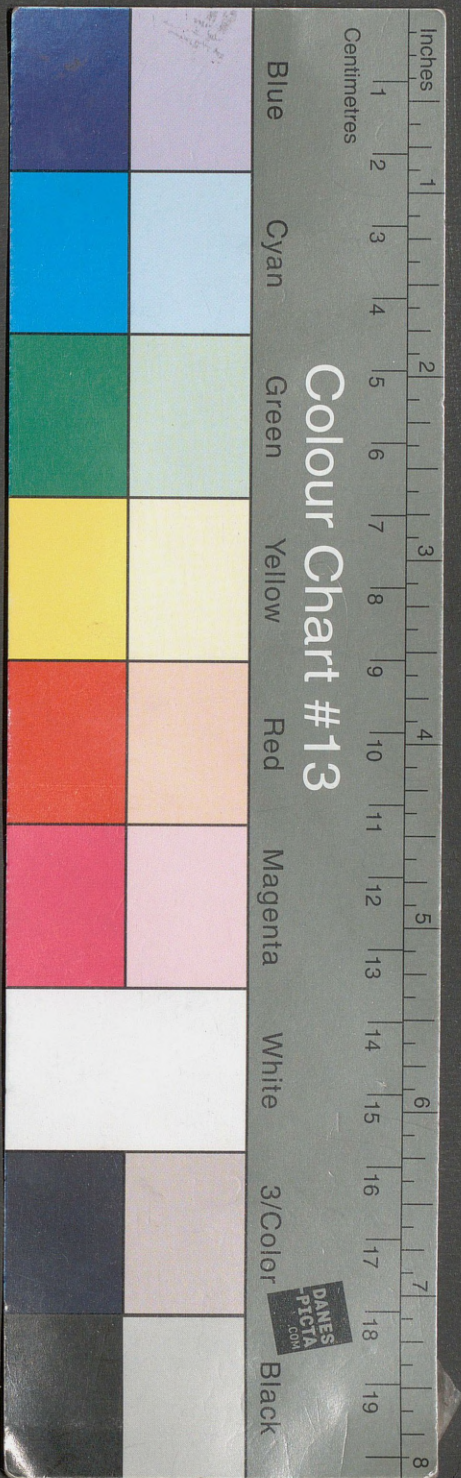
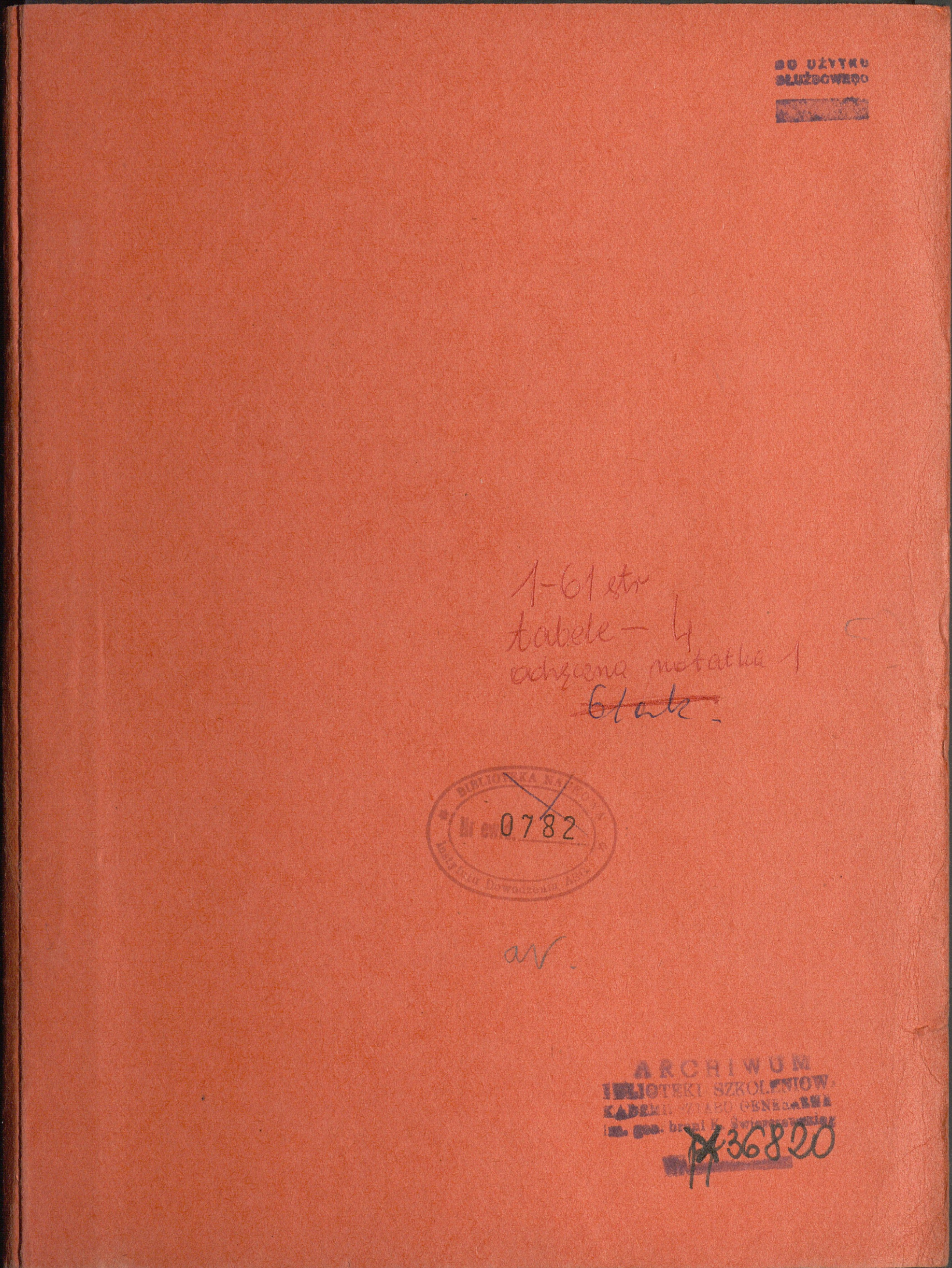
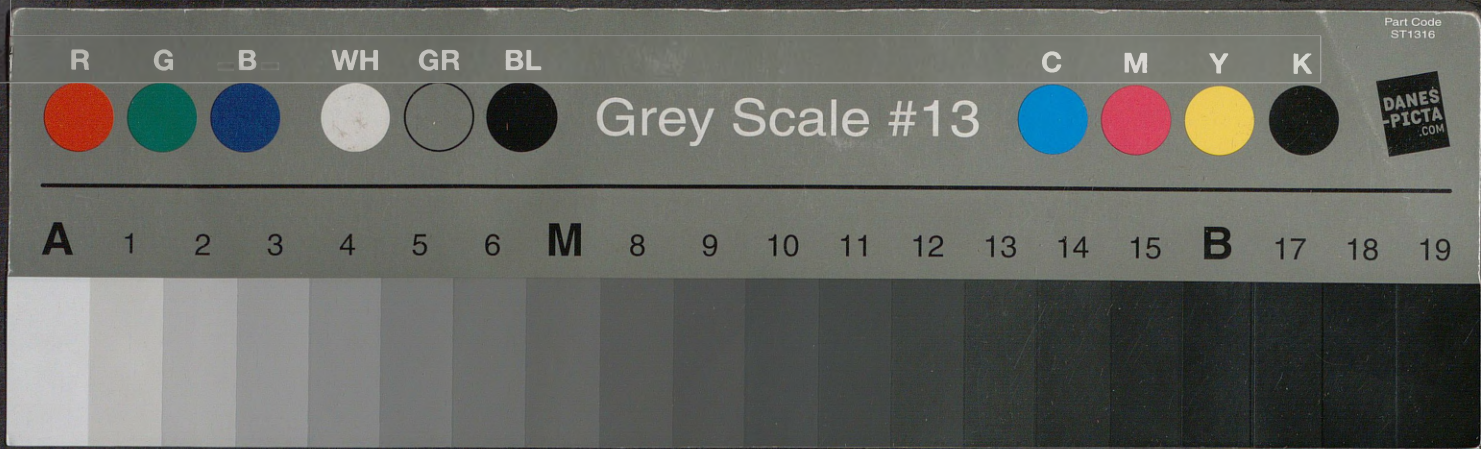




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dotycząca pracy pt. "Simulating International Conflict."

Praca ta dotyczy porównania ze sobą trzech modeli symulacyjnych konfliktów międzynarodowych z wykorzystaniem elektronicznych maszyn cyfrowych. Bardzo ogólnie schemat modelowania konfliktów międzynarodowych przedstawia się następująco.

Niewielkie grupy ludzi grały rolę rządów takich krajów, jak USA, ZSRR i NRF. Zakładano różne sytuacje polityczne i badano, jakie w danych sytuacjach mogą być decyzje tych rządów (tak polityczne, jak i przedsięwzięcia militarne) oraz jak zachowają się w tych sytuacjach między innymi zainteresowanymi krajami (w tym Francją, oraz kraje Obozu Socjalistycznego), kiedy sytuacja stanie się krytyczna, ale jeszcze bez konfliktu zbrojnego oraz w jakim momencie konflikt zbrojny będzie już nieunikniony. Oczywiście brano także pod uwagę możliwość oddziaływania psychologicznego na kraje naszego Obozu, próby porażenia gospodarczych krajów dla Zachodu, sytuacje ekonomiczne w gospodarczych krajach oraz ewentualne sytuacje wewnętrzne w gospodarczych krajach naszego Obozu i w krajach Zachodnich, w sytuacjach krytycznych i w przypadku wybuchu konfliktu.

Wnioski: Aczkolwiek treść gospodarczych modeli może być ciekawa, chociażby ze względu na sposób rozumowania ludzi zajmujących się modelowaniem sytuacji konfliktowych (dane wejściowe — dane wyjściowe), wydaje mi się, że nasz Instytut nie jest zainteresowany w utrzymaniu wymienionej pracy. Raczej mogła by ona zainteresować Sztab Generalny i GZP.

(płk J. Nowicki)

18.07.1970

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SIMULATING INTERNATIONAL CONFLICT:
A Comparison of Three Approaches

by

Hayward R. Alker, Jr. and Ronald D. Brunner
Yale University



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I. Introduction

More obviously than most other recently developed research methodologies, simulation techniques for the study of politics variously blend intuitions, science, and value judgments. Such procedures range from gaming possible future international crises with professional diplomats to discussions with a wholly computerized Barry Goldwater. As dynamic but artificial realizations of political processes, simulation models lend themselves to all kinds of analyses: philosophers and policy scientists may use them to clarify goals or to invent and appraise policy alternatives, while empirically-oriented simulators seek generally to describe and explain political behavior.

We are interested in comparing three applications of this new methodology to the substantive area of international conflict. In particular we shall explore the theoretical content, the plausibility, and the purposes of three different simulation models by using each to simulate the antecedents and consequences of a hypothetical accidental nuclear explosion in the Soviet Union. Our purpose is to learn more about the theories embedded in these alternative models, and about the potential contributions of such exercises to the study and practice of international relations.

Perhaps the best argument for the value of our comparative procedure is the degree of theoretical and practical concern with the issues this scenario was selected to explore: the likelihood and effectiveness of various conflict resolution

procedures, the adequacy of nuclear deterrents, and the problem of escalating from conventionally limited wars to major nuclear exchanges.

Each of the simulation models is in fact a complex, operating model, explicit or implicit, of the processes underlying these issues; therefore comparing these models by running them, rather than by merely contemplating their structure, seems particularly appropriate. By approximating the same crisis situation in each model and then operating the models to produce a sequence of events over simulated time, we believe we have uncovered several important differences in the models not immediately apparent from an inspection of their procedural rules or structural equations.

The diversity of the models we are comparing should help us to assess the potential contributions of simulation research. As subsequent discussion will show, they include three of the most widely used kinds of simulations: "games" involving groups of foreign affairs experts, student games played in partly computerized environments, and entirely computerized symbolic representations.

It should be clear at the outset, however, that our procedure has all the limitations of a single case study, and a hypothetical one at that. Certainly no general theory can be completely verified nor simulation model validated by reference to a single example. At best our confidence in a theoretical, procedural assumption can be somewhat strengthened when several simulations and our expectations agree, or

seriously challenged when the models, received knowledge, and our own intuitions sharply diverge. Without a real world counterpart to the imaginary situation being studied, our critical remarks can have little more than face validity. Using the hypothetical case method, however, surely helps us to compare various simulations at a number of choice points in decision-making sequences even when the extent to which we are evaluating the models is less satisfactory.

Our discussion can be divided into several parts. The next section is a brief overview of the principal characteristics of each of the simulation models being studied, followed by a comparison of the variously worded scenario inputs for each of the different simulation runs. Then, in narrative fashion, we shall briefly trace the course of events in each simulation run. Our substantive analysis of these developments will focus on theoretical similarities and differences among the models. In conclusion we shall offer some more general observations about the uses of simulation in international relations research.

II. The models to be compared.

The three simulation models to be compared are: 1) The Political Military Exercise (PME) developed by Lincoln Bloomfield and his associates from earlier influential RAND Corporation work reported by Goldhamer and Speier;² 2) The Inter-Nation Simulation (INS) developed by Harold Guetzkow and his associates at Northwestern University and currently being

used at a number of universities;³ and 3) The Technological, Economic, Military, Political Evaluation Routine (the acronym being TEMPER) developed by Clark Abt, Norton Gordon, James Hodder and their associates at the Raytheon Company for the Cold War Division of the Joint War Games Agency of the Defense Department.⁴

The explicit writeups of the Political Military Exercise gaming technique are highly procedural, emphasizing communication possibilities and limitations between the various groups involved. Over several periods of game play, small teams are asked to play the role of government leadership in such nations as the United States, the Soviet Union, and West Germany. The Control Group or "umpire" plays both other actors -- domestic, national, and international -- and the environment in which all actors try to move. Presumably objective in playing these roles, the Control Group often exerts considerable influence on the course of the game. Thus messages from DeGaulle, the press, or Walter Ulbricht, can have important and sometimes unanticipated consequences. The theories contained in the gaming model, by far the most concrete and intuitively plausible of the simulations to be discussed, are mostly implicit in the minds and behaviors of the Control Group and other game participants.

The Inter-Nation Simulation is an abstract, theoretically-oriented, man-machine simulation. It defines a "nation" by creating a number of important roles, such as Central Decision Maker (ODM, the head of state), External Decision Maker (EDM,

foreign minister) and Internal Decision Maker (IDM, second in command). In the simulation run reported here, two other roles were described and filled: The Force Decision Maker (FDM, defense minister) and the Aspiring Decision Maker (ADM, the leader of the loyal or not so loyal opposition). These "nations", given content-free names such as "Omne" and "Utro", are told to make national decisions allocating BC's (Basic Capabilities) to the production of more BC's, FC's (Force Capabilities), and VS's (Validator Satisfaction units). Mathematical formulas are used to calculate decisional consequences which include changes in the CDM's probability of staying in office as well as changes in resource levels. Each team receives this new information in a subsequent simulation period. Rules regarding preexisting alliances, going to war, sending aid and trade, forming alliances, and holding international conferences also exist, but the actual patterning of international relations is largely unprogrammed.

In a run of several move periods, both INS and PHE produce a game record consisting of international and domestic decisions, patterns of communications, and questionnaires filled out at various times by game participants. Conference meetings are sometimes recorded verbatim, sometimes summarized by participants or rapporteurs.

TEMPER is a highly complex and completely computerized simulation. Its principal "actors" are as many as 39 nation-groups whose memberships are chosen for each run by the investigator. For example, the Warsaw Pact nations may be

aggregated into one nation-group, while another nation-group might represent the United States alone. Nation-groups are characterized by a large data base which includes economic, military, geographic, political and cultural variables. Nation-groups are divided into two opposed military alliances (blocs) and a third set of neutral countries. Investigators may define as many as 13 land conflict regions within which opposing bloc members may go to war.

Each nation-group, using the same economic and decision making subroutines, but with characteristically different parameters, solves international military and political "problems" in its conflict region by altering its goals, by taking military or psychological action, by seeking extra-regional trade and aid relationships in exchange for political support, and by bargaining with the enemy. Balanced off against international problems are domestic demands for consumption, investment and growth in various sectors of the economy. As Basic Capability Units are a fundamental means of transaction in the Inter-Nation Simulation, so GNP dollars in TEMPER can be used to buy Force Units, satisfy domestic economic demands, and send aid, trade or investments to other nations.

Beside the definitions of nation-groups and conflict regions, principal inputs to TEMPER that are ordinarily set by the investigator include problem magnitudes to be considered as crisis levels, dyadic bargaining possibilities, procurement fractions, geographic proximity factors, the credibility of

nuclear attack, levels of military operations, and retaliation thresholds. (More specific meanings of these terms will be given below.) Different configurations of these and other variables can be used to design alternative situations, and, supposedly, to explore generalizations relevant to these situations.⁵ Outputs from computer runs include changing alignment and trade relationships, levels of military operations, retaliation levels, national accounts data, as well as many other possibilities.

In what sense can these three very different simulation models of international relations be compared? Clearly, the computer instructions in TEMPER and the inter-national equations of INS can easily be interpreted as interrelated partly comparable theoretical propositions. But even the equations of TEMPER or INS do not completely represent specific theoretical commitments -- magnitudes for various coefficients and variables may be estimated or assumed on the basis of alternative theoretical perspectives.

The international aspects of INS, plus both most internal and external behaviors in PME, can be interpreted in terms of what Guetzkow has called "unprogrammed hypotheses." These represent sometimes implicit but potentially discoverable patterns of behavior within and between nations. In principle it should be possible theoretically to compare and contrast equations in INS and TEMPER with each other and with relevant unprogrammed generalizations derived from PME and INS exercises.

A more synthetic approach to comparison, and one which we adopt in this paper, assumes that the analytical approach discussed above is limited by the complexity of the models. As the variety of possible explicit and implicit theoretical propositions increases, it becomes very difficult to assess the cumulative effect of passing through several of the interrelated links in the model. How, for example, without running the models one or many times, can we assess the consequences of different assumptions concerning the structural flexibility of international relationships? Given greater domestic constraints in one model than in another, will we therefore find characteristic divergences in the flow of international relations? If we want to search for qualitative, holistic similarities and differences among simulation models, it is the actual operation of these models that we ought to investigate.⁶

The significance of such comparisons of different simulation approaches most clearly depends on the intentions of their designers. The primary purposes of the various simulations range from policy-relevant heuristic or analytic exercises such as PME and TEMPER runs to empirical theory formulation and testing efforts to date most closely associated with INS. But whatever its purpose each model implies or states theories as to why preferred outcomes occur and, if not, how they might yet be achieved. For these reasons, making explicit, comparing, testing, criticizing, and revising the empirical generalizations involved in any kind of inter-

national conflict simulation remains an important but never-ending task.

III. Simulation inputs

The simulated international crisis in this paper is based on the scenario of DETEX II, a political-military exercise, designed by Lincoln Bloomfield and his associates and run in 1964 with highly qualified government and academic personnel as participants.⁷ In this section we describe this scenario, and how it was translated into the more abstract languages of INS and TEMPER. Together with the simulation models these inputs are major determinants of the sequence of events in each of the simulation runs.

The DETEX II scenario is set in February, 1967. The "general state of international relations" at this time remains "basically unchanged since 1964." Although "East-West tensions have continued to relax somewhat," a few potential trouble spots exist. In Finland, "worker unrest has led to a week-old general strike which threatens to bankrupt that nation" and in East Germany "small-scale worker protests ... have developed over new taxes, quotas, and work rules." Ulbricht "accused the West of secretly supplying small arms to the 'Perennial malcontents,'" and Khrushchev warned the West against intervention in the situation. In military affairs "no revolutionary developments have reached production stage," but some weapons systems have reached the levels projected in 1964. In recent weeks, the Soviet Union has been conducting tank maneuvers in

in DETEX II a political world that had to be made explicit in the INS and TEMPER runs. We began by defining the main actors in INS and TEMPER. For INS a five-nation world was defined in the first issue of the World Times, the simulation newspaper. The Soviet Union and the United States became "Omne and Utro, (which) in addition to being the only nuclear powers at this time, annually produce large amounts of BC's, that is, economic potential." The Warsaw Pact and NATO allies of these super powers became Egra and Yora, while a fifth nation, Algo, simulated the European neutrals. Unknown to Omne and Utro team members, Egra, Yora and Algo were instructed by the INS simulation director to approximate the behavior of their DETEX II counterparts.

In our TEMPER runs the United States opposed the Soviet Union in Conflict Region 1, West Germany opposed East Germany in Conflict Region 2, and other NATO nations opposed other Warsaw Pact nations in Conflict Region 3.⁸ European neutral nations became the neutral nation-group in Conflict Region 3. All other nations were divided into 10 nation-groups and distributed among four other conflict regions: the Middle East, Africa, Southeast Asia, and Latin America.

National military and political resources, most of which are implicit in DETEX II, also had to be made explicit for the INS and TEMPER models. INS resources are either basic economic capabilities (BC's) or nuclear or conventional force capabilities (FCn's or FCC's). In our INS run the BC level of each simulated nation was estimated by a logarithmic function of the

GNP of its real world counterpart. Estimates for force capabilities were taken from TEMPER's data base.⁹

TEMPER economic resources are measured in billions of dollars of GNP, and military resources are expressed in counterforce utilities. The latter are disaggregated into specific categories such as tactical air wings, paramilitary divisions, and submarines. We used the approximate resource levels for 117 nations which are already included in TEMPER's published data base. Economic and military resources of the various TEMPER nation-groups were calculated by summing published data on the resources of their real world counterparts.

Having defined the actors and their resources, we then translated the DETEX II crisis situation into the abstract terms of INS and TEMPER. The first issue of the INS World Times noted that "International tensions are somewhat relaxed, although some trouble spots persist;" the validators in Algo and Yora are dissatisfied; and "Omne is conducting routine military maneuvers near Algo and in Egra." We also mentioned that "Omne is covertly preparing a site ... within its own borders for a possible series of nuclear tests."

Setting up the crisis situation in TEMPER required specifying quantitative values for a number of variables, the most important of which are indicated in Table 1. Although their meaning can only be fully appreciated by reading and understanding TEMPER's equations, most of these have semi-intuitive meanings. Allied proximity to helper (ALPRXE) helps

	DETEK II	INS	THIRER
East	US - 7 member team U. Germany - Control Other Allies - Control	Utio - 5 member team Yora - 1 confederate (subject to secret instructions from the simulation director)	USA Nation-group (Conflict Region 1) U. German Nation-group (CR 2) NATO Nation-group (excludes USA and U. Germany)
East	USSR - 7 member team L. Germany - Control Other Allies - Control	Omne - 5 member team Esra - 1 confederate	USSR Nation-group (U. German Nation-group (CR 2) Warsaw Nation-group (Excludes USSR and U. Germany)
Neutrals	Finland and other neutrals - Control	Algo - 1 confederate	10 other Nation-groups in 4 other confederate regions
Economic	Basically 1964 military, political and economic situation as perceived by participants	FCn, ICC - force capabilities BC - basic capabilities Other resources and parameters	Strategic and tactical wings, missiles, tank divisions, etc., expressed in GUV's (counter force utilities). GNP in billions of dollars allocated to various economic sectors.

	DETEX II	INS	TEMPER
<u>Crisis Situation</u>	East-West tensions are somewhat relaxed. Soviet troop maneuvers in E. Germany, and near Finland. USSR is covertly preparing a site for possible nuclear test series in prohibited environments.	International tensions are somewhat relaxed. Omne is conducting routine military maneuvers near Algo and Egra. Omne is covertly preparing a site within its own borders for a possible series of nuclear tests. Two move periods (of one hour each) were played before the explosion was introduced.	1960 TEMPER world has been updated by 98 move cycles (2 years). Major earlier specifications included levels of: ALPRXE - Allied proximity to helper IMCRY - crisis threshold IMLAND - Historical land fraction ZDLAND - desired land fraction XORED - credibility of nuclear attack by opponent bloc ZDOMZ - military operations ZPSYZ - psychological operations
<u>Crisis</u>	Explosion of one megaton range nuclear detonation near Polunochnoe in USSR.	A nuclear explosion at the Omnian nuclear facilities near Wimo.	Maintain ZDOMZ of both sides in American-Soviet CR(1) at 4.0 (i.e. major deployments) and increase those of both sides in German CR(2) to 5.0 (i.e. armed reconnaissance). Increase both ZPSYZ's in CR 1 to 7 (i.e. toleration of only minor deployments). Decrease ALPRXE in CR 3; Increase ALPRXE in CR 2. Decrease IMCRY in CR 1 and CR 2. Increase XORED in CR 1 to 0.7.

parameter.¹¹

IV. Crisis developments in the three simulations

In this section we consider the historical development of the course of events in each of the three simulation runs. This discussion serves as an essential background for subsequent comparative analysis.

A. The DETEX II run

DETEX II actors responded to their scenario with quickly deepening involvement. On receiving initial intelligence reports of an explosion near Polunochnoe at the beginning of the first move period (move period A), both super powers went to high levels of military alert. The National Security Council (minus the head of the CIA who was hunting in Georgia) and the Soviet Presidium each met on an emergency basis to appraise the situation. The American team sent a Hot-Line message to the Soviet leadership, assumed to be headed by Khrushchev since the world of 1967 had not changed greatly from that of 1964. The United States asked for an explanation, maintained its own innocence, but admitted that it was checking to see if an unauthorized American missile firing had occurred. The Americans proposed inspection of the site by the UN Secretary General and informed the Russians that all allied bombers had been ordered to return to their bases. Choosing to respond to the admission that the explosion might have been caused by a U.S. missile, the Soviets in their reply via Hot

Line blamed the United States and threatened to destroy several Polaris submarines. The Soviet leadership ordered East German troops to sever the Berlin Autobahn, sent troop reinforcements to Berlin, and initiated a propaganda campaign for a free and united Germany.

In the next move period (move period D) Russians and Americans skirmished along the Autobahn, riots in East Germany threatened the existence of the regime, and the Soviets sank a Polaris submarine. As anxiety and political unrest increased throughout Europe and the rest of the world, criticism of NATO was heard in many capitals. The Soviet team directed its propaganda apparatus to blame the United States for the outrage against peaceful Soviet workers at Polunochmoe. Under the pressure of world opinion the Soviet team agreed magnanimously, but in principle only, to outside inspection of the site. The American team continued to press for UN inspection, and decided to maintain access to Berlin by whatever means were necessary. American optimism and initiative increased as it became more certain that the explosion was a Soviet accident and as workers revolted in East Germany. Great power attention began to turn toward the German situation even though general international interest was increasingly focused on the explosion, the "retaliatory" sinking of a United States submarine, and a UN meeting on the explosion situation.

In Germany at the beginning of move period C the CIA (played by Control) tore down the Berlin Wall and the Ulbricht regime was overthrown. The revolutionary government joined

with the regimes of Gomulka, Novotny, Gheorghiu-Dej, and Kadar (all played by Control) in issuing a Manifesto of Free Communism. By this time the Americans had positive proof from the analysis of radioactive fallout that the explosion was of Soviet origin. The United States publicly blamed the Soviets for the nuclear explosion, and called for an all-German settlement of the German problem. The American team decided not to intervene directly in the German situation but to encourage German paramilitary movements to the East by offering logistical support. Diplomatically the U.S. sought allied support for a United Germany, assured Gomulka of the acceptability of the Oder Neisse line, and offered the Soviets a NATO-Warsaw Pact treaty stabilizing the German situation. The Soviet team began to develop strongly opposed factions with the growing realization of Soviet culpability in the explosion, but even more because of Chinese and other hard line pressure to keep East Germany and Eastern Europe under Communist control. Hearing of confidential U.S. communications with Gomulka, the Soviet Union condemned western intervention in Germany, and threatened an IRBM attack on NATO bases in Western Europe if intervention continued.

As the East European revolt began to appear to be successful at the beginning of move period D, the teams became more and more resolutely committed to previous courses of action. The United States team demanded USSR acknowledgement of guilt in the nuclear incident and assured Erhard of support for his moves in East Germany. Using propaganda in an attempt to

conceal its guilt, the Soviet Union continued to reinforce its armies in Berlin.

In the last move period the American team condemned the USSR for precipitating the crisis through careless handling of fissionable material, and offered to protect Soviet troops if they withdrew from Germany. The Soviet team rejected inspection of the Pelunochnoe site and took reprisals against rebellious East European officials. By this time Western aggressiveness and Soviet threats had reduced the range of Soviet alternatives to two: giving up much of Eastern Europe or honoring their ultimatum and going to war. As the exercise ended the Soviets were arming their IREM's.

B. The INS run

In the INS run the accidental explosion was introduced only after two move periods in which the participants familiarized themselves with the relatively content-free world of INS. Although the existence of the Omnian clandestine test site was revealed in the first issue of the World Times, other problems generated during these two periods were given more attention than the experimentally induced crisis.

In the first two move periods the official decision-makers of Omne and Utro contacted each other only to exchange insults and, in the case of Utro, to threaten an automatic nuclear response to any test at Wimo. Their attention and actions were directed internally toward their decision forms and externally toward Algo, Yora, and Egra, the three smaller nations. With the beginning of the second move period, office holding

probabilities for both Omne and Utro began a continuing decline, occasioned in part by "inefficient decision-making" according to the logic of the INS program but also by experimenter induced miscalculations.

Omne, like the Soviet Union, was frustrated by its FCn (nuclear weapons) gap and BC (economic capability) gap in the Omne-Utro cold war. To reduce its military vulnerability Omne hardened its FC's, both nuclear and conventional, invested heavily in FCn generation, and discussed convening an international arms control conference. Omne proposed trade agreements with Yora and Algo, but was inclined to discount the value of maintaining bloc ties with Egra, whose generation rates were so low.

Utro initially pursued a status quo policy very much like that of recent American Cold War behavior. Its primary concern was to secure the allegiance of Yora, and toward this end it exported BC and FCn aid. Overtures for closer relations with Algo and Egra were made in the second move period, but were postponed as internal problems became more pressing. Utro's enterprising ADM had earlier contacted Omne in secret to suggest collaboration and also launched efforts to gain office in his own government. Repeatedly frustrated by his CDM in the latter pursuit, he provoked a nasty exchange with his CMI. The CMI in addition became locked in a personality conflict with his EDM over the immediate issue of initiating war with Omne. The EDM prevailed, convincing his CMI that Utro's FCn superiority was sufficient reason for an attack in the light of some

uncertainty about changes in Omne's military and economic capacity. This pre-emptive attack, which was launched at the end of the second move period, was delayed by the Simulation Director for a period of two hours in order that the game might continue into the planned crisis.

When the third move period began, and the EMI's of the super powers were notified that an explosion of uncertain origin had occurred, the situation temporarily moved beyond the control of the teams. Misperceptions multiplied and effective communications broke down. Initially, Omne's EMI interpreted the explosion as a successful nuclear experiment which increased Omne's FCn capacity. Then he and his colleague, the FDM, decided individually that it must have been an Utro attack. In the meantime Utro's EDM had not been informed by his CDM that their pre-emptive attack had been postponed by the Simulation Director; consequently, he interpreted the unexplained Wimo explosion as a part of the attack he had planned. These misperceptions persisted in some cases even after further information suggested that the explosion was an accident at the Omnian test site.

In the first half hour after the beginning of the crisis (an interval corresponding roughly to periods A and B in DETEX II), the moves of these decision-makers reflected their initial misperceptions and their increasing awareness of the actual course of events. Omne's EDM demanded from Utro an explanation of the explosion and threatened retaliation. Somewhat later, in messages to Yora and the World Times, he branded

Utro a war-tougher and proposed a conference with Yora. Omne, he explained, sought peace and needed Yora's support. In the meantime Utro's EIM notified Yora that a state of war existed, and requested Yora's active, militant support against Omne.

Both CIMs were noticeably less aggressive. Utro's CIM expressed his regrets to Omne, and assured the neutral Algo of his innocence in the matter and of his desire for peace. Omne's CIM chose to ignore the consequences of the explosion and ^{to} concentrate on completing his decision form.

As the situation appeared to deescalate in the next phase of the crisis, Utro's EIM dropped his demands on Yora and instead offered aid in return for Yora's moral support. In overt actions, Omne attempted to deescalate the crisis by elaborating the peace theme and sought to include Egra and Algo as well as Yora in the proposed conference. These were both defensive measures. Covertly, however, Utro's AMI had asked Omne for FCC's in support of his revolt against the CIM of Utro. Omne increased the likelihood of provoking a conflict by fulfilling this request.

Learning the outline but not the details of this plot, Utro's CIM dramatically took charge and deescalated the international situation in order to deal with the AMI. Both Utro and Omne accepted invitations to a peace conference convened by Algo and in due course offered inspection.

In the last phase of the move period the revolutionary conspiracy became the focus of attention and the experimentally induced crisis was nearly forgotten. When the Omnian decision-

makers became aware that Utro knew of their complicity in the plot, they reconsidered their relatively weak military capabilities and decided to withdraw support from the Utro ADM, leaving him isolated and exposed. Although the players were not then so informed, these were the last moves of the game. The course of future relations among the countries was unclear.

C. The TEMPER run

Like INS, TEMPER was allowed to run "quietly" for some time -- actually two years from its 1960 data base-- before the crisis of greatly intensified psychological threat levels was stimulated.¹² In retrospect perhaps the most important trend during this two year period was the growing autonomy and conservatism of West Germany. Its desired land fraction (ZDLAND) decreased sharply from an original value of 1.00 to about 0.73 (only 3% more than the 7/10 of German land that it already held), while its long run external dynamism (ZEXTD), operationally interpreted as a need for allies, was more than halved within the same two year period. Both Soviet and East German Nation-groups also decreased their alliance ties as the result of a generally relaxed period of international relationships.

Other pre-crisis trends included general increases in the gross national products and military expenditures of the nation-groups involved, especially the West German and Soviet ones. Both Germanies also increased their defense spending motivation, moves we can attribute to their overall force needs. Since a number of these motivational variables evidenced

little change over periods of less than 6 months, however, we need to refer to them in the present context only when they enter into short run crisis decision-making calculations.

In TEMPER it was impossible to make ambiguous the reason for a greatly increased retaliation threat level. Consequently, and contrary to our intention to make the situation ambiguous, military and psychological problems of both the United States and the Soviet Union were attributed in the computer printout to the other side. American and Soviet psychological threat levels, ZPSYZ's, were set at 7.0, which can be interpreted as a willingness to tolerate only minor troop deployments by the other side. Since each side already "perceived" the other side's major force deployments (ZDOMZ's) each team was causing the other an intolerable military operations problem. On the other hand both East and West Germany, with respective ZPSYZ's and ZDOMZ's of only 5.0, did not cause a "milops" problem for the other side.

In the ensuing computer cycles, problems continued to increase with a rate greater than the crisis threshold value (DMCRY), producing continuing crisis priorities in problem solving tasks.¹³ Early military moves included sending some American naval forces to the Baltic, and redeploying certain American forces stationed in the European Conflict Region back to the United States. Surprisingly, NATO military aid to the United States helped increase her military security, and resulted temporarily in closer American ties with her West European allies.

By the sixth cycle both super powers fully "realized" the magnitude of the military operations and psychological threat problems they faced. This perceptual delay occurred because neither side was quick in "digesting" and ⁱⁿ "believing" the other's retaliation threat to be a serious one. Short term bargaining was impossible (such events only happen at the end of the year for bloc leaders in TEMPER), but each was beginning to "realize" that a cost effective way of decreasing their psychological retaliation problems was to reduce their own military operations. These moves had the additional, unintentional effect of beginning to moderate the other side's perception of intolerable military operations, even though neither side was willing to back down from its retaliation threats. Retracting threats would in fact increase the likelihood of a successful attack and be considerably more costly for other reasons.

The German situation, however, was getting worse. Fortunately, the conservative trend in West German desires to annex East Germany meant that this desired land problem compounded only slightly the developing "milops" and "psychops" problems.¹⁴ Germans slowly became "aware" of each other's demand for cessation of military operations beyond the level of armed reconnaissance. As soon as these mutual problems were fully realized, however, the two Germanies were able to bargain successfully over joint reductions in military operations. Because West German military might was a good deal stronger than East Germany's, East Germany was forced to reduce some-

what its retaliation threshold. (Barqains occurred in the 5th, 17th, and 18th cycles after the accidental explosion). Considerable Soviet troop shipments to East Germany (arriving in the 15th cycle) also help improve East Germany's tactical force situation.

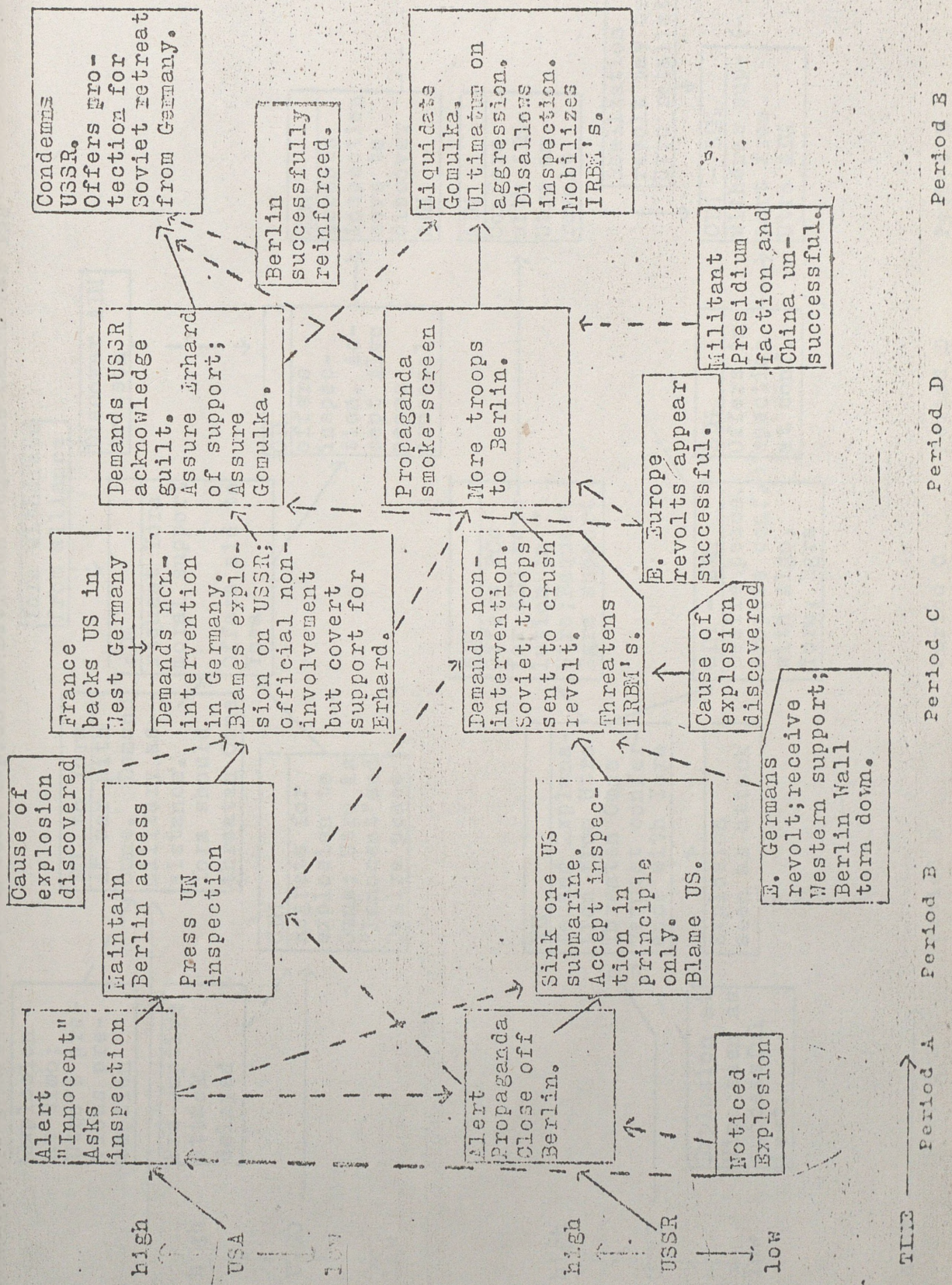
As a side effect of these developments, other Europeans seemed to have been somewhat neglected in trade and aid relationships. As a result political alignment with bloc leaders tended to decrease, and so did within-bloc allegiances for the same reasons.

D. The likelihood of War

In Figures 1, 2, and 3 we have selected and summarized for each run the path of one variable of particular theoretical importance, the likelihood of war. Our continuous line estimates of movements on the vertical axes are based either on computer printouts of the magnitudes of total problem levels in TEMPER or, more loosely, on questionnaire replies as to the likelihood of armed conflict in INS and DETEX. Other aspects of the figures are even less objective; they reflect our qualitative impressions of some of the important events, interactions, and decisions related to or causing changes in the likelihood of war. At selected points in time, each box represents decisions of major importance; dotted lines suggest the impact of certain information on particular decisions, including earlier events and decisions.¹⁵

table 2

FIGURE 1: A Decision Sequence Chart for DETEX II



(Subjective Interest and Strategic Objectives)

FIGURE 2: A Post-Explosion Decision Sequence Chart for INS

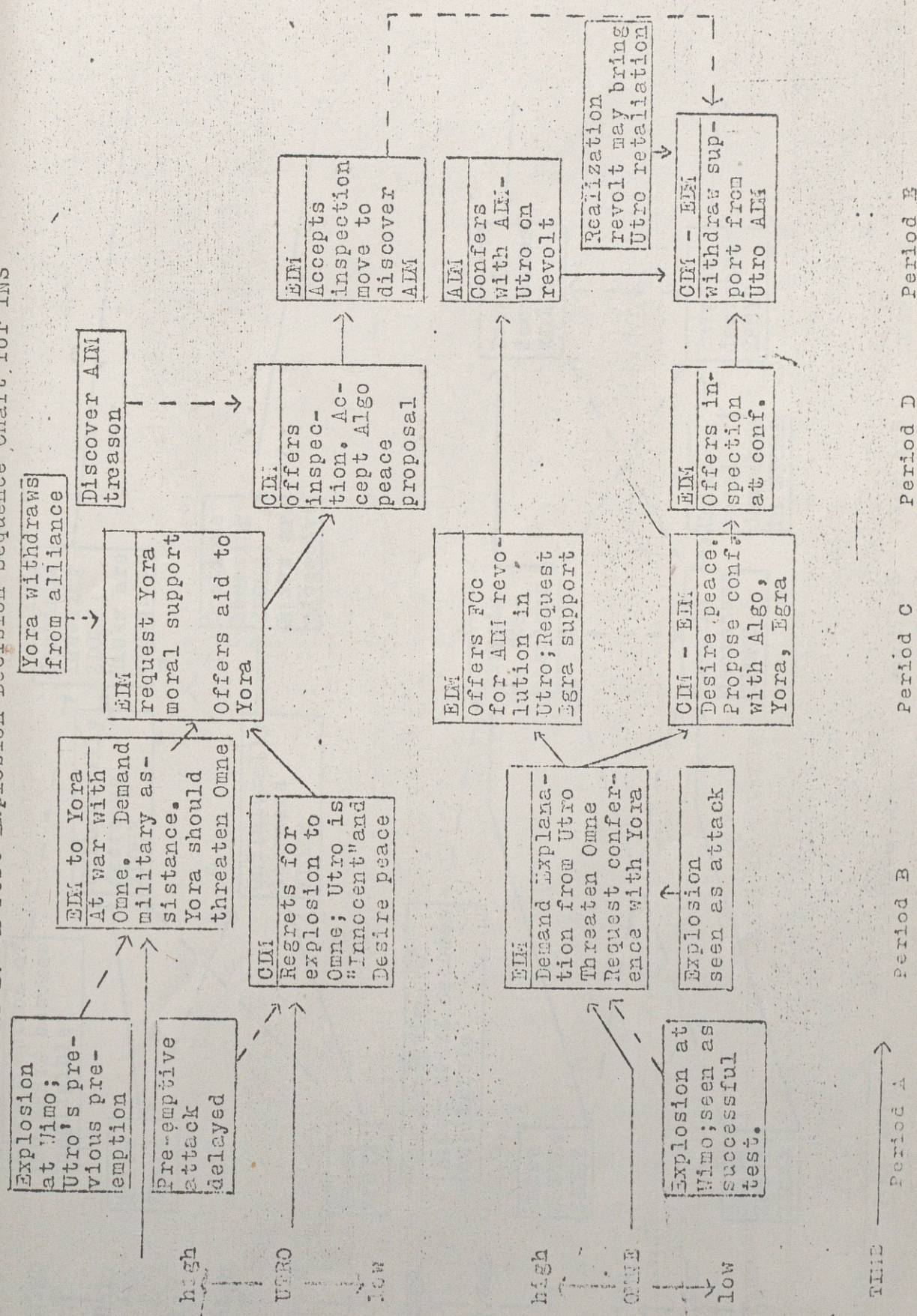
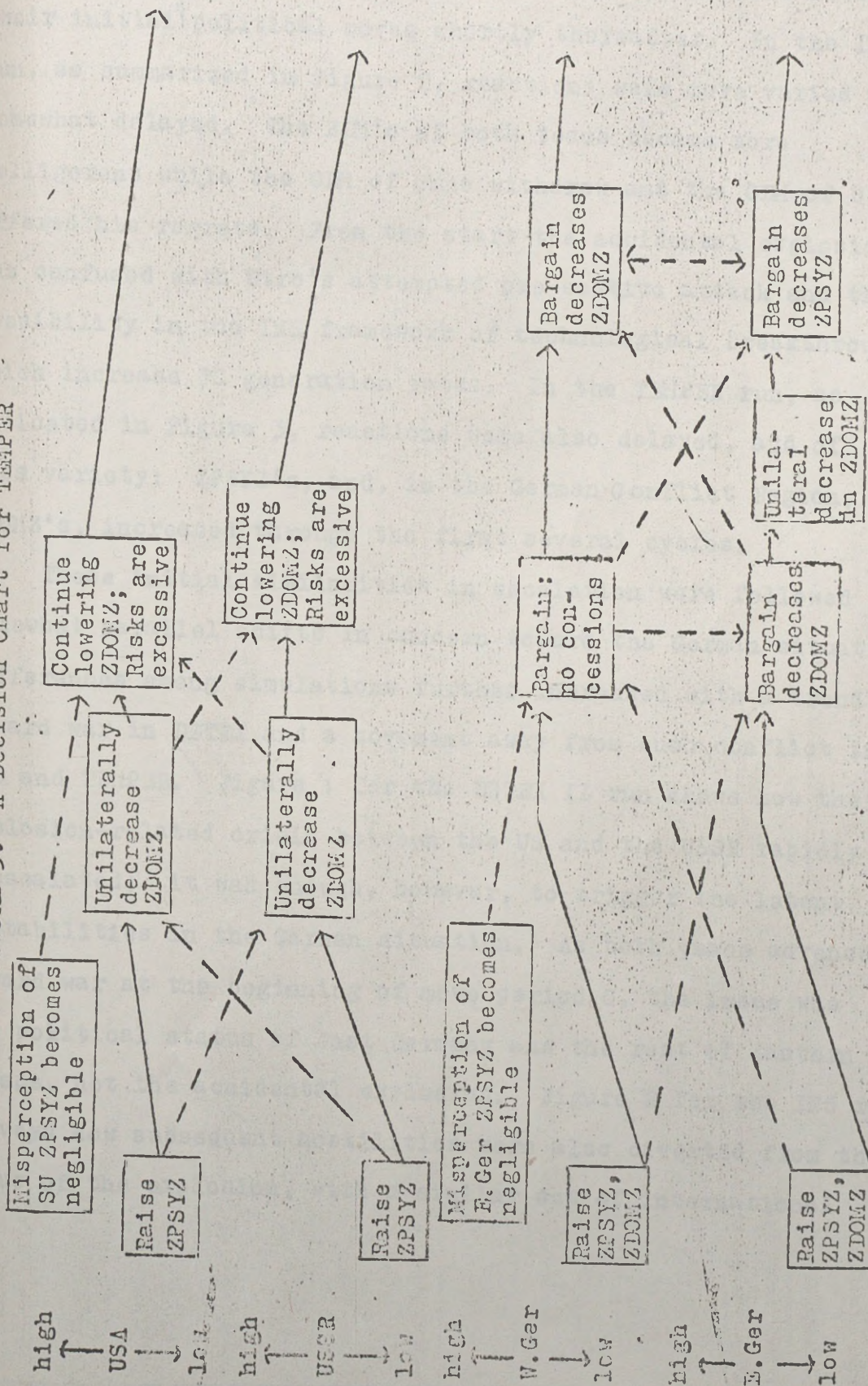


FIGURE 3: A Decision Chart for TEMPER



Labels in

TIME
→
Week 101
Week 104
Week 106
Week 113
Week 116

As each figure shows, the accidental explosion caused an increase in the likelihood of war in each simulation run. In DETEX II both teams went on alert immediately and formulated their initial political moves shortly thereafter. In the INS run, as summarized in Figure 2, reactions were more varied and somewhat delayed. The EDM's of both teams became more belligerent while the CDM of Omne withdrew and the CDM of Utro offered his regrets. From the start the accidental explosion was confused with Utro's attempted pre-emptive attack and the possibility in the INS framework of technological breakthroughs which increase FC generation rates. In the TEMPER run, as indicated in Figure 3, reactions were also delayed, and of less variety: ZPSYZ's, and, in the German Conflict Region, ZDONZ's, increased through the first several cycles.

These initial similarities in escalation were followed by somewhat parallel shifts in concern toward the German situation. Differences among simulations further increased with a trend toward war in DETEX and a movement away from such conflict in INS and TEMPER. Figure 1 for the DETEX II run shows how the explosion-related crisis between the US and the USSR rapidly deescalated; it was enough, however, to trigger the latent instabilities in the German situation. As both teams advanced toward war at the beginning of move period C, the issue was the political status of East Germany and the rest of Eastern Europe, not the accidental explosion. Figure 2 for the INS run conveys how subsequent hostilities were also diverted from the issue of the explosion, with a similar set of international

discussions. In this case, however, the explosion was not a trigger for compound escalation but mainly a temporary diversion from internal disorders, particularly Utró ADI's foreign-supported plot. The preprogrammed alliance problems had only a minor impact because of the dominance of this international issue. Figure 3 for the TEMPER run suggests smooth decay of the likelihood of war in both the German and the US-SU Conflict Regions. For the great powers unilateral calculations of the costs of escalation rapidly and effectively dampened the crisis; for the two Germanies conservative goals and bargained problem reductions were soon also to prove effective. Although neither TEMPER nor DETEX II went to war at this juncture, the greater variety of INS responses in Figure 2 as compared to Figure 3 also appears to be suggestive of a different path to peace in each of these runs.

The trends in the likelihood of war summarized in Figures 1, 2, and 3 can be attributed to chance, to similarities and differences in inputs, to the variety of decision-makers' reactions, or to the sequencing of decision opportunities. Our limited number of runs gives us no statistical information on the role of chance, nor on the reproducibility of simulation event sequences. Although an effort was made to set equivalent inputs, some differences were inevitable due to differences among the models and their unprogrammed inputs. With these several limitations in mind, we explore in the next section the aspects of the models which appear to underlie important trends in the likelihood of war.¹⁶

V. Similarities and Differences in Causes of Conflict

The flow of decisions in each of the above figures superficially resembles, at least in its warlike consequences, the kind of armament or disarmament paths characteristic of Richardson processes.¹⁷ If we were to change the hostility, defense costs, or cooperation level coefficients of such simple differential equation models, it would be possible to generate escalation and deescalation sequences not unlike those we have described. Do we then need to go further in explaining why one simulation was about to go to war and the others did not? Is it/^{enough} to observe that different configurations of hostility-defensiveness-cooperation tendencies occurred in each situation?

to the first question and no to the second.
Many would answer yes/ One might immediately wonder if such an explanation is an explanation at all: do we know why these parameters have changed or remained the same? Is such an explanation anything more than a description of the phenomena themselves? Without subscribing to the view that such a simple causal explanation would be entirely tautologous -- Richardson models do point to striking empirical regularities of conflictful interdependence -- we shall argue that a major advantage of simulation models is the richness and variety of their outputs, and correspondingly of their possibilities for explaining patterns of international conflict. Conflict is clearly a multicausal, dynamic process with actors subject to learning and feedback mechanisms of much greater variety than

changes in the decision-making process. The mechanisms whereby complex actors change their goals, solve their problems, change the weights of various influences, or choose different decision rules require a more complex decision-making framework of analysis.

In attempting to do justice to the richness of experience characteristic of all three of these simulations, we shall make the following analytical distinctions: similarities and differences in outcomes will be attributed to simulation inputs, the structuring of the important actors and their arenas of interaction, their policy perspectives, their problem-solving or decision-making behavioral rules, or the changing sequences according to which certain of these rules are invoked.¹⁸ Each of these aspects of a simulation model can be considered a separate cause of war or peace; but in making our comparisons we shall try, through a variety of cross-references among these analytical categories, to present a more holistic view of each simulation.

A. Inputs

Looking at the decision sequence charts once more, one is tempted to label as "causes of war" in the DETEX run such decisional "inputs" as the explosion at Polunochnoe, the discovery of the true cause of the explosion, Control's indication of apparently successful revolts in East Germany, France's support of the West, or the hard line pressure on the Soviet Presidium. Other significant inputs, most of them

specified in Table 1 as initial conditions rather than in the figures, might be the elements of a somewhat relaxed cold war situation: the conflicting national goals, historical patterns of international hostility, threats, and military activities. (Wars in an earlier run of TEMPER might similarly have been attributed to initially high ZDONZ and ZPSYZ levels in the Vietnamese and the Cuban arenas).

That some of these inputs to INS and TEMPER did not have all the ominous cold war overtones of the DETEX run is an important difference among the models which in part explains their different outcomes. Certainly the rich and perhaps determinative historical associations of the scenario inputs in the DETEX game contrast most sharply with the nearly content-free labels and facts of the INS run. TEMPER inputs are also abstracted considerably from reality, but their greater specificity and detail makes TEMPER a more historical simulation than INS.

Thus we can consider the Polunochmoe explosion a "catalytic" cause of war, but only against this background of initially captivating cold war conditions, which are much more vivid and salient in the inputs of the DETEX simulation.¹⁹ However, since a number of these inputs were at least analogously present in the other simulation exercises but did not lead to a warlike situation, the extent of hostilities cannot be explained in terms of inputs alone. We need further analysis of these initial conditions in order to know how the decision-makers reacted to these inputs and to discover the subsequent

alternatives they faced.

B. Actors and Arenas

If we define actors in the three models as those units of analysis having an influence over a particular range of simulation outcomes, then the ways these actors are structured and the arenas in which they interact provide important points for model comparisons. Within a bipolar international structure characteristic of the initial conditions of all three of the models we are here investigating, there are important differences in emphasis given to subnational actors, to national decision-making units, and to the international system in INS, the Political Military Exercise, and TEMPER.²⁰

Let us first consider how actors at the subnational and national levels influence the flow of events. The collegial manner in which DETEX II teams were structured leads to rather "efficient" decision-making that, depending^{on} simulation inputs and specific action choices, might cause a variety of different national policies. In an arena characterized by face-to-face collegial communications the DETEX II team chairman with reasonable political support was usually able to reach a policy-making consensus. Detailed and tacitly shared perspectives on the crisis situation (to be discussed further below) also facilitated the development of a common national position. But despite both these consensus-producing characteristics and the absence of any programmed provision for changing team leadership, the Soviet team, quite plausibly

we feel, developed hard-line and soft-line factions in dealing with the East European situation.

Because of greater communication difficulties and internal structural differentiation in their decision-making environments, intra-national and intra-bloc actors in EMS were constrained to narrow the range of acceptable policy alternatives. Here roles were more clearly specified, including a personified opposition in one case acutely threatening the team chairman's position (but without sufficient means at his disposal to cause his overthrow). CDM's, EIM's and FMI's frequently disagreed with each other, with CDM's being more concerned about public opinion and more worried about the costs of conflict. Structural requirements that most internal communications be written rather than verbal and face-to-face enhanced difficulties of communication and personality-related interpretations. For example, the FMI of Utro assumed the explosion was an attack and advocated all-out retaliation long after the EIM and CDM had full information on the problem; they neglected to write him until the crisis had deescalated. According to post-game discussions, the written message requirement enhanced psychological uncertainties and frustrations due to the lack of historical cues and the increasing burden of information processing. Several of these internal, structural factors, then, had an important effect on the high priority need for "efficient" team coordination and the related decisions by Utro and Oms not to get involved in international conflict.

If Figures 1 and 2 show intra-national and intra-bloc activities affecting national decisions, TEMPER nation-groups in Figure 3 act in strikingly unified and symmetric fashion. The parallel nature of actions and reactions is due to the unitary way in which each nation-group invokes the same set of information-processing and decision-making equations, differing only in their data inputs and parameters. Thus within-nation-group coordination and efficiency of communication between subunits are, in effect, perfect or at least constant in the TEMPER model.

Let us move now to a comparison of actors and arenas at the international level of analysis. An important similarity deserves to be stressed: the international environment in each simulation, in the realizations we are discussing here, resembles Horton Kaplan's "loose bipolar system."²¹ However labelled, bloc leaders dominate their blocs, pay some or a little attention to bloc members, are fundamentally opposed to each other, try to woo away members of the other bloc, and recognize and more or less avidly compete for the favor of a "third world," sometimes in the forum of an international organization.

But this basic similarity of international decision-making arenas may hide even more important differences. The fact that the INS run was the only one in which significant system changes could or did occur without the outbreak of a major war suggests, but does not prove, that system level changes at the international level are more likely to occur and to have important

effects in INS simulations. Certainly the ahistorical tendency of INS inputs makes systems changes more easily rationally conceivable than the commitment-laden worlds of DETEX and TEMPER. Previous patterns of usage of the three simulations also suggest more attention to the international level in INS and, in part, in TEMPER simulations.²²

A particularly important feature of the TEMPER simulation, its division of actors into conflict regions, also deserves comment from the perspective of the international alliance patterns. As we have already noted, bloc members directly affect neither the goal definitions nor the actions taken by national actors in TEMPER. That NATO was willing to send aid to the United States nation-group during the explosion crisis shows the peculiarly loose connections between conflict region actors: allies may be assisted but their immediate problems are not recognized, except residually in aid and trade relationships between bloc members and bloc leaders (but not between bloc members of opposing blocs even though they may bargain together as did East and West Germany). The loose interdependence of actors across regional boundaries meant that ZPSYZ's and ZDOMZ's in the NATO-Warsaw Pact region were not affected by the crisis "next door" in two other conflict regions; similarly, the Soviet team in DETEX clearly and realistically had an explicit major goal, undefinable in our TEMPER run if the great Powers and the two Germanies were to be put in different regions, of defusing the German situation in a satisfactory manner. If it had not been for the rather

"accidental" decay in West Germany's desired land fraction, this autonomy of decision-making by bloc members might well have led to a ground war unrealistically confined to West Germany and East Germany. Victory would then have depended on the extent of allied military support.²³

C. Perspectives

It has become proverbial that wars begin in the minds of men. One major difference in actor perspectives that appears to have affected war likelihoods has already been mentioned: more or less binding historical antagonisms. At least two others, the varying time perspectives of the different simulation actors, and their manner of problem definition, also deserve comment.

In setting up the DETEX II scenario it was possible, in lieu of the short term projection of specific situations into the future, to leave the detailed specification of the world situation in 1964 (and 1967) implicit in the minds of game participants. Game periods were supposed to occur in real time, sometimes with a few days (or possibly months) between them. Despite the virtual outbreak of war in our run, PHE is therefore perhaps the least likely to undergo major long term changes in the international system. In fact, with the exception of the DETEX II run, none of the Political Military Exercises of which we are aware have gone to war.

TEMPER cycles, on the other hand, were intended to study weekly trends for a period of up to ten years within a relatively fixed and historically determined bloc structure. That we were

interpreting weeks as if they were periods of only several hours should not obscure a modest capacity within TEMPER for indicating at least the beginnings of systemic changes at the international level. The typical INS decision form, suspended at the height of the crisis, was most easily interpreted as specifying yearly budgetary decisions although it too was interpreted as being for a shorter duration. Thus INS time perspectives were at least as long range as those of TEMPER and probably even more oriented toward systemic changes because of the relative lack of constraints on actors, restricting their alliance relationships.

Besides indicating the periods within which simulation designers tend to look for "important" or "dominant" international phenomena, these model differences, in combination with our own attempted time span modifications, seem to have had an impact on war and peace decisions. Thus trying to treat INS like a PME crisis simulation had as a partial unintended consequence, the frustrating communication overloads associated with learning to be writing-dependent, budget-oriented, bureaucratic decision-makers. Both this learning trauma and the relatively short time span of a weekend run might have been experimental artifacts contributing to the original pre-emptive strike decision by Utro.

Finally, and perhaps most importantly, decision-maker perspectives differed as to their manner of problem definition. If we were to try to formalize the "problems" facing DETER II and INS decision-makers, one could perhaps say -- in TEMPER

language -- that psychological and military operations were of significance, as were tactical and strategic force balances and land acquisition or preservation desires. But TEMPER's procedure of adding these problems magnitudes with equal weights would not find a close counterpart. First of all, as already noted, the more inclusive identities of bloc leaders with bloc members' problem definitions (e.g. mother Russia and fledgling Ulbricht) would need to be included. Secondly, strategic differences -- defined not in TEMPER terms of deterrence vis-a-vis an all out strike but vis-a-vis a disarming strike at American bases in Western Europe as well -- would probably be multiplicatively intensified by asymmetrical land desires, and certainly not causally unrelated to a nation's military and psychological operations. Thirdly, the importance of being morally "right" or credible in the eyes of wavering domestic, bloc, or world opinion might be somehow conjoined, but not added to, this list of problems. In DETEX II, for example, the US's more active "deterrent" posture midway through the game seems in part to have been occasioned by the expectation that their case concerning responsibility for the explosion could be proved to all beyond the shadow of a doubt. Similarly, Russian concerns with moral support in true "Marxist-Leninist" terms seems to have increased their chances of a decision to go to war.

The outstanding holistic difference in problem perspectives suggested by TEMPER's accounting-sheet practice of adding problem "credits" and "debits" is that between what might be

called "economic" problems in TEMPER and "political" situation structures in DETEX and INS. Even though there is considerable overlap in the variables concerned, there is no parallel in TEMPER to the prominence given in INS and in DETEX to maximizing validator support, office holding, or bloc leadership probabilities. It is possible that the most efficient TEMPER problem solver may have the fewest changes in leadership structures, but to assume that all actual political elites obey a cost-effective economic "ought" is wishful thinking. Nations are run by politicians, whose decisions are influenced by economic planners and administrators, but as Rosenau and others have argued, the relative influence of such actors on foreign policy is likely to vary considerably with political context.²⁴

D. Decision rules

The behavioral regularities that transform inputs into more or less hostile and problematic outputs can certainly be considered partial causes of war. Much of what has been said above suggests how such mechanisms, represented by boxes in Figures 1, 2 and 3, may turn inputs into decisional outputs. As an example of how one might compare these "decision rules" from several simulations, we shall now look briefly at several of the rules that appear to govern escalation and deescalation decisions with various simulations. Our remarks will be especially limited by the absence of firm knowledge of the largely unprogrammed assumptions guiding INS and DETEX II behavior.

We shall again look first at TEMPER equations, which have the advantage of being explicit and therefore falsifiable. Inspection of these equations indicates that a crucial rule is one which determines the perceived utility of military escalation, symbolically UTIL. For a UTIL above or below zero, escalation or deescalation, respectively, is considered as an appropriate response. If, for example, deescalation is chosen, on the resulting decrease in ZDOMZ is 0.05 times the cube root (diminishing function) of the problem magnitude! The equation for UTIL includes gain and loss values and probabilities, mostly defined in terms of land values.²⁵

What, then, are the comparable situations "driving" INS DETEX decision-makers into escalation or deescalation decisions in problematic or crisis-like situations? Without being more precise, we shall suggest that opportunities to ally domestic validators or to consolidate one's rule in one's land and nation are more important than possible but risky land losses. On the other hand, land losses, to oneself and to special allies in other conflict regions, may be more important than land gains because they are sure to be seized upon as losses raised by validator opposition groups. And the risks of nuclear retaliation will probably be considered with an eye to "spillover" from neighboring conflict regions and the probability of such attacks. In any case, a random term with considerably more variance than TEMPER allows would be needed to account for other factors not included in such tentative global generalizations.

E. Decision Sequences

As a comparison of the variety of noted decisions in the decision sequence charts suggests, there were a number of possible but unemployed behavioral alternatives in each of simulation runs. Systems theorists have long and rightly been concerned with the sequencing of alternatives: in which situations or contexts will which actors invoke which decision rules. A few such choices or restrictions can lead in their direct consequences to major differences in outcomes. In a simulation of international conflict "the decreasing availability of nonviolent decisional alternatives" might well be considered a more important cause of war than either situational inputs or the decision rules that are used in processing these inputs:

The central problem is, of course, to determine the particular combination of underlying source factors in a given situation which does result in the analytical preconditions [of conflict] [For example] what effect do the nature, flow, and interpretation of information have on the foreclosing of alternatives? Analyzing war decisions along these lines represents a much more fundamental approach than the listing of causes of war or the attribution of single, overpowering motives to nations.²⁶

From this perspective, one of the most important similarities among all three simulations is their ability in some sense to shift crisis decision-making from one issue, the explosion, to another, the German situation.²⁷ But differences in the flow of attention seem more important than these similarities.

Perhaps the three most important cases of dissimilar decision sequences affecting the likelihood of war were,

1) the "locking in" of DETEX actors in an increasingly non-cooperative, snowballing conflict process with fewer and fewer non-nuclear options available to the antagonists; 2) the existence of an effective cooperative, bargaining mode of decision-making for opposed small powers in TEMPER; and 3) the crucial turning of Uro decision-makers' attention to internal mechanisms for staving off revolutions and increasing validator satisfaction even when alliance problems were increasing. In the DETEX game, declining American responsiveness was evidenced by the misreading of a Hot Line message from a desperate Khrushchev ^{who was} allowed fewer and fewer viable alternatives by hard line elements in the Presidium; at a later point failure to believe a Soviet ultimatum also indicated a lack of ability to perceive both the problems and the alternatives open to their antagonist. The result was "problem-solving" in the military mode in the absence of oppositional elements capable of proposing effective alternatives.

By way of contrast, self-enforcing "economic" cooperation among antagonistic nations is allowed in TEMPER (if the game designer chooses, once and for all, the appropriate input conditions). But the decrease in West German land desires may well have been of major importance in allowing permissible ZPSYZ and ZDOMZ bargains successfully and peacefully to decrease total problem magnitudes. That war was very near in the TEMPER run is also suggested by its especially symmetrical set of coordinated decision-making responses, reminiscent of the cooperative or conflictful possibilities of Richardson processes.

Faced simultaneously with mounting domestic and international problems intensified by communication differences, both national teams in INS were forced to allocate their attention selectively and sequentially. During the early "learning" periods of the exercise, Utro leaders attempted to choose an externally oriented/pro-emptive strike; later on they passed a critical threshold in directing attention inward to prevent a revolution and to increase domestic validator support. Owne's disavowal of Utro's ADM also suggests a "phase shift" in attention patterns away from international conflict, partly due in this case to a successfully coopted ADM, longer time perspectives, and the recognition of military and economic inferiority. This sequencing of decisions contrasts rather radically in the way alternatives were progressively defined and eliminated in the DETEX II and TEMPER exercises.

VI. The Uses of Simulations

Since our comparative conclusions, tentative as they may be, have been presented in an already summarized and schematized form, we shall not repeat them here. What we would like briefly to discuss is the inference drawn from these findings that typical uses of the Political Military Exercise, INS and TEMPER help explain some of their theoretical differences. This leads to some final remarks about the validity of these simulations and their usefulness for the scholar, teacher, and practitioner of international affairs.

Recall the arguments that the inputs and perspectives are somewhat ahistorical, and that the simulation seems unusually sensitive to domestic actors, structural constraints, learning effects, and international realignment possibilities. These properties all are consistent with a major emphasis on research and teaching of the general principles of international relations. DETEX II's use of collegially structured national actors, on the other hand, corresponds to its heuristic utilization by government policy-makers only a few steps below membership in the Cabinet or National Security Council. The high degree of historical particularism, the focus on decision-making, and the lack of general, programmed domestic or international relationships are also consistent with many policy-makers' orientations toward upcoming crisis situations. TEMPER's atypical characteristics can be related in part to its being built for administrators in a cost-effective conscious environment with heuristic and perhaps training functions in mind. Its clientele is similar to that of the Political Military Exercise, but perhaps with a greater familiarity with the Link Trainer, a slightly longer time perspective, and a higher demand for reproducible, objective, quantifiable information.

If the theories embedded in these simulations are to an appreciable extent a function of their different uses, it is only fair to argue that the validity of such simulations also depends on their uses.²⁸ A good example of this viewpoint would be the claim by a DETEX II participant that the run was not designed to predict the most likely outcome of such a crisis

situation, but rather to explore decision-maker responses when it in an exceptionally difficult or plausible situation. Decision tendencies to take advantage of a novel situation in opportunistic, non-calculated ways, encourage more than a textbook appreciation of the problems involved in such a crisis.

INS researcher, on the other hand, could similarly argue that experience in thinking about long range systemic changes in international relations is far more valuable than the thoroughness of any one particular hypothetical exercise. PER designers could similarly argue that greater awareness of the relevant factors in conflict situations would be an important validation of the simulation model.

Each of these positions has some merit, but as political scientists with an interest both in teaching and policy matters, worry about the dangers of suggesting the "wrong" factors relevant to a particular context, or assuming the "right" ones, but in the "wrong" relationships. Like other simulations of our knowledge of international relations, simulations benefit more from highly developed classifications of inputs, actors, and actions than from our backward understanding of decision rules and interactive sequences. Examples of these simulations illustrate this point, even though each of programmed relationships in DETEX makes its political content more difficult to discuss.

In our post-INS critique session, when asked to compare and Utro with contemporary nations, one Utro participant surmised the planned similarities between his nation

and the United States. But another participant, from Omno, immediately responded, "What do you mean you were the United States? We were the United States!" Interpreting the revolutionary activities of Utro's ADM as a Richard Nixon attempt to get Soviet support for an American revolution would only heighten our awareness of the misspecification of actor relationships in the inputs to the INS run.

But the fallacies of misplaced variables and relationships, more easily detected in the INS run because of the availability of interviewable participants, also seems to characterize TEMPER and DETEX II. If, for example, both DETEX and INS indicate the importance of communication structure, revolutionary potentials and historically binding perspectives, the relationship of each of these factors to violent foreign conflict turned out to be very different in the two exercises we studied. And the cold war orientations of 1956 which seemed to have been important in the DETEX run were perhaps less appropriate in the relatively relaxed atmosphere of 1964 and the actual world of 1967 characterized by increasing peaceful polycentrism in Eastern Europe, Afro-Asian conflicts, and tentative super-power policy coordination. In this respect perhaps TEMPER and INS were more realistic.

Even if its implications need to be explored by many more operating runs, the TEMPER model is especially suggestive of debatable relationships, partly because of its explicit nature. Thus we have already noted the considerable overlap of DETEX and TEMPER problem components, but the rather implausible

relationships governing their aggregation in TEMPER. The projection of cost-effective decision-making rules onto the Soviet Union, East and West Germany is also controversial, especially when various kinds of deterrent capabilities are considered. A lot of psychological variables, such as misperception tendencies, are included in TEMPER, but their impact on perceived problem magnitudes and alliance conscious problem definitions in TEMPER differs considerably from either the DETEX II or INS experience.

These differences among simulation models of international conflict suggest that their designers held diverging theoretical views. Therefore much of what we have learned about international relations has been of a negative sort: disagreements concerning relationships among the many factors involved have been clarified and posed as issues for empirical investigation. But if such knowledge is somehow holistically more than the sum of its faulty parts, it is clear from this simulation exercise both that modelling procedures must oversimplify reality and at the same time should aim for greater empirical validity through periodic revisions. As Sidney Verba has argued, "little purpose may be served by creating a simulation so abstract that it cannot be connected to real political phenomena, or by creating one that contains all the ambiguity and confused chaos of the real world."²⁹

But this lack of consensus only enhances our feelings that the major substantive issues require complex modelling vehicles -- such as manual, man-machine, and computer simulations --

to catch, to explore, and empirically to reformulate our theoretical insights. We learn by doing, by operating our theories to discover their surprising implications, and by our own experiences, even if they are artificial ones.

Increased understanding leading to eventual transformation of the violent interchanges characteristic of contemporary international reality requires greater use of idealized, artificial representations of that reality.

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3 Guetzkow, Alger, Brody, Noel, and Snyder, Simulation in International Relations (Englewood Cliffs: Prentice-Hall, 1963). Two important research projects using and developing this technique are Richard Brody, "Some Systemic Effects of the Spread of Nuclear Weapons Technology: A Study Through Simulation of a Multinuclear Future," Journal of Conflict Resolution, 7 (1963), 665-753; and Charles F. Hermann, Crises in Foreign Policy Making: Simulation of International Politics, (Ph.D. dissertation, Northwestern University, 1965), forthcoming. See also H. R. Alker, Jr., "Decision-Makers' Environments in the Inter-Nation Simulation," forthcoming.

4 TEMPER, Volumes 1-7; Morton Gordon, "International Relations Theory in the TEMPER Simulation," unpublished paper, Abt Associates, Inc., October 1965; and Clark Abt and Morton Gordon, "Report on Project TEMPER," unpublished paper, Abt Associates, Inc.

5 See Gordon, op. cit., and the TEMPER, Vol. 3: Game Handbook.

6 Thus it should be recognized that ours is a very limited comparative sensitivity analysis. For our three models neither the inputs were varied (although some differences surely existed) nor were model parameters changed (even though random factors were varied in the several TEMPER runs and DETEX II

was partly replicated, and the INS scenario has also been rerun); rather, we varied simultaneously the more macroscopic assumptions that differentiate TEMPER, PME, and INS from each other. For examples of sensitivity analyses of a single model's inputs and parameters see R. M. Cyert and J. G. March, A Behavioral Theory of the Firm, Prentice-Hall, Englewood Cliffs, 1963, and G. P. Bonini, Simulation of Information and Decision Systems in the Firm, Prentice-Hall, Englewood Cliffs, 1963. For another comparison of three different models, see R. D. Brunner, "Some Comments on Simulating Theories of Political Development," paper delivered at Symposium on the Simulation of Decision-Makers' Environment, Wayne State University, May 1967. Clearly both more analytic and synthetic comparisons are needed for each and all of the models we are discussing.

7 DETEX II was chosen because of its substantive content, because of the feeling of many participants of unusual involvement, and because several attempts at replicating the scenario in Political Military Exercise terms had already been made. Had the runs not already been done, the authors would have been unable to generate the considerable time and expert talent brought together in the games.

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~~_____~~ We have omitted from our use of this material many technical details of the exercise not central to our purposes.

- 8 The design of the TEMPER model partially determines the world political structure. A Nation-group may interact with potential enemies in its own conflict region or with allies within its own bloc, but most other interactions with other Nation-groups are prohibited.
- 9 We also had to specify nations' BC generation rates, depreciation rates, decision latitude, and validator satisfaction for Omne, Utro, Yora, Egra, and Algo. Analogs of most of these variables are specified in TEMPER's data base and were useful in picking INS parameters, as were previous decisions made by Richard Brody and Charles Hermann in their simulation runs.
- 10 Various plausible interpretations for ZDOMZ and ZPSYZ levels are given in several TEMPER manuals. Ignoring misperceptions, the crucial idea is that ZDOMZ's and ZPSYZ's are reciprocally related: small ZDOMZ's mean low levels of military operations, but the threat "to do something" if such a low ZDOMZ is exceeded means a high psychological operations or ZPSYZ level. In the following table, adapted from JoAnne Lewis, The TEMPER Model, Vol. IV, Part III, p.26, note how "matched" ZDOMZ's and ZPSYZ's add up to ten.

ZDOMZ Value	ZPSYZ Value	Conflict Level (employed or tolerated)
0	10	Peacetime operations
1	9	Maintenance of Minor Forces
2	8	Routine Reconnaissance
3	7	Minor Force Deployment
4	6	Major Force Deployment
5	5	Armed Reconnaissance
6	4	Minor "Brush-Fire" Action
7	3	Local Conventional Actions
8	2	Limited Conventional War
9	1	Theater Limited Nuclear War
10	0	All-out Thernonuclear War

Other situational variables that game players are required to choose involve limitations on bargains, contiguity of sea regions, navy travel schedule, distance between regions, and tactical and strategic procurement policies.

11 The TEMPER Manuals distinguish between model changes made by a game designer interested in specifying and testing different theories of international relations, and player changes which serve as inputs to a basically unchanged model. Since we are interested primarily in the theory made explicit in TEMPER by its designers as an approximation to the real world, almost no designer changes were made -- misperception parameters being the single exception because we knew this part of the model was currently undergoing considerable change.

2 When the first computer run was attempted, relatively high levels of military activities (ZDOMZ's of 6.0) in Cuba and Vietnam immediately produced two land wars. These developed into a quick defeat of Cuban subversion by an alliance of other

Latin American states, while the Vietnamese war was dragging on somewhat inconclusively. Since the simulation automatically stopped with the termination of the Cuban war, it was decided to rerun the simulation with abnormally low ZDOMZ's and ZPSYZ's in these areas in order to see what would happen in the planned crisis situation. This procedure reflects the "relaxed tensions" view point of the original DETEX scenario as well as our desire to work with an at least partially updated 1960 data base.

13 The cycles in TEMPER are called weeks as the model is not expected to be able to resolve events more finely than into such aggregate periods. As will be clear from the following description, however, a number of events parallel to those of the DETEX and INS runs did occur at later periods. It is thus plausible interpretively to compress TEMPER time intervals for the investigation of some situations. Treating weeks as 12 or 24 hour periods would in fact give several parallel results with these other simulation exercises.

4 The total weekly problem facing decision-makers is calculated by summing the sizes of their a) "milops" problem due to threatening enemy military operations) plus b) their

"psychops" problem (derived from comparing one's own force commitment and perceived enemy retaliation threats), and c) a tactical forces ratio problem, and d) a desired land problem. For both German teams, land acquisition desires did not seriously compound their other problems. Otherwise it would not have been nearly as easy to deescalate out of the problem situation, and war like that of the DETEX run might well have resulted.

15 As ways of comparing computer, man-machine and all manual simulations, further refinements of this kind of visual summary of the flow of decisions are certainly in order. One such elaboration might be in terms of the "kinds of causes" discussion below. That other dependent variables -- ZDOMZ's, levels of communication, or degrees of intra- or inter-bloc cooperation, for example -- could be treated in a similar fashion should also be clear.

The form of these charts was suggested by game theoretic decision trees, Tinbergen-Wold causal model diagrams, and Ashen's techniques for the analysis of manual simulations. See Hermann Wold, ed., Econometric Model Building: Essays on the Causal Chain Approach (Amsterdam: North Holland Publishing Company, 1964); and W. Edward Cushen, "The Analysis of Political Games," (Cambridge: Center for International Studies, mimeographed, 1966).

16 At this point we report briefly the outcomes of replication attempts of the DETEX II, TEMPER and INS runs reported here. The DETEX-M run produced an active Russian response -- the occupation of Spitzbergen in the Arctic and claims of American culpability, but did not develop far enough so that pre-programmed East European inputs and the reactions to them could be compared. A two hour long INS replication by Professor Donald Puchala of Columbia University, involved misperceptions as to the cause of the explosion and escalation to the brink of war, but did not evidence severe internal dissension. Another partial replication by Professor Charles Powell of Temple University, exhibited misperceptions like those of INS, UN-type discussions, a limited retaliatory sneak attack something like DETEX and INS participants proposed, but no further great power escalation nor internal difficulties despite considerable unprogrammed provocation by restless allies. A TEMPER rerun, with only random numbers changed, was by far the most accurate replication, with only a few differences in the frequency of bargained armament and threat reductions.

17 Richardson's work has been reviewed in A. Rapoport, Nights, Games and Debates (Ann Arbor: University of Michigan Press, 1960), Part I, and generalized in K. Boulding, Conflict and Defense (New York: Harper, 1962).

The simplest model is ^{that} of the armaments expenditures X and of two countries interlinked through time according to the

equations

$$\frac{dx}{dt} = my - ax - c$$

$$\frac{dy}{dt} = nx - by - d$$

where m and n are hostility coefficients, a and b indicate defense costs, and c and d represent (initial) cooperation tendencies.

18 This abbreviated framework for analysis owes a good deal to the decision-making orientations of Lasswell, Coleman, Snyder, Bruck, and Sapin, and the simulation descriptions of Orcutt and Abelson. For details see Alker, "Computer Simulations as Political Theories," in preparation.

19 B. Russett, "Cause, Surprise, and No Escape," Journal of Politics, Vol. 24 (1962), uses a similar notion borrowed from J. S. Baker's work on traffic accidents to describe the outbreak of World War I, the Sarajevo assassination being the surprise or catalytic event. Then comes the point of no escape after which the war (accident) can no longer be avoided, and the key event of actual hostilities (the collision). Either war or an accident can thus best be thought of as a sequence of events, with a combination of remote, modiate, and direct causes.

20 These distinctions are reminiscent of the review of causal arguments at different level of analysis in K. Waltz's Man, the State and War (New York: Columbia University Press, 1959). But there are some interesting substantive differences. For example, whereas Waltz cited Rousseau's emphasis on the absence of restraints in the international environment, simulation actors in these runs found themselves in an arena of internationally organized antagonism.

21 M. Kaplan, System and Process in International Relations (New York: Wiley, 1957). Some of the subsequent discussion could also be phrased in Kaplan's terms whether the various simulations are sub-system, national system, or international system "dominant." These distinctions imply a composite notion also sometimes used in sensitivity studies, that variables defined at a certain level of analysis both show a high amount of variation and have strong effects on variables defined at other levels of analysis. We shall use both of these aspects of the "dominance" or "importance" notion in our own remarks.

22 The Brody-Driver runs, for example, were repeated a number of times and then averaged over the considerable variance in micro-level details; Brody was explicitly exploring various possible changes in the alliance structure of the international system due to a diffusion of nuclear weapons. (The feedback from international alliance level changes occurs through sub-

nationally programmed national security validators who act, sometimes in a revolutionary manner, in terms of a ratio of the strength of one's allies divided by the strength of unaligned and hostilely aligned nations). TEMPER has been used for runs of up to ten years of simulated time.

23 It will immediately be suggested that it was unrealistic to keep separate the three Conflict Regions containing Russia and her European allies. But to have made the appropriate mergers on both sides would have further aggravated TEMPER's regrettable tendency to aggregate the partly autonomous subunit actors found important in the other simulation runs, leading to extremely unrealistic problem definitions and action choices.

24 J. Rosenau, "Pre-Theories and Theories of Foreign Policy" in R. B. Farrell (ed.), Approaches to Comparative and International Politics (Evanston: Northwestern University Press, 1966), pp. 27 - 92. Rosenau suggests as important differences in decision-making arenas affecting both perspectives and decision rules, the size of the nation, its level of economic development, and its "open" or "closed" nature.

25 The UTIL equation, excluding a random term, is:

$$UTIL = PGAIN \times \text{others' land value} \times (PWIN - PLOSS) \times$$

$$\text{own land value} \times (1 - PWIN) - RISK_N - RISK_O - THRESH.$$

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Necessary definitions are PGAIN = potential fractional gain in territory by successfully escalating; PLOSS = the potential loss to you and gain to your opponent; PWIN = the probability that potential gain will be realized; RISK_N and RISK_O, potential losses due to nuclear and conventional retaliation; THRESH = a threshold of minimum calculated net gain. Certainly an awe-inspiring "ought," the equation is not very gratifying to our sense of empirical plausibilities.

26 R. Mack and R. Snyder (eds.), "Approaches to the Study of Social Conflict," Journal of Conflict Resolution, Vol. I, No. 2 (June 1957), pp. 222-224. Mack and Snyder are discussing Karl Deutsch's paper on "Mass Communications and the Loss of Freedom in National Decision-Making: A Possible Research Approach," appearing in the same volume.

27 This phenomenon is reminiscent of James Coleman's excellent monograph, Community Conflict (New York: Free Press, 1957), in which he describes an initial single issue as disrupting the equilibrium of community relations, allowing previously suppressed issues to appear, engaging new and old opponents, increasing stereotyping, and resulting in conflicts relatively independent of the initial conflict issue. In our runs it is clear that INS and DETEX both evidenced a good deal of this complex and fascinating kind of "snowballing process," while TEMPER did less so because of the relative autonomy of

quasi economic actors in different Conflict Regions.

28 See particularly Charles Hermann's stimulating paper, "Validation Problems in Games and Simulations with Special Reference to Models of International Politics," Behavioral Science, Vol. XII, No.3 (May 1967), pp. 216-231. He also goes on to argue that a variety of different kinds of validity are appropriate in different stages of model development: "Face validity can be used in the construction stages; internal validity can follow in the early trial runs; when research is being performed event and research hypothesis validity can be employed; if the previous validity checks indicate areas of poor correspondence, variable-parameter and programmed hypothesis validity can then be engaged" (p. 230). Our comments here are only impressionistic ones, i.e. at best of face validity.

29 S. Verba, "Simulation, Reality and Theory in International Relations," World Politics, Vol. XVI, No. 3 (April 1964), p. 496. A similar emphasis on the need for selectivity and modifiability of one's models is eloquently argued by Hubert Blalock in his Causal Inferences in Nonexperimental Research (Chapel Hill: University of North Carolina Press, 1961), p. 8: "The dilemma of the scientist is to select models that are at the same time simple enough to permit him to think with the aid of the model but also sufficiently realistic that the

simplifications required do not lead to [highly inaccurate] predictions.... The more complex the model, the more difficult it becomes to decide exactly which modifications to make and which new variables to introduce. Put simply, the basic dilemma faced in all sciences is that of how much to oversimplify reality."