aaa 30" when working on an Ann Arbor Ambassador terminal.

All of these commands (i.e., "fix", "w", "oldann" and "aaa 30") are typed at the Unix command prompt.

Print_names

The program "print_names" prints the names of the situations in the data bases in a multiple column format. It prints the situation names that were on the screen the last time Utility Option 5 ("Show all the Situation Names in the Data Base") was used. Utility Option 5 must be selected for each data base (Ivan 0-6 and Sam 0-6) to get a fully up-to-date listing. This can be done within the Utility Functions by changing the data base name and number as needed and then selecting the "Show all the Situation Names in the Data Base" option; then exiting the Agent program; and then running "print_names". These lists can also be printed directly from the Agent program.

Print_tableaux

The program "print_tableaux" prints the "blank" formats and the possible data values for each of the tableaux that used to define the situation. It then sends the file, tableaux.p, to the laser printer. The blank tableaux are useful for hand-writing new situations that are to be entered by an operator at a later time.


DAT
FILM


DAT
FILM