UNCLASSIFIED

AD NUMBER
ADB098178
LIMITATION CHANGES
TO: **Approved for public release; distribution is unlimited.**
FROM: **Distribution authorized to U.S. Gov't. agencies only; Administrative/Operational Use; OCT 1985. Other requests shall be referred to Office of Naval Research, Arlington, VA 22203.**
AUTHORITY
CNO ltr 28 Oct 1986

THIS PAGE IS UNCLASSIFIED

AD Bo 98178

AUTHORITY:
CNO notice
28 Oct 86

SECURITY CLASSIFICATION OF THIS PAGE

AD-B098178L

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT 10 JAN 1986 Distribution limited to U.S. Government agencies only; Operational/ Administrative information contained. Other requests for this document must be referred to the Chief of Naval Operations (OP95).
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) CRM 85-91	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Center for Naval Analyses 6b. OFFICE SYMBOL (If applicable) CNA	7a. NAME OF MONITORING ORGANIZATION Office of the Chief of Naval Operations (OP95)
6c. ADDRESS (City, State, and ZIP Code) 4401 Ford Avenue Alexandria, Virginia 22302-0268	7b. ADDRESS (City, State, and ZIP Code) Navy Department Washington, DC 20350-2000
8a. NAME OF FUNDING / ORGANIZATION Office of Naval Research 8b. OFFICE SYMBOL (If applicable) ONR	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-83-C-0725
8c. ADDRESS (City, State, and ZIP Code) 800 North Quincy Street Arlington, Virginia 22217	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 65154N PROJECT NO. R0148 TASK NO. WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

An Introduction to Wargaming and Its Uses

12. PERSONAL AUTHOR(S)

Peter P. Perla and Raymond T. Barrett, LCdr., USN

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 1966 TO 1984	October 1985	38

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP
09	02	
15	07	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Analysis, Characteristics, Decision Making, Defense, Documentation, War Games

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

This paper discusses the nature of wargaming and its uses in exploring defense issues. It is the first in a series of papers written to help wargame designers, players, analysts, and decision makers at all levels to better understand and exploit wargaming.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Captain J.M. Smith	22b. TELEPHONE (Include Area Code) (703)694-1344 22c OFFICE SYMBOL OP-953D

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted.

All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

A Division of CNA Hudson Institute

CENTER·FOR·NAVAL·ANALYSES

4401 Ford Avenue • Post Office Box 16268 • Alexandria, Virginia 22302-0268 • (703) 824-2000

4 November 1985

MEMORANDUM FOR DISTRIBUTION LIST

Subj: Center for Naval Analyses Research Memorandum 85-91

Encl: (1) CNA Research Memorandum 85-91, "An Introduction to Wargaming and Its Uses," October 1985

1. Enclosure 1 is forwarded as a matter of possible interest.

2. This research memorandum discusses the nature of wargaming and its uses in exploring defense issues. It is the first in a series of papers written to help wargame designers, players, analysts, and decision makers at all levels to better understand and exploit wargaming.

Ralph W. Passarelli

RALPH W. PASSARELLI
Director, Fleet Employment
Concepts Program

Distribution List:
Reverse page

DTIC
ELECTE
JAN 16 1986
S D
A

Subj: Center for Naval Analyses Research Memorandum 85-91

Distribution List

SNDL		OPNAV
A1	SECNAV	OP-00
A1	UNSECNAV	OP-00K
A1	ASSTSECNAV RES	OP-09
A2A	CNR	OP-090
A6	DC/S, PP&O	OP-91
A6	DC/S, RD&S	OP-094
A6	DC/S, TRNG	OP-095
21A1	CINCLANTFLT	OP-950
21A2	CINCPACFLT	OP-951
21A3	CINCUSNAVEUR	OP-952
22A1	COMSECONDFLT	OP-953
22A2	COMTHIRDFLT	OP-954
22A2	COMSEVENTHFLT	OP-955
22A3	COMSIXTHFLT	OP-956
24H1	COMTRALANT	OP-098
24H2	COMTRAPAC	OP-987
24J1	CG FMFLANT	OP-02
24J2	CG FMFPAC	OP-22
26KKK1	TACTRAGRULANT	OP-03
26KKK2	TACTRAGRUPAC	OP-04
FF38	USNA	OP-05
FF42	NAVPGSCOL	OP-06
FF44	NAVWARCOL	OP-60
FT43	SWOSCOLCOM	OP-603

CRM 85-91 / October 1985

AN INTRODUCTION TO WARGAMING AND ITS USES

Peter P. Perla
Raymond T. Barrett, LCdr., USN

Naval Warfare Operations Division

A Division of CNA Hudson Institute
CENTER·FOR·NAVAL·ANALYSES
4401 Ford Avenue • Post Office Box 16268 • Alexandria, Virginia 22302-0268

QUALITY INSPECTED 3

Accesion For
NTIS CRA&I ☐
DTIC TAB ☑
Unannounced ☐
Justification
By
Distribution /
Availability Codes
Dist | Avail and / or Special
B-3

ABSTRACT

This paper discusses the nature of wargaming and its uses in exploring defense issues. It is the first in a series of papers written to help wargame designers, players, analysts, and decision makers at all levels to better understand and exploit wargaming.

TABLE OF CONTENTS

	Page
Introduction	1
Background	1
Wargaming and Its Uses	1
The Nature of Wargames	3
Setting the Stage	3
What Wargaming Is and Is Not	3
Elements of a Wargame	4
Levels of Play	5
Global/Strategic	6
Theater/Operational	6
Local/Tactical	7
Other Characteristics of Wargames	7
The Use of Wargames	10
Learning From Wargames	13
Types of Learning	13
Learning by Playing	13
Learning by Analyzing	15
Learning by Designing	16
Conclusions	17
Documentation and Analysis of Wargames	19
Wargame Validity	19
Wargame Documentation	20
Wargame Analysis	22
References	24
Appendix: Questions for Wargame Analysis	A-1 - A-4

INTRODUCTION

BACKGROUND

"We proved that in the wargame" is heard more and more frequently in the corridors of the defense community. Since the beginning of the decade, gaming techniques have been applied to a wide variety of topics, from the development of concepts of a maritime strategy to the exploration of new tactical ideas.

Yet wargaming is not a new concept; as a tool for studying defense issues, it has existed for many years and has gone through several cycles of popularity and disfavor. The proponents of wargaming have sometimes oversold its potential. The opponents of wargaming have often undervalued its capabilities. As a result, the participants of wargames and the users of gaming "lessons learned" have frequently misunderstood its nature. This misunderstanding was not due to the lack of wargaming literature (for example, [1] through [3]), but to its lack of coherence.

Partly as a result of all these trends, the Director of Naval Warfare (OP-095), through the Director, Tactical Readiness Division (OP-953), asked the Center for Naval Analyses (CNA) to undertake a wargaming applications project. This paper is the first in a series written to help wargame designers, players, analysts, and decision makers at all levels to better understand and exploit the power of wargaming while avoiding its pitfalls. This paper discusses the nature of wargaming and its uses; subsequent papers deal with specific examples of wargames, game design, development, and play, and the similarities, differences, and complementary roles of wargaming, exercises, and analyses in the study of defense-related topics.

WARGAMING AND ITS USES

Wargames revolve around the interplay of human decisions and game events. Mathematical models are essential in simulating such events, but their numerical outcomes are best regarded as inputs to the gaming process rather than results.

The research documented in this paper is based not only on the sources cited in the list of references and the experience of the authors, but also on the advice, discussion, and encouragement of many people within the Center for Naval Analyses and others. Particular thanks go to the staff of the War Gaming Department, U.S. Naval War College; the War Gaming and Analysis Division of Science Applications International Corporation's Military Systems Group; and the Applied Physics Laboratory of Johns Hopkins University.

Wargaming is a tool for gaining insights into the dynamics of warfare. It is a source of questions whose answers may often be found through the use of exercises or analysis. Wargaming is not a good tool for producing such answers, especially to technical or quantitative questions.

Wargaming is best used to investigate processes, not calculate outcomes. It can help naval commanders and staffs practice decision making under conditions difficult or impossible to reproduce in peacetime (massed battle group operations, high intensity air attacks, or full-scale mobilization, for example). Wargames can impose a strict discipline that forces designers, analysts, and participants to organize separate bits of technical facts into operationally coherent packages, or helps them explore the feasibility and implications of plans, concepts, or new technologies. Finally, wargaming provides a forum for communicating ideas in vivid and memorable ways.

Though powerful, wargaming is still just a tool. It is an imperfect mirror of reality, reflecting it best in the decision-making processes of its players. As a result, interpreting the insights derived from wargames requires special care. Learning from wargames comes not only from the research conducted during the design process, nor just from the experiences of the participants. These sources must be supplemented and extended by careful analysis and interpretation of the structure and play of the game.

Good wargame analysis resembles exploratory science or historical research far more closely than it resembles systems or operations analysis. To be of value, wargame analysis must be based on careful and comprehensive observation of the gaming process and must include thorough documentation of critical assumptions, decisions, and rationales.

THE NATURE OF WARGAMES

SETTING THE STAGE

Wargames can take many forms and serve many functions. At the Surface Warfare Officer School in Newport and at the Naval Academy in Annapolis, for example, naval officers and midshipmen can study fundamentals of tactics using a microcomputer gaming system known as the Naval Tactical Game (NAVTAG). Analysts at Navy research organizations may design and use manual games consisting of paper maps and cardboard squares that represent opposing forces to explore new operational concepts.

The center of Navy wargaming activity, however, is at the Naval War College. The War Gaming Department (WGD) hosts on the order of 50 games each year. In some of these games, the Naval Warfare Gaming System (NWGS), consisting of over 20 separate command centers and computer and communications links, is used to help fleet officers exercise their concepts of operation and stress their command and staff system. In others, representatives of the Office of the Chief of Naval Operations (OPNAV) play a different type of game, discussing moves and countermoves around a conference table in a seminar format.

This section discusses what makes all these different activities wargames. It defines the nature of wargaming and describes some of the key characteristics and types of wargames.

WHAT WARGAMING IS AND IS NOT

The term wargaming has been defined in many ways. In its broadest application, it is used to describe any type of warfare modeling, including simulation, campaign and systems analysis, and military exercises. A more restricted and more useful definition is that wargaming is any type of warfare model or simulation, not involving actual military forces, in which the flow of events is affected by and, in turn, affects decisions made during the course of those events by "players" representing the opposing sides. This definition includes not only the training and research games conducted at the Naval War College (NWC), but also encompasses a much wider variety, from the Global War Game series with its hundreds of participants to small one- or two-person manual or table-top games and their microcomputer derivatives.

What wargaming is not is often even less obvious than what it is. First and foremost, wargaming is not analysis in the usual sense of rigorous, quantitative dissection of a problem. Nor is wargaming real, despite the similarities of gaming language and the gaming experience to many aspects of actual operations. A wargame is not duplicable; you cannot refight a game changing only the "random numbers." A wargame is,

at heart, an exercise in human interaction, and the interplay of human decisions and the outcomes of those decisions make it impossible for two games to be the same. As a result of such factors, wargames are not universally applicable to defense problems. If physical or technical parameters are of greater interest and importance than human decisions, then wargaming is less relevant than other forms of research.

ELEMENTS OF A WARGAME

A good wargame must be structured to help human players make decisions and to allow them to learn about the effects of those decisions. Such a structure contains seven key elements:

- Objectives
- Scenario
- Data base
- Models
- Rules, procedures, umpires
- Players
- Game analysis.

A wargame must have a clearly defined and clearly stated set of research objectives. In specifying objectives, game sponsors, designers, and analysts must clearly identify how and in what ways the game can provide the type of information needed to achieve them. The objectives should be as specific as possible to allow the game design to focus on those elements critical to the collection of the necessary information. The definition of objectives should be the principal driver of a wargame's entire structure.

The scenario sets the stage for the game, placing players in the situation with which they must deal. The scenario can have a significant if not overwhelming effect on the decisions players are able to make. As a result, the game designer must carefully determine how the scenario may affect the factors he is most interested in exploring. Detailed scenario descriptions should allow the players to understand those factors and how they arose so that they can understand how the underlying assumptions may affect the scope of their decision making.

The data base contains the information players may use to help them make decisions. Typically, this information includes forces available, some measure of their capabilities, physical or environmental conditions, and other technical facts. Because of its importance to decision making, the data base must present clearly and concisely the information

players would reasonably have available to them in an actual situation and do so in a manner easy for them to use during play.

The fourth element of a wargame is a set of models, usually mathematical expressions, that translate data and decisions into game events. Models must be flexible enough to deal with unforeseen player decisions. They should be designed to allow the data base to change without requiring major changes to the models themselves. Their mechanisms should reflect accurately those factors most important to the decision-making levels represented by the players. As much as practicable, the question of whether a model will depend on random numbers should be driven by the underlying process. Just as real battles are affected by chance, game battles should sometimes reflect the role of luck in executing any operation, and game analysis should report on those effects.

In addition to models, a game must have a set of rules and procedures, typically monitored in large games by a team of umpires, to define what players can and cannot do and why. These procedures help sequence game events to allow for accurate chains of cause and effect. Game procedures also must ensure that players receive the appropriate quantity and quality of information during play and should introduce error and delay to simulate the "fog of war."

Most importantly, a wargame must have players whose decisions affect and, in turn, are affected by the flow of events. A game is most effective when the players can be cast in operational roles and given the information and responsibility required to make the decisions appropriate to those roles. Because learning from a game requires understanding why players make decisions, thorough player understanding of game objectives and preparation for their roles are essential to useful game play.

Finally, if the efforts involved in assembling the first six elements of a wargame are not to be wasted, they must be tied together by solid analysis. If the objectives of the game define the information that must be extracted, analysis assures its capture. A good analysis plan, outlining where observers should be placed and what they should be looking for, is essential, but the process of game analysis is not simply one of mechanics or even observation. As described at the end of this paper, the data collected during game play is only the raw material for the synthesis of insights and identification of issues.

LEVELS OF PLAY

The different levels of game play that are most often used can be described in many ways--the most useful combines the idea of geographic scope and level of warfare. This scheme defines three broad classes of games: global/strategic, theater/operational, and local/tactical.

Global/Strategic

In global/strategic games, the primary decision makers represent opposing National Command Authorities. Typically, the goals of such games are to improve the perspective of the participants, test strategies, and identify important issues at the global level. Usually these games have focused attention on prehostilities and transition politics and force deployments, the D-day engagements, and questions regarding escalation or war termination. Their primary output is qualitative, consisting typically of game narratives with some interpretations of events and little numerical data. Games on this scale usually require large personnel and time commitments and are seldom, if ever, repeated under identical conditions.

The Global War Game series conducted at the Naval War College for the past 7 years has had a growing impact on the development of strategic thinking in the Navy and in the defense community as a whole. The scope of the effort, both in the global nature of its scenarios and the numbers and diversity of its participants, has served as a catalyst for raising important research issues. It has facilitated the exchange of ideas among professionals who seldom have the chance to interact (such as experts in Soviet political affairs and scientists working on advanced technological concepts).

Theater/Operational

The primary decision makers in theater/operational games are typically cast as commanders-in-chief of the unified or specified commands in the region. Some games actually combine multiple theaters to achieve a pseudo-global scope, but because decisions are made at theater level, these games are closer to the operational rather than strategic scale.

Theater/operational games are usually designed to explore specific issues and identify strategic, operational, and tactical problems in the theater. Often they point out areas in need of further study. Such games focus on the force levels and employment options necessary or feasible for carrying out specific military missions. Although the output of these games is similar in nature to that of global/strategic games, there is a tendency to run the game more than once and generate more numerical data.

Theater/operational games may be the level of game most usefully and most frequently employed for many research areas. They are used to "pre-play" or test plans, from exercise designs to fleet war plans. When well-designed, such games force participants to deal with the same situations they might face in an actual operation. They allow commanders and their staffs the chance to explore why and how their plans might be able to deal successfully with the problems they have perceived, and also provide fertile ground for identifying unforeseen difficulties and unexpected solutions.

Local/Tactical

The primary decision makers in this category are generally battle group commanders or below. As is the case with the global/strategic games, a primary purpose of these games is to give their participants an improved perspective. Local/tactical games are also used to compare various tactics and forces and, even more than in the other types of games, to identify topics for further analysis.

Typically, these local/tactical games focus attention on force levels and tactical deployments, weapon and sensor performance, and interrelationships among various warfare areas. The outputs of these games usually have a greater balance of qualitative and quantitative results than do the others. The number of iterations of a local/tactical game varies, but does tend to be higher than in either of the other two categories.

Games at this level, dealing as they do with the most basic level of warfare, are the most difficult to design "accurately." Because in many ways they resemble operations analysis even more than the other types of games, there is an unfortunate tendency to focus more closely on numerical "results" than the reliability of such results deserves. Yet, when properly designed and executed, tactical wargames can be incomparable tools for exploring the feasibility of tactics, identifying the hidden assumptions, both valid and invalid, on which such tactics might be based, and highlighting their potential strengths and weaknesses. The ideas evolving from such games are often easily translated into concepts that can be further tested and refined by at-sea exercises.

Table 1 compares the three categories of games defined here.

OTHER CHARACTERISTICS OF WARGAMES

In addition to the level at which the game is played, wargames may be characterized by:

- The number of players or "sides"
- Modeling and computer support
- Information limits
- Format.

Most wargames are two-sided, one player or team representing friendly forces and the other the opposition. Often a third, nonplayer team (control) handles matters outside the scope of the player decision levels and carries out umpire functions. Although the two-sided game is far and away the most frequent type, multisided games, with three or

TABLE 1

LEVELS OF WARGAMES

	Global/strategic	Theater/operational	Local/tactical
Primary decision maker	National Command Authority	Commanders-in-chief	Battle group or lower
Goals	Give participants a better perspective, test a strategy, identify key issues. Facilitate exchange of ideas.	Explore specific issues. Identify strategic, operational, and logistical problems in theater or exercise. Identify areas for further study.	Give participants a better perspective. Compare various tactics/forces. Identify critical factors and areas for further study and exercise/testing.
Focus	Prehostilities and transition politics and force deployments, the D-day shootout, and escalation/war termination.	Necessary/feasible force levels and employment options for accomplishing specific military missions.	Force levels and tactical deployments, weapon and sensor performance, and interrelationships among warfare areas.
Primary output	Qualitative. Narratives and interpretations with little numerical data. Typically only a single game run.	Qualitative. Narratives and interpretations with some numerical data for more support. Typically a small number of games run.	Balance of qualitative and quantitative results. Number of iterations may vary, but tends to be higher than in other categories.

more independent active player teams, can be useful for many applications, especially political-military games. One-player games, in which control actually assumes direction of the opposition as well as its usual functions, are frequently employed for training purposes.

In addition to players and umpires, games need tools to keep track of and display data, force movements, and interactions. In many cases, such tools consist largely of maps, charts, and books of data and orders of battle. Such strictly manual games were once the primary mode of wargaming, but are now being complemented by computers. Computer-assisted games use machines ranging from personal computers to large mainframes to help keep track of force positions and movement, weapons capabilities, and other critical, data-intensive items. Extrapolating beyond such computer-assisted games is being pursued at places like the Rand Strategy Assessment Center, at which the human decision maker is being replaced by computers built around artificial intelligence and expert system concepts. Computer-controlled games of this type are difficult to categorize as true wargames and may develop into a new, but related, tool.

Another typical distinction is between "open" and "closed" wargames. An open wargame allows all players essentially free access to all available information (except for the other side's plans). Typically such games use a single situation map on which forces from both sides are, for the most part, openly displayed and force capabilities freely accessed. A closed system introduces limits on information available to players, better simulating the "fog of war." Closed games almost always require some sort of computer assistance unless they are very small in size or scope.

Finally, a wargame's format may be characterized as either seminar games or system games. In a seminar game (typically an open game), opposing players discuss the sequence of moves and countermoves they are likely to make in a given situation, and agree on what interactions are likely to occur. The control team assesses the results of those interactions and reports back to the players. The process is repeated for each of the "moves" in the game. Seminar games usually use moves of various lengths of real time (time steps) and so tend to resolve different periods of the war at different levels of detail. A system game, which is often a closed one, substitutes a system of highly detailed rules and procedures for the discussion process. Players make their decisions independently, and the system runs them against each other to determine the interactions.

THE USE OF WARGAMES

Wargames of all types and all levels are best used to investigate processes, not calculate outcomes. To define the results of wargames only in terms of what happened, not why, or only in terms of "lessons learned," not "issues raised," is to lose sight of what a game really is and where its main benefits can be found. Wargames can help explore questions of strategy, human decision making, and warfighting trends. They are of little use in providing rigorous, quantitative measures to "objectively" prove or disprove technical or tactical theories. Instead, they can often provide the kernel of new theories that can be tested with other tools.

Wargaming is most productive when used as an organizing and exploratory tool or as an explanatory device. It seems especially appropriate for exploring the dynamic character of warfare. The design of the game (organizing) and the play and subsequent analysis of the game (exploring) form a loop in which the questions and issues arising from one play can reshape or reorganize the game system itself to make it a more accurate representation of reality.

As an organizing tool, wargaming helps designers and participants tie their thoughts together and give them a more operational focus. Designing a game requires comprehensive and coherent study and modeling of the interplay of different types of forces that are carrying out different kinds of missions for different sorts of reasons. The successful translation of quantitative and qualitative tactical analysis into a workable and meaningful game requires a basic understanding of all possible force interactions, how and when they might occur, and what might determine their outcome. It also requires an understanding of how players interact as they develop different approaches to the problems posed by the game. Finally, it requires an ability to translate that understanding into intelligible and practical procedures so that the players can concentrate on making realistic decisions, not on remembering artificial rules.

When used as training aids, wargames force the participants to take the first steps toward translating what they have been taught about strategy, tactics, or administration into something they have learned and can use in carrying out their mission. A student may have been taught the rate of fire of a surface-to-air missile system, the reliability of the missile, and the radar horizon of a ship's search and guidance systems. He may have studied the speed and altitude of an enemy submarine-launched cruise missile and the number of such missiles a threat submarine might carry. He may even be aware that the time he might have available to react to an attack on his ship by such a missile submarine may be less than 1 minute. Yet, the true meaning and interconnections of all those facts are difficult to perceive in an abstract

setting. By placing the student in "command" of a ship that is the target of such a missile attack in a game, however, instructors can not only demonstrate the facts, but also allow the student to demonstrate their implications to himself.

As an exploratory tool, wargaming can give participants and analysts new insights, leading to further investigation of the sources of their beliefs. It forces participants to look at reality from a different angle and can lead to fundamental changes in how they see that reality. If the initial design of a game incorporates well-known critical factors into its models and procedures, the play of the game and the questions and issues it raises can lead to the discovery of other factors whose importance may have been previously unsuspected or undervalued.

By explicitly allowing human decisions that are made under the press of time and on the basis of imperfect or incomplete information to influence the course of events, and by incorporating randomness and "luck," wargaming comes closer than any other form of intellectual exercise to illustrating the dynamics of warfare. By helping its designers, its players, and the users of its briefings and written reports to see the effect of these "unquantifiable" factors in concrete terms, a game also helps to illuminate the sources of that dynamism. Gaming provides an opportunity for deeper understanding of the realities of warfare, even if it cannot improve the accuracy of estimates of exchange ratios.

Finally, as an explanatory device, wargames can effectively communicate analytical insights to other members of the community. The latest intelligence about threat operational doctrine or options can present commanders with new problems and challenge them to find feasible solutions. The operational implications of advanced weapon systems can be portrayed vividly by forcing players to deal with the opportunities and difficulties they present, rather than by simply providing decision makers with numerical estimates of a limited number of technical parameters.

Participants in wargames are not a passive audience. Their interaction with the scenario, the systems, and each other provides opportunities for the development of new insights. These insights can, in turn, prompt more detailed quantitative and scientific analyses, whose results can become incorporated in follow-on games. This process of sharing, testing, and revising knowledge and understanding is fundamental to the productive use of gaming.

The power of a wargame to communicate and convince, however, is also a potential source of danger. Wargames can be very effective at building a consensus on the importance of key ideas or factors in the minds of participants. They attempt to create the illusion of reality,

and good games succeed. This illusion can be a powerful and sometimes insidious influence, especially on those who have limited operational experience. A poorly designed game could allow players access to an unrealistic quantity and quality of information. Such a game could give players a false picture of the worth of a weapon system that relies on just such unattainable information to be effective.

In wargames, as in any approach to study and analysis, there is always a possibility that intentional or unintentional advocacy of particular ideas or programs may falsely color the events and decisions made in a game and lead to self-fulfilling prophecies. The designer of a game has great power to inform or to manipulate. The players and others involved in the game and its analysis must be aware of this danger. They deserve and should demand explanation of why events run counter to their expectations. They must be allowed, indeed encouraged, to be wary and skeptical and to question the validity of insights derived from the game until the source of those insights is adequately explained. If the reasons underlying an insight seem artificial, the insight may be a false one.

LEARNING FROM WARGAMES

TYPES OF LEARNING

Because of its emphasis on human interaction and role-playing, wargaming can be a powerful learning tool. Participation in a game allows players to "practice" the roles they assume. At the same time, games allow analysts to observe this practice and to interpret the implications of what the players do. Because a wargame is not real, however, there are limitations on the extent and validity of what can be learned in both cases. As he crafts his game, the designer's job is to learn all that he can about his subject and use that learning to minimize the limitations of the gaming environment.

LEARNING BY PLAYING

Admiral Arleigh A. Burke touched on the central artificiality of wargaming when he said, "nobody can actually duplicate the strain that a commander is under in making a decision during combat" [4]. In a wargame, real forces do not deploy, real weapons do not explode, and real people do not die. Wargames, like exercises, are only an imperfect image of real war. To understand what can be learned from playing a wargame, it is necessary to understand what game experiences are most like what goes on in actual combat operations.

In an actual military operation, a commander is assigned a mission and the forces with which to carry out that mission. The commander and his staff must plan how to accomplish the mission, communicate that plan to their subordinates, and then see that the plan is executed by their forces. During the planning phase, the commander must analyze his objectives and the alternatives for attaining them, assess the enemy's capabilities and possible courses of action, and identify his own strengths and weaknesses. He must then choose a concept of operations that appears to have the best chance of success. In many cases he must understand not only military technical factors, but environmental and political ones as well, translating all of these into operational opportunities and devising ways to exploit those opportunities.

Once the plan is complete, subordinates must be informed of their roles and how they are expected to perform them. The commander must clearly explain his concept and identify the decisions he reserves for himself and those he delegates to subordinates. To control the execution of the plan, the commander must specify what information he needs to make his decisions, how he expects to receive and store that information, and how he plans to evaluate it. Once the operation is under way, the commander must integrate the information he receives with his own tactical and operational expertise to interpret events, weigh advice, assess the developing situation, and modify his orders as required.

Many, if not all, of these same activities must occur in a wargame. What differs, however, is the environment in which they take place. Aside from the fact that actual forces are not maneuvering and shooting at each other, perhaps the largest artificiality of the gaming environment is its generally poor re-creation of communications and data-handling facilities. Even the elaborate Naval Warfare Gaming System uses only a relative handful of communications circuits, status boards and displays, and data-transfer rates are often deficient when compared to high-speed real-world systems. On the other hand, the communications that are available in most wargames are generally highly reliable and seldom interfered with by the enemy.

Complete re-creation of the actual processes by which commanders receive information in battle appears to be impractical in a wargame. It may be feasible, however, to re-create what the commander would learn about the situation, even if the details of how he learns it are imprecise. For example, a battle group commander may best learn about the course and status of an antisubmarine warfare (ASW) operation by monitoring the ASW coordination circuit. By keeping track of the information that might actually be passed over such a circuit and the errors and delays associated with it, a wargame can allow the commander to obtain the information without actually re-creating the circuit. Such "design for effect" techniques can be useful when a full simulation is beyond the scope and capabilities of a game.

In a similar manner, complete re-creation of the entire staff and command structure appropriate to a player's decision level is virtually impossible in most wargames. As a result, to define the appropriate roles for various participants, the game designer must carefully consider the game's objectives, scope, and level of activity. Although many players will prefer to allocate tasks to their assistants as they see fit, at the very least a summary of the types of tasks important to game play should be given to them. Some structure of this sort can help prevent the overlooking of critical staff functions whose performance during an actual combat operation would be impossible to ignore or forget.

Although many artificialities limit a wargame's realism, many of a commander's operational activities can be simulated. The intellectual experiences resulting from such activities often reflect many of the critical aspects of similar real-world situations. Thus, a wargame can be not only a good vehicle for teaching lessons about the job of a commander to those inexperienced at it, but also an opportunity for commanders to practice the intellectual skills they need to do their job well. Table 2 summarizes the activities for which a wargame can provide reliable experiences.

TABLE 2

AREAS OF ACTIVITY ADEQUATELY SIMULATED IN WARGAME PLAY[a]

Operational

- Force selection and employment
- Integration of platforms to accomplish a task
- Tactical decision making (at appropriate level)
- Exploitation of platform and system capabilities
- Overcoming platform and system limitations
- Rapid assessment of operational and tactical situations
- Revision of plans in response to changing situations

Command

- Delegation of authority
- Articulation of battle philosophy, directives, and orders
- Establishing information requirements for decision making
- Devising effective ways to display and evaluate information
- Assessment of advice
- Crisis leadership

Scenario

- Exploitation of geography
- Exploitation of environment
- Exploitation of international political relations

---

a. Adapted from [4].

LEARNING BY ANALYZING

The second kind of learning available in wargames is based upon analysis of the sequence of player decisions and the game events resulting from them. Two basic approaches are used to examine the history of a game. The first approach, and the one most likely to be fruitful, focuses on why players made certain decisions and why, in turn, these decisions led to particular sequences of game events. Such an investigation examines the important driving characteristics of the scenario, the rationale for each side's actions, and how alternative choices might have changed the course of events. This focus on the decision-making process, as described earlier, is the most appropriate

one for game analysis. In many cases, however, attempts are made to treat each game event "as a source of scientific evidence on matters of research interest, such as tactics, employment of new platforms or weapons systems, and certain organizational or procedural ideas" [4]. The intent of such investigations is to treat each game event as a single data point arising from a scientific experiment, and the collection of many such events from many games is treated as a single body of evidence. Investigations of the first type employ the techniques of good analytical history and are most often useful in game analysis; investigations of the second type are more quantitative and more resemble scientific inquiry [4]; they are also less applicable to most games. Game analysis and documentation are discussed in more detail in the last section of this paper.

LEARNING BY DESIGNING

The process of game design is difficult and dynamic. The designer must do extensive research to collect the quantity and quality of information relevant to the game's objectives. He must then translate the research into the scenario, data bases, models, and procedures needed for the game. Finally, he must test, refine, and tune all of these pieces until the game is coherent and able to achieve its goals. Thus, the game designer must assume the roles of player and analyst throughout the design process. In so doing, the designer learns many of the same sorts of things that those who participate in or analyze the play of the game do.

As described earlier, good game design seeks to incorporate what is known about the interplay of different forces on different missions, the factors that might affect the occurrence and outcomes of interactions between those forces, and the decisions players might make and their rationales. Thus, the game development process of playing, testing, and refining is crucial to a game's ultimate success. Carefully going through this process allows the game designer not only to fine-tune his system, but also to improve his own understanding of the nature of the military operations he is attempting to game.

Thus, game design is another way to help systems and operations analysts organize their thinking. The iterative process of design and development can then help analysts explore the implications of their research and analysis, leading to refinements of those as well. Ultimately, a well-designed and well-developed game provides analysts the opportunity to explain their interpretations to others and to learn from the reactions of players and analysts where they may have been correct, where in error, and where to explore further.

CONCLUSIONS

The primary learning to be derived from a wargame is based on the fact that the game resembles reality most in its treatment of decision processes. Yet, although making decisions in a wargame is similar to making decisions in reality, the context of that decision process is very different; players know that, after all, it's only a game. As a result, decisions may be distorted by the fact that no one has to live or die based on them.

Given this and the many other gaming artificialities touched on earlier, game design, game play, and game analysis provide only limited answers to some kinds of questions; their real contribution lies in the new questions they generate and the insights participants derive by combining their experience in the game with the rest of their knowledge and background. As a result, it is usually a mistake to expect wargames to provide detailed quantitative support for proving theories.

The quantitative "results" of wargames are, in fact, the numbers produced by the wargame's models. Such models are often similar to the models used in campaign or systems analysis, although in many cases they are less rigorously defined because their intended use is different. In other cases the "gaming" models may be essentially identical to such "analytical" models. Under these circumstances, if the main interest is the numerical result, there appears to be little reason to go through the bother and expense of a game.

If the goal is to derive quantitative measures to judge the worth of a system or tactic under a wide variety of conditions, and not to explore how human tacticians might actually seek to implement or exploit such a system or tactic, wargaming seems to be an inappropriate tool. "With the proper pattern of trials established beforehand and with reliable models, one ought to be able to generate as much [quantitative] evidence as one gets in a wargame by cranking through the models the requisite number of times for each situation in the privacy of an office" [4]. Thus, "if the models are good, a game episode furnishes little tactical evidence that cannot be gotten in an easier way than running a wargame, and if the underlying models are either of unknown quality or known to be poor, the game episode may even end up providing misleading evidence" [4].

In rare cases, the quality of a wargame's models and the sheer number of times those models are used under similar circumstances, either in a single game or series of games, can lead to a body of quantitative evidence similar to that obtainable from the kind of "office" analysis described above. In such cases, these results can be viewed as potentially useful by-products of the game; they should not, however, be a prime objective of play. The reporting of such numbers requires extreme care, especially in the definition of the various

tactical circumstances that gave rise to them and in the necessity of placing them in the correct operational context.

Although wargames provide little quantitative evidence to prove theories, they often can provide insights and questions that can lead to the development of new ideas and concepts. The wargame environment, by removing participants from their day-to-day routines and placing them into a new, artificial, and sometimes stressful "reality," can often stimulate participants to think in new and more operationally oriented ways. "It would not be surprising if new ideas popped up during the game and were reflected in the game episode. In fact, it would be surprising if they did not. Extraction of these innovative ideas is clearly worthwhile, but using wargames to 'test' tactics, new systems, or new platforms seems ill-advised [4]," unless that testing focuses on what information wargaming can legitimately provide in these areas.

Analysis can produce detailed calculations measuring the importance of a weapon system's rate of fire to a unit's combat capability; wargaming can provide fleeting glimpses of the importance of a human being's decisions to the effective employment of that unit in combat. Wargames will not tell us a new tactic will be successful with a 90-percent probability, but they can allow us to better understand the interplay of a new tactic and its effects on both friendly operations and the enemy's reactions to counter them. It is this interaction that is most important in gaming. Even when models are limited, such interactions are the sources of issues that may be further explored through more detailed and more "accurate" analytical techniques or through real-world testing and evaluation.

Wargaming is not analysis, it is not real, it is not duplicable, it is not universally applicable. Yet, in its ability to help us understand better the roles, capabilities, and limitations of that most ubiquitous warfighting system, the human being, it is a powerful and effective learning device. To best exploit its abilities and make its insights available to nonparticipants, however, wargaming requires careful and insightful documentation and analysis.

DOCUMENTATION AND ANALYSIS OF WARGAMES

WARGAME VALIDITY

As described above, even the participants of a wargame often find it difficult to judge the limits of its validity. For those who were not actually present, assessing a wargame's validity is an even more difficult and complex question. The first problem, simply defining validity, is also the most nebulous. As a start, a wargame's validity can be defined as the extent to which its processes and results represent real problems and issues as opposed to artificial ones generated only by the gaming environment.

Given such a definition, assessing the validity of a wargame's results seems to require answering the following questions:

- How are the game's "results" defined by the participants (when available) or by the available game documentation?
- What outcomes from warfare models define or quantify these results, and how are they obtained?
- How and how strongly do "going-in" assumptions drive results and interpretations; in particular, what is the possible influence of scenario and unstated "subliminal" assumptions?
- How and how much does reliance on "accepted" interpretations of enemy reactions drive the perceived principal lessons of the game?
- How do game mechanics, especially action and reaction capabilities, affect the course of the game and its interpretations?
- How do mathematical models and analyses and the values of the parameters they employ affect game play results and insights?
- How does the occurrence of low-probability events drive perceptions of players during the game and conclusions reported about the game?

Clearly, specific games may require other more specific and technical questions to be answered before the validity of their results can be assessed. If nonparticipants in a wargame are to have a fighting chance of fairly interpreting what that game has to say, however, they must be

able to find answers to the questions listed above. The answers to such questions must be available in game documentation, and so these questions must also guide game analysis and documentation from the start.

WARGAME DOCUMENTATION

Just as wargame analysis is closely related to analytical history, a wargame report should more closely resemble an historical treatise than the documentation of a campaign analysis. Just as good historical analysis treats events as indicators of deeper underlying realities, good wargame analysis and documentation treat game events only as indicators of the decision processes of the players. Although game reports describe the major events of game play, they should focus on the underlying reasons for the players' decisions that gave rise to those events. They should also evaluate the extent to which those reasons were driven by realistic concerns or effects rather than by the artificialities of the gaming environment.

The structure of a wargame report should reflect this relative importance of events and causal factors. In general, a simple, straightforward structure is best. It should begin with a short executive summary that outlines the objectives and structure of the game and highlights the key events and insights. Perhaps most importantly, the summary should point out areas or issues raised in the game that require further, more detailed research.

The report should end with a brief appendix discussing the important elements of the primary models used to support the game. The discussion should explain the roles and relative importance of the various models, describe inputs required, and identify those that drive the results. Where possible, umpire variations of model inputs or outputs should also be discussed, at least for major engagements or classes of engagements. Finally, if models are documented, the appendix should provide references to allow those interested readers a chance to explore the models in more detail.

As shown in table 3, the main body of the report should be built around four main sections: introduction or background, game play, insights or issues raised, and conclusions. The introduction should relate the origins of the game to its objectives and structure or design. It should allow the reader to understand why the game was played and how its results were expected to provide information about specific questions or objectives. The summary of game play should describe the scenario and its effect on play, specify the number of actual players and their roles and commands, and describe in broad terms the courses of events, focusing on player decisions and their underlying reasoning. At times, assessments of the validity of these reasons and the sources of such assessments may also be warranted. The sections on insights derived or issues raised from game play should concentrate on

specific matters either pointed out during the course of play or raised in discussion or "hot wash-ups." Where possible, such issues should be keyed to specific game events or classes of events that gave rise to or illustrate the importance of the issue.

TABLE 3

MODEL OUTLINE OF A WARGAME REPORT

Executive Summary

Introduction

- Origins of game
- Game objectives
- Game design to meet the objectives

Game Play

- Scenario
- Player roles
- Key events and decisions, integrating the rationales for each

Insights or Issues

- Driving factors
- Specific ideas, preferably keyed to major game decisions or events

Conclusions

- Broader insights into major underlying factors
- Topics for further research

Appendix

- Model roles and importance
- Inputs, outputs, and umpire modifications
- Sources of documentation.

The first three sections of the report largely represent the historical chronology and causal analysis. The concluding section should identify the deeper factors that may underlie and relate several,

possibly diverse, individual insights and issues. Sometimes such themes are not to be found; if discernible, however, such broad insights can prove to be the major contribution of a game to the accomplishment of the objective. Finally, the conclusion section should also identify those issues raised by the game that are both important enough and tractable enough to be addressed constructively by further research. In this way, the game can help direct the attention of other defense analysts toward high priority topics.

Perhaps the biggest problem in wargame documentation is the need to balance the speed with which a game report is produced and the amount of time necessary to reflect on and assimilate the insights the game may provide. The pressure to produce "results" and "lessons learned" quickly is similar to that experienced in exercise analysis, and similar care must be used in game analysis. (Reference [5] contains a discussion of some aspects of the latter problem).

In many cases, the purposes of the game will dictate the relative importance of speed and depth of analysis. Training games clearly require almost immediate feedback if they are to be most useful. Games conducted more for the purpose of research may have the luxury of several months of careful analysis before a report is required. Most games, however, are probably well-served by the same devices seen in exercise analysis: a "quicklook" report touching on the highlights and produced quickly, followed by a more thoughtful and careful full-scale report.

Both quicklook and full reports should follow the outline proposed above. The majority of a game's primary objectives should be addressed in the quicklook report. The follow-on report can cover those issues in more detail, raise new ones in unexpected or tangential areas, and address other topics resulting from additional reflection and analysis.

WARGAME ANALYSIS

Plans for game analysis must be made as early as possible in the gaming cycle, with a view toward producing a report structured as outlined above. Ideally, the game sponsor, designer, and those responsible for game analysis should jointly determine the objectives of the game, the overall shape of the design that will allow those objectives to be met, and the data and information that must be collected to meet those objectives. Early joint discussions of objectives, mechanics, and analysis can help prevent the potential problems of designing a game that addresses the wrong issues and structuring a game analysis that focuses on the wrong measures.

Typically, those game participants responsible for analysis are the game's only historians. During the course of play, analysts must record the major decisions made by the participants, their rationales, and the

game events to which the decisions led. The analysts are also responsible for cataloging the key insights participants derive from game play and discussion.

The functions of observer and data collector are only a part of the analyst's responsibilities, however; in essence, they provide only the raw material for analysis and synthesis. The analyst must go beyond merely what happened in the game to understand not only the immediate causes of events, but also the deeper themes that may underlie an entire chain of cause and effect. This analytical process differs from the quantitative "scientific" analysis to which that term is most often applied. The data base of a wargame is the interaction of players and their decisions; it is history, not science. The process of game analysis is much more akin to exploratory research and historical analysis than the evaluation of physical experiments or systems analysis. Most wargames use the conceptual if not always the mathematical models so often found in operations research or systems analysis approaches to defense problems. Thus, the analysts must be well-versed in the characteristics, capabilities, and limitations of such models to understand how well or poorly they represent the reality of military operations and how appropriately they affect the play of the game.

To analyze the game effectively, the analyst must keep in mind the entire gaming process, from the initial formulation of the game's objectives, through design, play, and documentation, and even to the interpretation of results by nonparticipants. The set of questions given in the appendix can serve as a guideline or starting point for collecting the raw material needed to analyze a game. It is not, however, a substitute or even a recipe for good game analysis.

Wargame analysis is a complicated process requiring careful observation, questioning, thought, and synthesis of events and insights; it is essentially the art of discerning order in the midst of chaos. To do a credible job of game analysis, the analyst must have a coherent idea of what to look for and why before being thrust into the game itself.

Once play is over, the game and its "results" must be documented in a form that allows nonparticipants to understand not only the key insights derived from the game, but also the real sources of those insights. Only good analysis and documentation can allow valid interpretation of the game and application of its lessons to real-world problems.

REFERENCES

[1] U.S. Naval War College, "Fundamentals of War Gaming," 3rd edition, by Francis J. McHugh, Unclassified, Mar 1966

[2] U.S. Naval War College, "Manual War Gaming," Unclassified, Jan 1969

[3] Brewer, Garry D., and Shubik, Martin. The War Game: A Critique of Military Problem Solving. Cambridge: Harvard University Press, 1979

[4] CNA, Memorandum 83-0271, "Beyond the War Game Mystique: Learning From War Games (U)," by Frederick D. Thompson, Unclassified, 22 Feb 1983

[5] Thompson, Frederick. "Did We Learn Anything From That Exercise? Could We?" Naval War College Review Vol. XXXV, No. 4 (July-August 1982): 25-37

APPENDIX

QUESTIONS FOR WARGAME ANALYSIS

APPENDIX

QUESTIONS FOR WARGAME ANALYSIS

PREPARATION

- What information was provided to participants prior to arrival?
- How are game objectives defined in preliminary briefings?
- What information is briefed to participants before play begins?
- How and to what level of detail is the scenario described; what is it?

STRUCTURE AND STYLE

- What is overall game structure and style?
- Who are the players?
  - Is there a team structure?
  - From what commands do team members and leaders come?
  - What are the names and real-world jobs of the principal players?
  - How many sides are there in the game (one, two, or many)?
  - What are the decision levels of the players and how do they communicate?
  - What are the responsibilities and limitations of the players and how do these correspond to their roles?
- What are the roles of control?
  - How are Command levels above and below the players represented?
  - How do players and controllers/umpires communicate?
  - What are controller/umpire responsibilities, powers, limitations?

- What is the formal analysis plan?
  - How many analysts are there and where are they assigned?
  - What are analysts told to look for?
  - What other instructions are the analysts given?
  - Who has overall responsibility for analysis?
  - How frequently do analysts meet?
  - What are topics of discussion at analyst meetings?
  - How will analysis be integrated, when, where, and by whom ?

PLAY

- What data and displays are available to the players?
  - What information is provided?
  - What types of displays are employed (books, charts, computers)?
  - What are the sources of the information?
  - Are there any questions about the accuracy of the data?
  - Are the data available and the players' access to it appropriate for the command level they represent?
  - Is the detail of data available commensurate with its importance or merely driven by availability?
  - How often, easily, and well do the players make use of the data displays? For what reasons?
- During the course of play, what decisions are made by the players and which are left up to others (control, umpires etc.)?
  - How detailed are decisions regarding force employment?
  - What sort of control do players have in combat situations?

- How well do players control reconnaissance and intelligence assets?

- Are players questions focused on what they should do, what they can do, what they must do, what they will do, or how can they do?

- How are game events defined?

  - What are players told about what is happening and when?

  - What do control and the umpires <u>not</u> tell the players?

- How are events sequenced?

  - What defines a move (time, activity, other)?

  - How is game time controlled relative to real time (steps or clock speed)?

  - How do players' decisions construct sequences of events?

  - What is the level of player interaction and response to developing situations?

- How does battle damage assessment (BDA) or event resolution work?

  - Who does BDA? When?

  - What techniques, models, data do they use and how?

  - How do they receive instructions and information about events to resolve? From whom? When?

  - What are the factors critical to individual resolutions or classes of actions?

  - How do umpires/BDA translate player decisions into force movements, interactions, etc.?

  - How are players given BDA results? With what frequency, time delay, and accuracy of reporting?

  - Is the "fog of war" appropriate for player decision levels?

  - How does BDA affect later decisions?

ATTITUDES

- What are player feelings about their roles and ability to influence events?
  - What is the source of those feelings?
  - What do the players see as the good points of the process?
  - What do they see as the problems?
  - What critical decisions did the players make? Why did they decide as they did?
  - What were the critical factors, understanding, and prejudices affecting decisions?
  - What special insights and ideas did the players bring to the game and how has the play of the game affected them?
- What are the attitudes of control?
  - How does the sponsor feel about the course and value of the game?
  - Does this feeling change? What influences it?
  - How do controllers/umpires feel about their role and how well they are carrying it out?
  - How do attitudes of the sponsor and control group about the course of the game and its smoothness or value compare to the attitudes of those in the trenches? What appears to be the source of any disagreement in these attitudes?

THIS REPORT HAS BEEN DELIMITED
AND CLEARED FOR PUBLIC RELEASE
UNDER DOD DIRECTIVE 5200.20 AND
NO RESTRICTIONS ARE IMPOSED UPON
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.