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WAR GAMES—A SOUND PROCEDURE FOR TESTING MILITARY PLANS AND CONCEPTS?

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(6) WAR GAMING--A SOUND PROCEDURE FOR TESTING MILITARY PLANS AND CONCEPTS?

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SUMMARY

This thesis presents a non-technical analysis of the utility and validity of modern war gaming procedures for evaluating military plans and operational concepts. Selective contemporary applications of war gaming methodologies are investigated and their capabilities and limitations are identified and examined. The conclusion is reached that the war gaming process provides a meaningful and viable method for combining military expertise with modern analytic techniques to assist defense planners and decisionmakers in making rational choices among complex alternatives. Recommendations for improvements in the state of the war gaming art are made.

CHAPTER I

INTRODUCTION

> The general who wins a battle makes many calculations in his temple ere the battle is fought.[1]
>
> Sun Tzu, 500 B. C.

The process of maneuvering pieces or symbols representing military elements over reproductions of terrain in an attempt to conduct imaginary military operations is a military tradition with a long historical record. The relative respectability of these procedures in terms of their military worth has been the subject of ancient and sometimes bitter controversy.

> I know that there exist many good men who honestly believe that one may, by the aid of modern science, sit in comfort and ease in his office chair, with little blocks of wood to represent men, or even with figures and algebraic symbols master the great game of war. I think this is an insidious and most dangerous mistake.[2]
>
> William Tecumseh Sherman, 1869

Whether this technique has survived over the centuries because it is a meaningful method for thinking through complex military problems, or merely because it provides mental exercise in some form of entertaining pastime, is not significant. That it has survived,

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[1]Milton C. Weiner, "Gaming Methods and Systems Analysis," Analysis for Military Decisions, ed. by E. S. Quade, (Santa Monica: The Rand Corporation, 1964), p. 217.

[2]Joint War Games Agency, Organization, Joint Chiefs of Staff, Joint War Gaming Manual, (Washington: 1966), p. 104.

undergone a multitude of improvements, and is used extensively in the highest levels of our national defense establishment is very significant.

Even a cursory review of the available literature concerning the full range of operations research-systems analysis techniques, of which modern war gaming is but a single method, will disclose that the usefulness of any scientific method which attempts to abstract reality, mathematically manipulate these abstractions, and then draw conclusions from the resultant data is suspect. War gaming in particular is the subject of heated debate. There is historical similarity in the arguments used by both critics and protagonists, alike. Advancing technology and state-of-the-art improvements have caused substantial changes in the contents of the arguments; however, through the years the basic themes have not changed. On the one hand, critics argue that war games and the decisions based on the results of war games tend to ignore the human equation and to overlook reality in applying gaming techniques and their computerized counterparts. The views expressed by Irving L. Horowitz in his book, The War Game, are representative of the typical antagonist's view. He states:

> . . . 'The War Game' has become a characteristic feature of modern life. From amateur 'war game' clubs to professional academicians playing the war game in the company of the higher military circles, we have come up against a phenomenon of the 'robotization' of mankind. We treat people as if they were tools, and before long we

gradually slip over into the treatment of people as if they were toys (pawns to be sure).[3]

On the other side, protagonists treat the subject of war gaming as a scientific method of analysis complementing the knowledge, judgment, and experience of military advisors to executive level decisionmakers. The value of war gaming operational plans was recognized by the allies and axis alike in the decade preceding World War II and games were used by both sides during the war.[4] In 1943, with the publication of Theory of Games and Economic Behavior,[5] John von Neuman and Oskar Morgenstern refined the former's earlier thoughts on the utility of a mathematical solution to problems involving opposing interests. The authors elaborated a method for mathematically defining rational behavior in a social economy. Since then, serious, but relatively unsuccessful, efforts have been made to apply this theory to the full spectrum of military planning and decision-making. Today, direct uses of game theory are relatively rare; in a broader sense, it has made significant contributions to the way operations analysts now perceive conflict situations.[6]

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[3]Irving L. Horowitz, The War Game (New York: Ballantine Books, Inc., 1963), p. 9.

[4]Kingsley S. Andersson, The Game of War (Burlington: Technical Operations, Inc., 1960).

[5]John von Neuman and Oskar Morgenstern, Theory of Games and Economic Behavior (Princeton: Princeton University Press, 1953).

[6]E. S. Quade, "Mathematics and Systems Analysis," Analysis for Military Decisions (Santa Monica: The Rand Corporation, 1964), pp. 243-245.

The ever increasing worth of war gaming as an adjunct method for evaluating complicated military problems is widely recognized. In 1954, Alexander M. Mood summarized the value of gaming in a world of complex international attitudes and modern technology in the following strong statement:

> . . . . A game is the perfect vehicle for studying strategy and tactics. A good high-level game, for example, would be of immense value in the formulation of war plans. . . .[7]

Herman Kahn has not been as enthusiastic in his endorsement of the utility of war gaming, but in 1957 he undeniably supported the method in a paper published by the Rand Corporation:

> . . . . War gaming might find a very important application in the testing of hypothesis generally and War Plans in particular. . . .[8]

War games and computers are distinctive in the modern decision-making process and this particular process shows no indications of diminishing in importance.[9]

This paper develops a non-technical assessment of the utility and validity of modern war gaming techniques as a method for making rational choices among alternative military plans and operational concepts. Research has been directed at current literature in the subject area and from personal association with military and

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[7]Alexander M. Mood, War Gaming as a Technique of Analysis (Santa Monica: The Rand Corporation, 1954), p. 10.

[8]Herman Kahn and Irwin Mann, War Gaming (Santa Monica: The Rand Corporation, 1957), p. 13.

[9]"Defense Savings Laid to Analysis," New York Times, November 27, 1967, p. 8.

civilian personnel concerned with the uses and abuses of analytic methods involved in the solution of military problems. The following chapters trace the historical development of modern gaming methods and applications, describe the general types of games in common use, and evaluate the adequacy of current techniques.

CHAPTER II

EVOLUTION OF MODERN WAR GAMING TECHNIQUES

The long history of human activity is replete with examples of man's fascination with efforts to systematize and thereby simplify the military decisionmaking process as the tactical and materiel alternatives became increasingly complex. This chapter attempts to synthesize the history of the development of war gaming from its earliest forms, through rigid and free rule war games, to the modern applications of gaming techniques in the various activities of the Department of Defense.

If one accepts the widely held view that the game of chess is a form of war gaming, then it can be said that war gaming is an ancient art and probably had its beginnings in the eras before recorded history. Archaeological evidence indicates that a crude form of war gaming, similar to chess, was invented by the ancient Persians.[1] Through the passing years and into the latter part of the 18th century other chess-like games simulating combat were developed. However, these earlier forms appeared to be devised for pleasure and were not recognized either as valuable teaching aids or as analytic tools in the context of military problem-solving.

During the last half of the 18th century, an attempt was made to treat warfare as an exact science. A popular term, "military

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[1]Gordon B. Rogers, "Battles Without Bloodshed," Army Information Digest (December, 1960), p. 32.

mathematics,"[2] was coined to describe the great emphasis that was placed on this rigid, mathematical approach to warfare. Battles became scientific exercises and, apparently, it was preferable to lose rather than achieve victory by unscientific methods. A prominent militarist is alleged to have characterized the military thinking of this period with the remark:

> A true strategist of that epoch did not know how to lead a corporal's guard across a ditch without a table of logarithms.[3]

It is not surprising that the approach to warfare which placed greatest emphasis on mathematical precision would find expression in relatively sophisticated, highly detailed, and complex battle games. In 1780, Helwig, the Master of Pages in the Court of Brunswick, designed a game called War Chess.[4] In this game, single pieces representing entire military units were maneuvered about on a modified chess board with 1,666 small squares colored to depict five classes of terrain. The moves were made according to a set of mathematical rules describing how the individual pieces moved, won, and lost. This game was invented to train young men for future careers in the army. It has been speculated that the term "Queen of Battle," as a designation for the infantry was born in this game. The pieces representing infantry battalions could move about the game board in a manner similar to that permitted the "Queen"

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[2]Joint War Games Agency, Organization, Joint Chiefs of Staff, Joint War Gaming Manual (Washington: 1966), p. 104.

[3]Kingsley S. Andersson, The Game of War (Burlington: Technical Operations, Inc., 1960), p. 4.

[4]Ibid.

in chess.[5] During the same era another game, New Kreigspiel, was invented by George Venturenus, a famous military writer and tactician of Schleswig. His game, also an elaborated form of chess, was played on 3,600 squares and employed up to 1,800 brigades to a side. The game was played according to 60 pages of intricate and complex game rules.

The success of Napoleon, as he overran Europe with a citizens army, spelled the end of stylized conflicts and led to a decline in interest in the mathematical, pseudo-scientific view of warfare. However, the irrepressible German fascination with gaming war could not be denied and the German Army remained a strong practitioner of gaming throughout the 19th century. Modern war gaming techniques came into existence during the early years of this century as the German militarists developed a number of innovative and relatively realistic models of typical historical conflicts. Von Reisswitz and his son devised the most prominent games, Kriegspiel and Guise of War,[6] in 1811 and 1824 respectively. These forerunners of our modern techniques used realistic maps and charts to a scale of 1: 8,000 while realistic situations were written in scenario forms and real-time was introduced. The scenarios and intelligence information were issued to opposing commanders and umpires were used, for the first time, to supervise the moves and apply the rules. The Chief

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[5]J. K. Hjalmarson, "The Development of War Games," Canadian Army Journal, XV (Winter, 1961), p. 6.

[6]Andersson, pp. 5-6.

of the German General Staff, Marshall von Moffling, was so impressed with the value of Guise of War as a training device that it was adopted by the army and integrated into regimental training schedules as mandatory training for all officers.

The next major change came in 1876 when Verdy de Vernois, an instructor in the Prussian Army, introduced a philosophy calling for the free conduct of games and a departure from the rigid-rule application of assessment criteria. This movement split the thinking of German gamers into two factions, the original rigid-rule Kriegspiel school and the Free Kriegspiel school.[7] The protagonists of the rigid-rule method retained the rules and formalities of the original game concept, while the Free Kriegspiel faction insisted on fewer rules and a free evaluation of tactical problems using experienced and knowledgeable directors and umpires. Vernois' Free Kriegspiel was faster and more realistic than the older, more tedious games. It introduced professional judgment as a substitute for the complex and time-consuming mathematics of the rigid-rule game and thus received wide acceptance throughout Europe and in the United States.

In 1833, Major W. R. Livermore developed the American Kriegspiel from British translations of the documentation of German games.[8]

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[7]Arthur W. Pennington, "History and Classification of War Games," First War Gaming Symposium Proceedings, ed. by John Overholt (Washington: Washington Operations Research Council, 1962), p. 3.

[8]Robert D. Specht, War Games (Santa Monica: The Rand Corporation, 1957), pp. 7-10.

Major Livermore's game followed the rigid-rule format modified by his Civil War experience and his interpretations of the Prussian Wars of 1866 and 1870. American Kriegspiel was an extremely flexible game for its time with more closely approximated actual battle conditions than any other game of that period. However, it was highly complex and met with the same resistance and disinterest as its German counterpart.

At the turn of this century, war games of the Free Kriegspiel type were introduced in the United States and proved acceptable as a training device. Historical surveys indicate that Germany continued to dominate the field of war gaming in the years prior to World War I.

During the first two decades of the 20th century, the Germans were the first to document the use of gaming to formulate and evaluate war plans. Two important examples cited were the gaming activities supporting the Von Schlieffen Plan and the plan for the German Spring Offensive of 1918.[9]

In the post-World War I era, war gaming continued to play an active part in the training of officers in the United States and the major foreign military establishments. The American Army used many variations of the free game method in its service schools. These included the tactical walk, the tactical ride, command post

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[9]Girard, p. 11.

exercises, and map maneuvers. Germany continued the multi-purpose application of gaming techniques with even greater emphasis on the broader aspects of planning and plan evaluations. The limitations imposed on German military activity by the Treaty of Versailles forced the German militarists to turn to gaming for the testing of new concepts, to train future commanders, and thus retain some viable level of military expertise. Several, if not all, of the major German offensive operations in World War II were rehearsed in games similar to the Free Kriegspiel procedures.

During the second World War, the Germans gamed portions of planned operations prior to initiating major campaigns. For example, a proposal to invade England was war gamed and the results of these games indicated that major difficulties would be involved in such a campaign. These games significantly influenced the decision of the German High Command to confine the battle for Europe to the continent. In similar fashion, the Russian campaign and the defense of the Ardennes were gamed in 1941 and 1944 respectively.[10]

In 1940, the Japanese attempted to examine future political and military courses in a series of games played at the Total War Institute and the Imperial War College. Among the games played were the attack on Pearl Harbor and the offensive operations against

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[10]Riley Sunderland, An Outline History of War Gaming (Ft Monroe: War Games Division, Combat Developments, USCONARC, 1956), pp. 5-7.

Midway and the Aleutians. In later years, Japanese war gaming addressed the plans for the invasion of India and the East China Offensive. Historical documents indicate that the results of these games pointed to the prospects of high casualties and serious reverses. However, aggressive umpires required reiterations of the games, adjusting the rules until favorable outcomes resulted.[11] It is interesting to speculate on the course of the war in the Pacific had the Japanese military authorities taken a more reasonable approach to the original game outcomes.

Although the American Army war gamed Mobilization Plans in 1934, no extensive gaming was conducted to support operational planning in the years just prior to World War II. During World War II, advisors to the military services developed systematic approaches to problem-solving based on the work of von Neuman and Morgenstern. von Neuman's game theory was applied successfully to such diverse problem areas as logistics, submarine search, and air defense. Gaming was also used to test the plan for the Allied invasion of Normandy prior to the actual operation. This latter example is the only historical record of any significant allied operational gaming efforts during World War II.

Exposed to the utility of gaming methods and the extent to which the Germans and Japanese used these techniques prior to and

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[11]Girard, p. 12.

during World War II, the War Department in 1947 began an extensive examination of the potential for war gaming in the American military establishment. General Eisenhower established the Haislip Board to review the status of the Army and to recommend measures to ensure the availability of an effective ground force. One of the Board's strongest recommendations concerned the need for critical evaluation of all war plans. General G. R. Cook was the principal proponent on the Board for this use of gaming techniques. His experience at the Command and General Staff College with the "murder board" system for evaluating classroom tactical problems was the basis for his strong feelings about the value of war gaming. His view prevailed and gaming was initiated in 1948.[12]

The initial efforts, although conducted unilaterally by the Army, considered both join and army plans and highlighted several factual deficiencies in the plans. The final report of this effort was used by the Army as the basis for major revisions. Since 1948, war plans have been gamed by all services, at various levels in the command structure, and in the Department of Defense.[13]

The use of war gaming techniques in the research and development process has been a common practice throughout American and foreign military establishments for the last two decades. Although this use is considered a relatively modern innovation, there are

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[12]Joel F. Thomason, Testing High-Level Plans With War Games, Thesis (Carlisle Barracks: US Army War College, March, 1955), p. 3.

[13]Ibid., p. 4.

historical indications that the Germans used the rigid-rule Kriegspiel game in 1866 to complement field testing of a proposed breech-loading rifle.[14] These low-level games not only provided indications of the value of this weapon compared to that of the traditional musket, but suggested the necessary changes in tactics needed to exploit it. Britain and Japan used gaming techniques to isolate weaknesses in naval materiel prior to World War II. The resultant data led the British Royal Navy to shift to oil fuel. The Japanese revised aerial attack tactics against ships in shallow water. This latter change further led the Japanese to the development of a quick-leveling, air delivered torpedo.[15]

In its contemporary application, war gaming has received increasing attention both within and without the Department of Defense. Modern war games are used for training; exposition and examination of tactics and strategy; testing of current and future plans; and to provide a context for the analysis of proposed innovations in weapons systems.

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[14] Girard, p. 12
[15] Ibid., p. 13.

CHAPTER III

REPRESENTATIVE TYPES OF WAR GAMES

Modern war gaming procedures have become accepted, though perhaps controversial, tools of the military planner and decision-maker. Within the Department of Defense, the Organization of the Joint Chiefs of Staff and each of the military departments retain outside gaming agencies or have local "in-house" capabilities to conduct gaming activities.[1] The Joint War Games Agency, a staff activity of the Organization of the Joint Chiefs of Staff publishes an annual catalogue of currently used war games. The 1968 catalogue lists and describes over 100 different games.[2]

The proliferation of available games and the multiplicity of gaming capabilities and methods used by the various federal and civilian agencies involved in war gaming activities could be the subject of a separate study in any attempt to categorize or classify modern war games. As it is not within the scope of this paper to examine in detail the entire spectrum of available games and their various uses, this chapter will present a delineation of games by their common features.

Essential to all war gaming procedures is a model or set of models representing the relevant characteristics of the materiel

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[1]James J. Cockrill, "Validity of War Game Analysis," US Naval Institute Proceedings, Vol. 92, January, 1966, p. 46. Table 1 catalogues 56 war gaming activities.

[2]Joint War Games Agency, Organization, Joint Chiefs of Staff, Catalogue of War Gaming Models, (Washington: 1968).

and/or organizations to be used in the game. Models are idealized, abstract representations of the significant features or conditions of a system[3] and can vary from stylized descriptions in which only judgment and experience are used to a set of complex mathematical expressions such as a computer program. Models are used to organize the fundamental elements of a system and to represent the manner in which the system behaves. In this respect, they are generally less complicated than reality. In addition to providing a usable structure or framework for analytic purposes, models serve the secondary purpose of introducing terminology. Thus, models provide analysts having diverse skills and expertise with an effective method of communicating with one another.

Warfare involves a wide variety of related military activity; therefore, war games used to examine conflict situations must be capable of realistically representing the interactions of the postulated forces, organizations, equipment, and tactics. This is usually accomplished by designing a game which uses individual models for each specific function of combat activity to be considered in the analysis of a military problem or the evaluation of a military plan. Today, the greater majority of the frequently used games consist of models representing functions of intelligence

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[3]In this context, the system defines either materiel, organization, or combinations of both.

and target acquisition; maneuver and mobility; ground combat, and combat service support (logistics).

The second common feature inherent in all modern war games addresses the manner in which the range of combat activity described in the preceding paragraph, and represented by models, is combined or interacts in the game. The procedures or rules governing the dynamic relationship of the models involved in the game, to include their frequency of occurrence and the sequence in which they advance through the game, is called the game methodology. Normally, a specific game will have a methodology which is peculiar to that game and is not applicable to any other game. In addition to ordering the interactions of the models within the game, the methodology also specifies other conditions, i.e., input data for each model, the echelon or organizational level of combat activity examined, the time increments for each set or cycle of combat interaction, and formats for the flow of information. Assessment routines are frequently integral to the operation of the individual models; however, the game methodology can dictate specific adjustments to properly account for degradations in unit effectiveness due to attrition; in systems capabilities due to weather and visibility conditions; or to adjust the attrition assessments to avoid "overkilling" an opposing, targeted unit.

By establishing the commonalities among war games, categories can be developed for listing games. These categories, or representative types of games, are classified in the following

sections according to differences in models and methodology and described as manual war games, computerized war games, and manual, computer-assisted war games.

MANUAL WAR GAMES

Manual war games are essentially hand-played games utilizing maps or terrain boards and usually addressing either very low or very high levels of resolution.[4] Games in this category are designed to examine in great detail the simulated combat interactions of small units or of individuals. Conversely, they can be designed to analyze highly aggregated postulations of interacting elements of national power. In their latter context, these games produce order of magnitude data or a range of indications addressing international actions/reactions. Manual war games can be further classified according to the methodology used. Three subcategories are now in common usage, i.e., informal war games, rigid-rule war games, and minimum rule war games.

Informal war games can range in size or scope from a single analyst thinking through a scenario to the collective effort of a large group studying complex national policy or strategy options.

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[4]The term, levels of resolution, describes the echelon of the tactical formation (unit or organization) which is critical to the game analysis. As a general rule, this is four echelons below the major organizations being gamed. Thus, in a corps-level game, the level of resolution is normally at maneuver and combat support battalion-level.

These games rely heavily on role-playing and judgment to determine the extent and results of the interactions of the opposing interests being examined and to a minimum degree, if at all, on formalized structures, models, or assessment routines. This lack of formal structure and methodology is contrary to the usually accepted notion of a war game and suggests the proceedings involved are similar to the activities associated with symposia. In this respect, informal games might better be termed adversary procedures. The political-military desk game conducted periodically by the Joint War Games Agency is a good example of informal gaming or adversary procedures.[5] Played by national-level policy and decisionmakers, these procedures are used to analyze national objectives, policies, strategies, and organizations in a simulated crisis environment. They are prepared by the Joint War Games Agency with assistance from other interested federal activities and are conducted in the Pentagon. Action officers from the agencies involved meet for several hours daily, in four to six sessions, and perform the Red, Blue, and control functions in reaction to a series of scenarios. Senior members of the represented agencies meet at the end of each increment or cycle of play to review the results and provide guidance for further reaction to subsequent scenario projections. Thus, a method is provided to the national leadership for

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[5]Thomas J. McDonald, "JCS Politico-Military Desk Games," Second War Gaming Symposium Proceedings, ed. by Murray Greyson (Washington: Washington Operations Research Council, 1964), pp. 63-74.

examining critical policy or strategy issues in a dynamic, simulated international environment.

Rigid-rule war games describe the manner in which this type of manual gaming is controlled. The control device is a comprehensive set of fixed rules which decide the success or failure of interactions between opposing military forces. Control teams may or may not be involved depending on the nature and scope of the game being used and the reason for conducting the game. When all rules are explicitly stated, control groups are unnecessary and the opposing player teams follow precise formats to achieve the results sought by the game. Models are normally used to depict the combat functions required by the game situation and assessment routines determine the outcome of the simulated battles. Fixed rules set forth the manner and sequence of model interactions in accordance with player plans and orders during each cycle of game play. Rigid-rule gaming is widely used today for training purposes. The Marine Corps is perhaps the strongest proponent of these games and uses them extensively in training student officers in command and staff procedures.[6]

Minimum-rule war games utilize the fewest rules possible in controlling the combat interactions. A control group is required

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[6]Ernest C. Cheatham, Jr., "United States Marine Corps Educational War Game," Proceedings, Fifth Symposium on War Gaming, ed. by Edward W. Keller (Pennsylvania: HRB-Singer, Inc., 1966), pp. 431-439.

when using this type of war game. The control group functions to safeguard the credibility and objectivity of the game without unduly restraining the free exercise of player judgments and decisions. Additionally, the control group assesses the results of each increment of play and projects the game scenario for subsequent moves. Player judgments are critical in the minimum-rule game; therefore, these games encourage the use of military expertise to a much greater extent than the rigid-rule type of war game. Minimum-rule games have been used to uncover deficiencies in military capabilities studies, to examine military doctrine, and to analyze current and proposed weapons systems. They are extremely flexible and are used to evaluate the lower spectrum of conflict situations involving military formations no larger than a division. Games of this type can produce discreet examinations of the details involved in specific interactions between military formations or they can perform a detailed examination of an organic weapons system in the context of its contribution to the unit. However, minimum-rule war games require large player and controller staffs, they usually run for long periods of time, and the game produced data tends to be subjective. They are most commonly used by the Army and the Air Force to study problems associated with limited war. Two examples worthy of note are the MINIGAME, developed in 1964 for the United States Army Combat Developments Command by a civilian research organization, Combat Operations Research Group (CORG) and VALOR, developed in 1962 for the Department of the Air Force by

Technical Operations, Incorporated.[7] Of the three general types of manual war gaming methodology, the minimum-rule game offers the most viable possibilities; however, little or no manual gaming is currently conducted in support of high-level military planning.

Manual games are useful for gaining detailed insights into the functional areas of combat activity and for examining the range of possible international implications of national policies and strategies. They can be extremely flexible, relatively simple, and inexpensive to operate. Two critical limitations inherent in their methodologies make them unsuitable for general use in many analytic situations. These limitations are the slow pace of gaming and the possibility of biased results.

Research Analysis Corporation (RAC), a civilian research agency supporting the Department of the Army, is developing a family of five minimum-rule war games for the Organization of the Joint Chiefs of Staff designed to analyze combat interactions at theater-level. The generic title of these games is Theater Battle Model 68 (TBM-68). The specified purpose of this development project is to provide unified, specified, and allied commands with a device for testing plans.[8] If successful, this project could cause a renewed interest

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[7]Darold W. Silkwood, A New War Gaming Methodology for Military Planners (Washington: Technical Operations, Incorporated, 1963), pp. 4-30.

[8]US Army War College, Appendix II, War Game Handbook (U), Course Directive, Course 4 (Carlisle Barracks: US Army War College, 1968), TAB C (SECRET).

in the application of manual gaming procedures throughout the military services.

COMPUTERIZED WAR GAMES

Innovations in military technology and an increasingly complex world environment place a continual strain on the state of the war gaming art. The two major weaknesses in manual war gaming procedure became unacceptably bothersome in the early years of the preceding decade and in 1956 the Department of the Army retained Johns Hopkins University to conduct a study to determine the feasibility of converting selected manual war gaming methodology to a computerized process.[9] Prior to 1956 computers had been used primarily to analyze single weapons system performance through simulations[10] of the systems operating characteristics. This study extended the application of Monte Carlo techniques[11] to the

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[9] R. E. Zimmerman, Monte Carlo Computer War Gaming--A Feasibility Study (Chevy Chase: Operations Research Office, Johns Hopkins University, 1956), pp. 1-5.

[10] Simulation describes a technique for mathematically representing the internal operations of a system and its interactions with other systems. Simulations consist of a set or sets of precisely designed equations and are usually written in computer languages for ease of replication.

[11] Monte Carlo techniques are used in both manual and computerized war game methodologies. They are methods for deciding the outcome of events by comparing probabilities of occurrence with random numbers. In this fashion real world uncertainties and chance happenings are considered in the war game. These techniques were derived from statistical methods; however, they often deal with abstract rather than real populations or samples. Early games used dice for the random selection required by the technique, hence the title, "Monte Carlo." Modern gaming facilities use special machines to generate random numbers or computer programs in which random numbers are automatically generated.

possibility of solving complex problems involving the multiple and interrelated uncertainties associated with a battlefield environment. The study concluded that the digital computer had the capability of automatically performing sequential, mathematical operations according to a specified logic or set of instructions. A trial model was designed, tested, and reported as an example of how a complete battle could be simulated on a digital computer.

Fundamentally, modern computerized games are mechanized, rigid-rule games possessing many of the characteristics of their manual counterparts. They are most effective when applied to idealized conflict situations dealing primarily with equipment such as tank-antitank battles, aerial combat, naval engagements, and similar situations where a high degree of understanding of the nature of the combat interactions exists. No human intervention is involved once the game is initiated and each move or cycle can be exactly repeated.[12] During the game the computer carries the scenario through a chronological series of events, orders into operation the combat, combat support, and assessment models. It performs probability computations and maintains records of attrition and unit combat effectiveness.

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[12]The desire for repeatability significantly influenced the efforts to develop computerized war games. Sophisticated analytic techniques required that data produced by games have great statistical reliability. These demands could not be met by manual gaming procedures which permitted many player-model interactions and involved the natural learning process in any attempt to replay a move or an entire game.

The computerized war game, with its capacity for replication, can investigate many combinations of different military formations and indicate their relative capabilities to operate in a planned tactical environment. Strategy and Tactical Analysis Group (STAG), a Department of the Army agency under the control of the Deputy Chief of Staff for Operations, does just this. STAG has a flexible, computerized war gaming facility and is involved almost exclusively in conducting computerized war games in support of the planning activities of the Army Staff. STAG's TARTARUS war game is just one example of their use of the computerized methodology. TARTARUS is a computerized division-level war game used to examine force requirements/capabilities for various war planning purposes.

Computerized war games have the obvious advantage of near-perfect objectivity, speed, and repeatability all of which are required in the production of large quantities of statistical data for comparative analysis. However, the extremely detailed and highly sophisticated models often take years to construct and the savings realized in rapid operation are lost in lengthy preparation. Additionally, the quantification of rules and assumptions is normally difficult and sometimes impossible. It is in this area that computerized war games frequently receive the same criticisms as manual games, i.e., lack of objectivity. Judgments are involved in these quantifications and the temptation to compromise when faced with extremely difficult problems is great. In the sense that computerized games are capable of many replications they can be

considered flexible; however, this is essentially an external flexibility. To vary the organizational structure of a unit or to include different units in the game requires extensive and time-consuming reprogramming.

MANUAL, COMPUTER-ASSISTED WAR GAMES

As suggested by the description, manual, computer-assisted games combine the more desirable aspects of the types of games examined in the preceding sections into a single methodology. In this type of game, decisions and judgments are performed by players and controllers while high speed digital computers carry the combat interactions through a logical sequence. The computers also perform the casualty/damage assessments and the necessary bookkeeping chores. Computer-assisted games are flexible, relatively quick, and capable of a more realistic examination of conflict situations than either the manual or the computerized game.[13] The combined procedures permit the dynamic analysis of a wide range of combat, combat support, or combat service support (logistics) interactions involved in either limited or general war situations.

Each scenario situation is developed in a logical sequence with appropriate interruptions for the exercise of judgments and

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[13] F. J. Cripwell, "A Discussion of Computer Assisted Land Combat Games," Proceedings, Fifth Symposium on War Gaming, ed. by Edward W. Keller, (Pennsylvania: HRB-Singer, Inc., 1966), p. 268.

to make decisions. The data base, including the cumulative equipment and personnel status of all portrayed units and their levels of supply is updated by the computer prior to the continuation of each interval or cycle of the game. Thus, a running account of unit effectiveness is maintained throughout the game and is readily available to the players and controllers as well as for intermediate analysis, if this is desired.[14] Additionally, the computer automatically records and stores data concerning the results of each move and can perform much of the post-game analysis.

Other important techniques, static and side analyses, may be included in a single game. A static analysis is the detailed examination of some critical situation which develops in the course of dynamic play. A side analysis is repetitive dynamic play of one or more game-developed or predetermined situations in which variations of conditions or equipment are evaluated. Both types of analysis may be conducted manually or on the computer. The method depends upon the availability of appropriate models, programs, and on the nature of the critical situation being examined.[15] Added flexibility is thus gained in that one or more smaller games may be run in the context of a single, large game with no delay or interruption of the main effort

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[14]Ibid., pp. 257-258.

[15]US Army Combat Developments Command, Methodology Notebook for Action Officers (Ft. Belvoir: US Army Combat Developments Command, 1967), p. V-14.

Two examples of currently used manual, computer-assisted war games are worthy of note. The first, Synthetic Tactics (SYNTAC), developed by CORG under a Department of the Army contract is a research war game used by the US Army Combat Developments Command to support a wide variety of concept studies.[16] The second example is the Navy Electronic Warfare Simulator (NEWS) which was developed by the Naval War College and is used to evaluate naval force requirements/capabilities as well as naval warfare plans.[17]

SYNTAC is actually a body of techniques and methods of war gaming representing a modern, highly-developed manual, computer-assisted war game. The methodology is adaptable to games involving units from squad or section to field army or larger; however, its most frequent use is in a corps-level game with battalion-level resolution.

> The SYNTAC War Game provides a dynamic method of analysis particularly suited for studying the ineractions of combat systems and the evaluation of conceptual organizations, weapons, equipment, and tactics. The method permits a realistically objective assessment of combat actions in terms of movement of the FEBA, casualties, equipment losses, and consumption of supplies. These data can be obtained for different levels of combat ranging from platoons to corps or to theater operations as a whole. However, no one game will simulate in detail all of these levels of combat.[18]

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[16]Combat Operations Research Group, SYNTAC War Gaming Manual (U), CORG-M-344 (Ft. Belvoir: US Army Combat Developments Command, 1968), pp. 2-5 to 2-8 (CONFIDENTIAL).

[17]US Naval War College, Fundamentals of War Gaming, 2d ed. (Newport: US Naval War College, 1961), pp. 5-1 to 5-24.

[18]CORG M-344, p. 2-2.

NEWS, a complex of computers and electronic simulators, evolved over a 17-year period from 1945 to 1957. The game was originally intended to support student exercises, and it still does. However, as its capabilities were expanded it became a method for examining selected naval operations plans. In its latter role, NEWS is played by the members of the fleet staff charged with the responsibility for conducting the naval plan being gamed. It is a dynamic, two-sided game in which player decisions and actions are assessed by computers and evaluated by controllers. The results of each move are graphically displayed on large screens and status boards by electronic projection equipment that is linked to the computers.

Manual, computer-assisted war games have the objective qualities of computerized games and the inherent realism of manual games. The flexibility provided by the integrated methodologies is the unique feature of this type of war game. However, the intrinsic limitations of the component methodologies are present to varying degrees in manual, computer-assisted games.

Of the three representative types of games examined in this chapter, this methodology offers the greatest challenge for state-of-the-art improvements. Advanced computer technology and innovations in the fields of mathematics and logic will undoubtedly revolutionize war gaming techniques. The manual, computer-assisted game appears to provide a viable intermediary for the application of progressive analytic techniques to military planning.

CHAPTER IV

UTILITY OF WAR GAME PROCEDURES

In a world characterized by staggering technological advances and inconstant international political situations, the modern planner faces perplexities having no historical precedent. He is confronted with requirements to choose from an increasingly complex and expensive array of weapons systems under a variety of restraints reflecting both economic and political implications. His planning responsibilities involve a full range of possible conflict situations requiring carefully designed, measured responses under conditions of general war, limited war, and permutations of both. In view of this uncertain knowledge, the planner knows he cannot ignore any element which has a possible bearing on the outcome of a war, not at least without convincing assurances that a given element is insignificant. How is he to decide what is pertinent in the profusion of complex facts and opinions available to him? How can he best use the total body of information at his disposal to design the right strategy or plan, opt for the proper weapons system, adopt the appropriate concept, or espouse the correct tactical doctrine? These same considerations permeate the entire defense establishment and are obvious at the highest levels. Dr. Alain C. Enthoven described the perplexing nature of the fundamental problem inherent in the decisionmaking process at the national defense-level in a statement before the United States

Senate in 1967. In summary, it is a matter of devising a reliable and credible method for sifting through great quantities of information to choose the proper weapons systems and strategies from the available alternatives.[1]

Dr. Enthoven's statement addressed the use of systems analysis techniques by Department of Defense analysts. Although systems analysis is not within the scope of this paper, a brief treatment of the subject is considered relevant in establishing a proper context for contemporary uses of war gaming techniques. Rooted in the procedures used by World War II operations analysts to apply scientific methods, particularly those involving mathematics and logic, to the solution of operational problems, systems analysis is a product of the post-war decades. During the 1950's business and economic analysts recognized that operations research methodologies were not sufficiently comprehensive for their purposes. In their search for better analytic techniques, they combined elements of operations research methods with more sophisticated statistical manipulations, econometric theories, and the rapidly advancing computer technology to form a body of new analytic procedures they called systems analysis. Military application of these new techniques was pioneered in 1957 by Charles J. Hitch, then

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[1] US Army War College, Selected Readings, Command and Management Seminar (Carlisle Barracks: US Army War College, 1969), pp. 343-351. A reprint of the statement of the Assistant Secretary of Defense (Systems Analysis) before the National Security and International Operations Subcommittee of the United States Senate.

a research analyst at the Rand Corporation and later the Assistant Secretary of Defense (Comptroller).[2]

Systems analysis techniques were adopted by the Department of Defense in 1961. Included in this body of loosely related, often interacting scientific methods are operations research methods, cost-effectiveness analyses, war gaming, and computer programming/applications.[3]

Recently, it was estimated that in the United States alone there were approximately 200 organizations engaged in analytic support for the Department of Defense and the military services. These organizations produced nearly 3,000 reports and war gaming techniques or results were used to some degree in 25 percent of all reported projects.[4] This is a significant proportion of the total effort in view of the fact that gaming represents only one of ten or more possible analytic techniques available under the generic title, Systems Analysis.[5] A logical extension of this evidence would indicate that war gaming is an accepted and useful analytic tool, particularly to the military planner, to assist in making rational choices among several possible alternatives. The following example illustrates the manner in which war gaming can be used

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[2] Ibid., p. 362.

[3] For a non-technical synthesis and history of systems analysis techniques, see: Analysis for Military Decisions, R-387-PR, ed. by E. S. Quade (Santa Monica: The Rand Corporation, 1964).

[4] E. W. Paxon, War Gaming, RM-3489-PR (Santa Monica: The Rand Corporation, 1963), p. 4.

[5] R. D. Sprecht, "The Why and How of Model Building," Analysis for Military Decisions, ed. by E. S. Quade (Santa Monica: The Rand Corporation, 1964), pp. 79-80.

to investigate complex alternatives at the national policymaking level.

In 1962, the Rand Corporation was asked to address the problem of defining the relationships between alternative strategic force posture, force structures, and national defense policies.[6] In this example force structure is considered to include the mix of strategic offense and defense weapons systems and the doctrine for their use and deployments. Force posture planning entails the procurement and creation of forces that support the announced policies concerning national defense. The interactions between the two would appear to involve the extent to which policy guides posture and posture constrains policy. However, this does not mean that posture and policy are interrelated since other considerations enter into posture determination. Some of these we control, e.g., resources, present strategy, and present policy; some are controlled by our opponents, e.g., his posture and his future capabilities; and others are bilateral in nature. What is the role of analysis and what analytic techniques can be used in assisting the military planner and policymaker to decide the nature of this relationship in arriving at recommendations and decisions concerning strategic military force postures and national defense policy?

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[6]Roger Levien, "The Analysis of Force Policy Planning and Posture Interaction," Systems Analysis and Policy Planning--Applications in Defense, ed. by E. S. Quade and W. I. Boucher (New York: American Elsevier Publishing Company, Inc., 1968), pp. 279-297.

The interactive nature of the principle elements of the problem suggests that analysis has two tasks to perform. First, investigate the required forces, including their costs, to achieve the posture level necessary to support a given range of policy alternatives and second, examine the constraints (technology, budget, and strategies) on the policy alternatives. The choice of analytic techniques relates directly to the nature of the problem. In this case, a five-year time frame was directed, peace and war conditions were to be examined, and the joint/combined implications were to be explored. Further, this analysis must consider the two-sided aspects of the problem, i.e., the uncertainties involved when the reactions of potential opponents are taken into account. The analysis, therefore, must accommodate the enemies' perceptions and his subsequent reactions in terms of his own posture,and, possibly, his strategic concepts and tactical doctrine. Finally, the incremental and/or quantum research and development implications must be a recognized characteristic of the force structure, particularly at the far end of the analytic time frame. The analytic technique applied to this problem must be sophisticated and comprehensive.

Rand used an advanced war gaming methodology comprised of computerized models, war gaming, and scenario writing in their analysis. The methodology was entitled SAFE, an acronym for Strategic-and-Force Evaluation Game. SAFE is a manual, computer-assisted war game conducted in three phases. In the first phase,

Red and Blue teams receive policy guidance, budget estimates for the time frame, and an initial scenario describing strategic force postures. Player teams plan and deploy the necessary forces, allocating resources according to the restraints postulated in the initial scenario. Five dynamic increments are then played covering two five-year time frames. After each interplay (game increment) player teams evaluate their successes and failures and revise or modify their original plans accordingly. The third phase consists of post game analysis and report preparation activities.

The preceding example cites but one instance in which war gaming was used to assist in extremely complex planning problems at the national level. There are many others, some just as complex and some involving lower levels of national interest and complexity. Regardless of the relative legitimacy ascribed to gaming techniques by virtue of the user's high position and purpose, war gaming as an analytic procedure provides no universal solution to the planning process at any level. This fact is emphasized by the many critics of the method.

Much of the criticism directed at the use of gaming for analytic purposes results from overly ambitious expectations about the analytic value derived in terms of immediately available, absolute data or scientifically derived conclusions. This type of criticism results from a lack of understanding of what war gaming is not.[7]

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[7] Ibid. M. G. Weiner, pp. 265-266.

Another group of critics can be found among practitioners of the war gaming art. They assert their parochial points of view when condemning the various types of games in common use. In their terms, war games are either too slow, too subjective, or too general. These dissatisfactions can be found in the profusion of available literature produced by profit-oriented civilian research firms defending or stating a preference for a specific commercial product.

War games merely produce bodies of synthetic data recording an attempt to approach reality in the examination of a given range of probable interactions between adversaries. In this respect, any analytic tool has utility only to the extent that the nature and purpose of the analysis properly recognizes and accommodates the methodological capabilities and limitations. War gaming procedures can provide a means for gaining valuable insights concerning the subleties of complex plans, concepts, and strategies, thus assuring that pertinent considerations are not overlooked in the maze of details involved in modern military planning.

> The heuristic effect of collaborating on the construction and use of a simulation model is particularly powerful when the simulation takes the form of an operational game where the opponents act out the roles of decision-and-policy-making entities (individuals or corporate institutions). By being exposed within a simulated environment to a conflict situation involving an intelligent opposition, the 'player' is compelled, no matter how narrow his specialty,

> to consider many aspects of the scene that might not normally weigh heavily in his mind when he works in isolation. . . .[8]

On balance, war gaming appears to have historical utility and its contemporary viability is suggested by numerous examples of serious, on-going efforts to improve the state of the art.[9]

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[8] O. Helmer, Special Technology (New York: Basic Books, 1966), pp. 17-19.

[9] The records of symposia proceedings published by the Washington Operations Research Council, the East-West War Games Council, and the National Gaming Council cite many examples of improvement efforts.

CHAPTER V

VALIDITY OF THE WAR GAMING PROCESS

The validity of the entire war game process pivots on the ability of the game methodology to produce raw data for subsequent analysis in developing the game findings. In turn, these findings must then address the purpose and objectives of the game. The circular nature of this analytic procedure requires that the game produce not only consistent and credible data but that these outputs be relevant to the purpose and objectives. Thus, an essential characteristic of a war game analysis is that a valid reason exists for the game. This is particularly important because war gaming is a special analytic process and different games have quite different methodological designs and input requirements.

Frequently in the problem definition stage, the complexities and implications of the various alternatives tempt the analysts involved to take a broad, "let's game it" approach.[1] There is no simple rule or criterion for sorting out problems appropriate for gaming. Each analytic situation must be carefully examined in the light of its own difficulties prior to choosing the specific form of the analysis. Hitch states:

> I want to . . . talk about some of operations research's most intractable problems, those

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[1]G. H. Fisher, "Some Comments on Systems Analysis," US Army War College, Selected Readings, Command and Management Seminar, Academic Year 1969 (Carlisle Barracks: US Army War College, 1969), pp. 243-259.

> associated with uncertainties, and especially with those uncertainties tinged with 'game' elements. . . . In fact, no characteristic of decisionmaking is as pervasive as uncertainty. When as operations researchers, to simplify a first cut at an analysis, we assume that the situation can be described by certain equivalents, we may be doing violence to the facts and indeed the violence may be so grievous as to falsify the problem and give us a nonsense solution. . . . It was E. Bright Wilson who said: 'Many scientists owe their greatness not to their skill in solving problems but to their wisdom in choosing them.'[2]

Once war gaming has been selected as the method of analysis the war game objectives must be defined. This is necessary because the objectives establish the parameters of a specific gaming methodology which, in turn, determines the type of game to be played and identifies the input requirements. The credibility of the game produced data is totally dependent upon the manner in which a selected gaming methodology manipulates the input data to stimulate combat interactions at a level consistent with the game objectives. For example, if the game objective is to examine several force structure alternatives to determine the proper mix of battalions to deploy under a contingency plan, the game must have the ability to examine the combat interactions of maneuver battalions and the contributions of combat support battalions. The methodology should be capable of handling terrain and weather situations; tactical

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[2]Charles Hitch, Uncertainties in Operations Research, (Santa Monica: The Rand Corporation, 1960), pp. 1 and 4.

mobility; target acquisition; fire support and weapons effects; and, at least on an order of magnitude basis, the consumption of supplies. Additionally, the methodology must be sensitive to tactical decisions reflecting organizations for combat, employment of reserves, and other shifts of combat power in relatively narrow sectors or zones of the battlefield. Finally, the methodology must be sensitive to realistic time increments or to critical events. In this case, the requirements for flexibility and relatively discreet examinations of battlefield interactions suggest that a manual, computer-assisted game be played. On the other hand, if the problem is to determine the impact of a new artillery weapons system on the firepower of an infantry division or of a new tank or the mobility of an armored division; a computerized war game, at theater-level activity might be the appropriate methodology to select. Thus, in developing the game findings, the analyst must weigh the objectives against the methodology and inputs to that methodology in his evaluation of the raw data outputs.

Input data requirements are associated with both overall game methodology, e.g., tactical doctrine and command and control arrangements; and with individual game models, e.g., TOE's, weapons/munitions effects, mobility, and weather/visibility conditions. The obvious criticality of these data to the ability of the methodology to produce credible results does not require elaboration. However, the existence and availability of current data could affect the methodology selected and could possibly impact on the decision to use a gaming analysis as a part of the problem-solving format.

This is more likely to be a prevailing consideration in an examination of alternative, futuristic weapons systems than in capabilities and requirements studies associated with force planning.

Games addressing ground combat situations are perhaps the most difficult to play and achieve the degree of realism that the study or project effort requires. The current state of the art aggregates unit capabilities and vulnerabilities over the spectrum of the opposing forces and terrain to determine advancement and/or withdrawal on the basis of the relative unit effectiveness existing at a given time in the scenario or as a result of a critical event. Individual weapons and munitions capabilities can be quite accurately portrayed by the models used; however, unit firepower and relative tactical mobility as a function of vulnerability and movement capabilities versus terrain and weather are difficult to stimulate. Target acquisition and intelligence functions are modeled on the basis of an aggregate of opposing unit acquisition devices and relative locations with respect to the forward edge of the battlefield. Probabilities of detection and acquisition are combined to produce gross indications of target location, composition, and activity. Personnel casualties and materiel damage are assessed by imposing mathematical "templates" of average weapons effects over stylized patterns representing tactical dispersion, unit posture and activity, vulnerability (protection), and terrain. The validity of the data produced by these methods is obviously open to a wide range of criticisms. The limitations of current

gaming methodologies used to simulate ground combat are directly related to the uncertainties inherent in the ability of these methodologies to accurately and realistically reproduce the total dynamic environment in which opposing interests, each with different capabilities and many available course of action, interact.

In essence, war games produce a wealth of data reflecting a multitide of attitudes, judgments, and opinions about alternative choices or courses of action. War gaming is used to study very complex situations involving non-sequential and dynamic interactions of units and materiel which are extremely difficult to define clearly or measure precisely.

The preceding paragraphs have addressed the first two of three phases in a typical war gaming process. These are the preparation and the gaming phases. The third phase involves an evaluation and interpretation of the game produced data and the development of game findings. The ability of the game-produced data to support reliable and credible game findings is the final test for validity. Normally, war games are not conducted to determine who wins. Rather, they examine the implications of various alternative ways of accomplishing something. Therefore, the final phase must be carefully planned to avoid overemphasis on the absolute outcome (who won) and to concentrate on the comparative outcome (performance).[3]

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[3]M. G. Weiner, "Gaming," Systems Analysis and Policy Planning--Applications in Defense, ed. by E. S. Quade and W. I. Boucher (New York: American Elsevier Publishing Company, Inc., 1968), p. 277.

A single game can produce large amounts of a great variety of data concerning the problem being studied and the nature of the evaluation of these data is dependent on the objectives of the game. In this respect, different kinds of evaluations are usually possible.

An overall evaluation of the game can be made. This produces a detailed narrative comprising a synthetic history of the simulated conflict situation according to the outcome of each interval or cycle. In this kind of analysis the influence of a variety of conditions and circumstances on the use of a weapons system or concept can be examined. Within the context of this overview, a specific event in the game or a particular aspect of a tactical concept can be examined. The analyst might examine the number of times and under what conditions a unique organization was committed or he could compare the number of casualties and the amount of materiel damage a weapons system achieved with its survivability and logistics requirements.

Another type of evaluation might concern the opportunities and restraints involved in the commitment of a unit or a weapons system. In this case, the essential requirement might be to evaluate the effectiveness of the new unit or weapons system under the influence of critical terrain or weather conditions or in consonance with current target acquisition capabilities. This evaluation could be conducted in terms of specific isolated situations developed by the game rather than in the total context of the game.

Finally, an evaluation might be performed to identify problem areas for further, detailed examination. The problems sought might address the impact on the existing training base of the deployment of several specialized units or the logistical implications of introducing an advanced weapons system into an organization.

The limitations of the various techniques of gaming have been discussed to some degree in previous chapters under the descriptions and examples of the various types of games in common usage today. A brief summary of these limitations appears to be meaningful in terms of their impact on the credibility of game produced data and the validity of game findings.

The first of these, bias, can be intentional or unintentional and exists to the extent that it is introduced by the professional individuals who develop the models, write the rules, play and control the game, and conduct the post game analysis.

The second limitation is directly related to bias and involves the possibility that a lack of professional judgment and experience degrade the results of a game. There are two aspects to be considered under this limitation. First, that the game methodology does not properly account for professional judgment and experience, and, second, that these qualities are present but are not competently exercised in the game.

The third limitation is inherent in any attempt to abstract reality and deals with the intangible factors of leadership,

morale, and esprit de corps. These qualities are generally held constant in a war game and assumed to be present in their most ideal form.

The fourth limitation is perhaps the basis for most of the criticism that is directed at gaming as a meaningful analytic technique. This is the reliability of the input data and is generally associated with the level of detail involved. Much of the input to gaming models and methodologies must be aggregated. In many cases this aggregation is the only approach to quantifying a complex function, even when detailed data can be obtained and used in operating the game models. Weapons and munitions effects are good examples of reliable, readily obtained, and easily measured data. Unit effectiveness in terms of its relative capability to continue fighting is a good example of a sensitive aggregation which includes not only the remaining military strength of the unit but the effects of its organic weapons on the opposition.

The problems posed by these limitations are related to all modern analytic techniques. The credibility of war game produced data and the validity of the findings developed from these data must be evaluated within the framework of the game and with full knowledge that the data is imperfect when compared to reality.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

A war game has the unique ability to approximate the postulated conflict situation and to account for professional experience and judgment. It should be emphasized that war games are never conclusive, only indicative. Games do not attempt to produce military decisions. To the contrary, alternate military decisions are gamed in various combinations to gain insights concerning the possible consequences. The unalterable purpose of war gaming is to gather a body of data which will provide a credible basis for making a decision.

Gaming gives full credit to the opposition's capabilities; actions and reactions; and persistence. In this sense, a game can provide a hostile and critical review of a plan or concept. In this age of nuclear warfare, the capacity for total destruction inherent in the major world powers' military capabilities places serious imperatives on military planning and preparedness. Obviously, we cannot conduct live-fire nuclear exercises to test the credibility of our plans against intelligent opposition. The various war gaming methodologies offer the next best alternative. Gaming provides a framework within which experts representing all relevant areas of national power and science/technology can systematically combine their talents and expertise. Gaming methodology offers a medium for enlightening the planners and

policymakers at all levels of command forcing them to abandon their parochial views. The sequence of events postulated in a scenario and dynamically portrayed by player moves exposes a plan or concept to a comprehensive critical review for the specific purpose of determining flaws and oversights. It is far more economical to make mistakes concerning our national security posture on paper and in war game facilities than to learn from the disastrous environment of a nuclear battlefield.

Much of the utility and validity of a war game analysis depends on the manner in which the decisionmaker uses the various gaming methodologies available to him. As indicated in the preceding chapter, judgment and experience are inherent in all gaming methodologies in varying degrees and the extent to which judgment explicitly or implicity impacts on the game can be predetermined or controlled.

Bias can be present in either the methodology or the analysis of the game results. However, bias is not peculiar to just war games. Pure, scientific objectivity is a rare achievement in any analytic technique used to examine complex problems. The use of experienced personnel as gamers will minimize the risks of intentional or accidental bias and is perhaps the best method of eliminating questionable judgments. E. S. Quade states:

> . . . Human judgment is used in designing the analysis; in deciding what alternatives to consider, what factors are relevant, what interrelation between these factors to model, and what numerical values to choose; and in analyzing and interpreting the results of the

> analysis. The terminology may be inherently vague, and the reasoning may be informal. In short, since judgment and intuition are fallible, caution and reservation on the part of both the analyst and the decisionmaker are necessary to avoid errors or misconceptions that could bias or even negate the implications of the analysis.[1]

The user has the right and responsibility to be suspicious of any war game until he has resolved this question. The emphasis here is not that bias does not exist or that it can be eliminated, but that it does exist and that it can be insidious. The solution is to recognize the bias and account for it in the post-game analysis.

The many intangibles inherent in military operations cannot be quantified or even accounted for in war gaming methodologies. These factors must be considered prior to deciding that a war game analysis is appropriate and then accounted for in the post-game analysis. The limitations they impose on gaming techniques are relatively insignificant when compared to the benefits derived from a war game analysis. The nature of their impact on the validity of game findings is directly related to the purpose of the game. Ground combat games, for instance, are sensitive to these limitations; however, the sensitivity is not critical to the outcome of the game and can be taken into consideration when developing the game findings.

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[1]E. S. Quade, "Pitfalls and Limitations," Systems Analysis and Policy Planning, Applications in Defense, ed. by E. S. Quade and W. I. Boucher (New York: American Elsevier Publishing Company, Inc., 1968), p. 363.

The utility of war gaming techniques is influenced by the availability and credibility of the input data. The validity of war game analysis is sensitive to the input data and to the manner in which these data are manipulated in the game. These are serious limitations and perhaps the most challenging areas for innovative action. A meaningful analogy to war gaming and its real-world counterpart, war, is the relation between maps and the real world itself.

> . . . Maps cannot predict exactly what the surface of the earth is like; they must resort to selected conventionalized symbols and 'aggregations.' War games must select appropriately important matters to portray and must conventionalize and aggregate units depicted in the game because the selection must focus on appropriate details; in the same way, an oil company's road map would show towns and road distances but leave out vegetation.[2]

A war game analysis has the capability to assist military planners who understand the game limitations to examine plans and concepts and to explore areas in the future.

RECOMMENDATIONS

The most obvious recommendation addresses the need for a serious research effort to develop the ability to duplicate reality for purposes of abstract analytic studies. This is an impractical

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[2]William H. Southerland, Some Basic Problems in War Gaming of Ground Combat, (McLean: Research Analysis Corporation, 1965), p. 27.

and improbable approach. There are several aspects of currently used techniques that lend themselves to practical innovations and, if major improvements could be achieved, would greatly enhance the usefulness of the war gaming process.

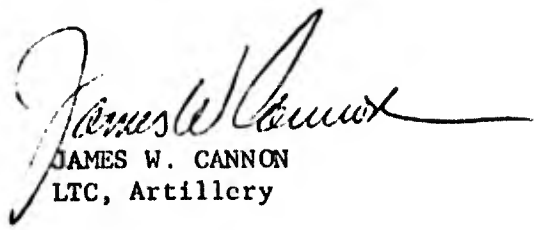
The first of these, to define and quantify the relationship between maneuver/mobility and firepower, is probably within current state-of-the-art capabilities. A breakthrough in this area would raise the general level of acceptability of war gaming techniques and increase the flexibility of the process to examine ground combat situations.

The second addresses a requirement to combine methodologies much in the same manner that manual, computer-assisted games were developed in the last decade. Currently, there are games which accommodate logistical considerations and games which accommodate tactical considerations. The opposite but dependent considerations are only barely considered in each type of game. It is currently possible to conduct a logistical (tactical) game and simultaneously a tactical (logistical) game and cross fertilize one game with the output of the other. This is expensive, time consuming, and much of the accuracy of both games is degraded in the transfer of data. Experienced gamers approach the idea of using the outputs of one game as inputs to another with considerable caution. The increasing complexity of our logistics systems and the dependence on logistic feasibility in operational planning combine to create the demand for the availability of a gaming methodology which is

capable of examining all aspects of war plans in the context of the interrelations among combat, combat support, and combat service support functions.

The third area for improvement involves the target acquisition process. The greater majority of contemporary models aggregate this function in the manner described in Chapter V. In view of the many sophisticated target acquisition devices in common use on the battlefield, there is a need to provide war game methodologies with a more realistic capability to examine battlefield intervisibility between opposing forces. Of the three improvements recommended herein, this is perhaps the most difficult. However, the characteristics and capabilities of the current target acquisition systems are measurable. The primary difficulties involve the ability to properly degrade each system present in a unit for weather and terrain disadvantages and to realistically account for the synergistic effects of all systems in a unit, to include tactical observation. A third difficulty lies in the capability for simulating the act of communicating the target information acquired by all systems in a proper time sequence.

Recommended improvements in the state of the war gaming art could be the subject of a lengthy study. The three recommendations presented above are within the immediate horizon as computer technology advances at an ever increasingly rapid pace and as innovations in mathematics and logic keep pace with the complex world of science and technology.



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This thesis presents a non-technical analysis of the utility and validity of modern war gaming procedures for evaluating military plans and operational concepts. Selective contemporary applications of war gaming methodologies are investigated and their capabilities and limitations are identified and examined. The conclusion is reached that the war gaming process provides a meaningful and viable method for combining military expertise with modern analytic techniques to assist defense planners and

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decisionmakers in making rational choices among complex alternatives. Recommendations for improvements in the state of the war gaming art are made.