



# Doing Analysis

U.S. Naval War College War Gaming Department

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Margaret M. Polski PhD and Jon Scott Logel PhD

## ABSTRACT

The War Gaming Department at the U.S. Naval War College has been war gaming since 1887. This paper describes how we think about analysis and how we approach it in each phase of our war gaming process. It provides background on analytical war gaming at the NWC, our terminology, and our research design process.

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Drs. Polski and Logel are Associate Professors and analysts in the War Gaming Department supporting analytical war gaming for the Navy's senior leadership.



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The War Gaming Department (WGD) at the U.S. Naval War College (NWC) has been war gaming as a means to explore military decision challenges since 1887. Today, the WGD principally executes analytical war games to address Navy senior leaders' most difficult questions about war fighting.<sup>1</sup>

In our view, analytical war gaming is a flexible method for analyzing and experiencing strategic and operational decision-making and interaction. It is a tried and true approach to rapidly advancing knowledge about warfighting challenges. In a joint and combined arms environment, war gaming also provides the opportunity to build and sustain essential working relationships across services, partners, domains, and theaters.<sup>2</sup>

From an analytical perspective, war games, like real war fights, are unique events. The results that emerge from a single analytical war game are specific to the problem, purpose, objectives, and research questions that provide a framework for design and execution, the participants, and the event. In order to produce insights that are useful for command decision making, analysts must use a disciplined method, adhere as closely as possible to the principles of scientific inquiry, and identify the strengths and limitations of their work.

In the sections that follow we elaborate on how we think about analysis. The first section provides background on the development of analytical war gaming at the NWC, our terminology, and our research design process. The second section explains how we approach analysis in each phase of our war gaming process. The final section summarizes and provides advice.

### Background

Analytical war gaming at the NWC is based on the work of Captain William McCarty Little, Captain Wilbur Van Auken, and Francis McHugh. These early military operations researchers developed war gaming at the College over a period that spanned the founding of the college, the interwar period, and the Cold War era. McCarty Little is credited with introducing war gaming to the Navy, and he wrote a number of papers on the topic in his time at the NWC.<sup>3</sup> Van Auken established a research

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<sup>1</sup> The WGD defines analytical war gaming as a systematic research method for analyzing war fighting decisions and decision-making behavior. A war game is a representation of a decision-making challenge, which may or may not closely resemble what we can or will observe in the naturally occurring world. It is a representation of "real warfare" in the sense that players are making real war fighting decisions. From a practical perspective, analytical war gaming provides an opportunity to think deeply about policy, strategy, operating concepts, operating plans, or course of action; rehearse decision-making; or create a learning experience for participants in making decisions and experiencing the effects of interaction with an aggressive competitor.

<sup>2</sup> The U.S. military is a joint force (Air Force, Army, Coast Guard, Marines, and Navy) that prepares to fight in combined arms with coalitions and other partners in all warfighting domains (air, space, land, the surface of the oceans, undersea, and in the littorals) using a full range of hard and soft power capabilities including cyber and other information operations.

<sup>3</sup> McCarty Little was appointed in 1887 as a member of the faculty and developed two-sided war gaming at the College. Hank J. Brightman and Melissa K. Dewey, "Trends in Modern War Gaming: The Art of Conversation," *Naval War College Review* 67, no. 1 (Winter 2014), pp. 17–30. McHugh also credits McCarty



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department in war games at the College in 1932, and was one of the first to analyze systematically the BLUE-ORANGE games of the interwar period.<sup>4</sup> However, it is McHugh who is most closely associated with developing and documenting the methodological approach that the WGD uses today.<sup>5</sup> His definition of analytical war gaming, which incorporates the definition McCarty Little articulates in a lecture at the NWC in 1912, is called-out in the textbox.<sup>6</sup>

*“A war game is a simulation, in accordance with predetermined rules, data, and procedures, of selected aspects of a conflict situation. It is an artificial - or more strictly - a theoretical-conflict ‘... to afford a practice field for the acquirement of skill and experience in the conduct or direction of war, and an experimental and trial ground for the testing of strategic and tactical plans’.”*

Francis McHugh (1966)

As Figure 1 shows, the WGD is an integral part of the U.S. Navy’s (USN) research enterprise and supports national defense strategy and operational design. The USN uses war gaming to research military operations, provide experience in decision making, educate personnel, and shape critical decisions and investments. The WGD is responsible for designing and executing war games to help leadership and their staff better understand their most vexing dilemmas. WGD war games are designed to challenge the assumptions underpinning joint and naval operating concepts and plans,

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Little with introducing war gaming in the College: see Francis J. McHugh, *Fundamentals of War Gaming*, 3<sup>rd</sup> Edition, U.S. Naval War College (1966). McCarty Little’s papers on war gaming include “Rules for the Conduct of War Games,” Naval War College, Newport RI (1901 and 1905); “The Strategic Naval War Game or Chart Maneuver,” *U.S. Naval Institute Proceedings*, Vol. 38, No. 4, Whole No. 144 (1912); and “The Chart Maneuver,” Naval War College, Newport, RI (1920).

<sup>4</sup> Jon Scott Logel reports on Van Auken’s appointment as Director of the Research Department at the College and his team’s work analyzing war games in the inter-war period. See Jon Scott Logel, “Captain Van Auken and the Research Department of the Naval War College: Considerations of Analytical War Gaming in the Decade Before Midway,” paper prepared for the 2017 McMullen Naval History Symposium, US Naval Academy, 14-15 September 2017. Also see, John M. Lillard, *Playing War: War Gaming and U.S. Navy Preparations for World War II*, page 100, University of Nebraska Press (2016).

<sup>5</sup> For a professional war gamer’s perspective on McHugh’s influence see David DellaVolpe’s “Forward” to the Naval War College reprint of McHugh’s 1966 volume. McHugh’s influence is reflected in the current U.S. Naval War College *War Gamers’ Handbook: A Guide for Professional War Gamers*, which was edited by Shawn Burns (2014).

<sup>6</sup> See McHugh (1966). McCarty Little’s 1912 lecture, which is entitled “The Strategic Naval War Game or Chart Maneuver,” is reprinted in *U.S. Naval Institute Proceedings*, Vol. 38, No.4, Whole No. 144. The U.S. Department of Defense Modeling and Simulation Glossary defines a war game as: “A simulation game in which participants seek to achieve a specified military objective given pre-established resources and constraints.” War gaming is defined as; “Simulating, by whatever means, a military operation involving two or more opposing forces, using rules, data and procedures designed to depict an actual or assumed live situation.”



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identify critical issues for further analysis, and produce a “punch list” for action. Every analytical war game has educational and experiential as well as research components: Typically a fleet commander’s objectives for a war game include not only gaining insights, but also providing an opportunity for senior staff to experience decisions when executing a concept or planning against an aggressive adversary.

In our experience, a successful analytical war game addresses the research questions and generates questions that inform further analysis, exercises, experiments, and planning. At the end of a war game, the sponsors and participants should have a better understanding of what they know, what they need to learn more about, and where they need to focus refinements. A well-designed war game properly analyzed can also have implications for national security policy, strategy, and naval enterprise management.



**Figure 1: The U.S. Navy’s Approach to Analyzing and Researching War-Fighting**

Source: Adapted by the authors based on Mr. Patrick Molenda’s and RADM John T. Palmer’s classified briefing, “Integrated Training, War Gaming, and Modeling and Simulation,” dated 14 December 2017

Today the WGD uses a team research method that includes steps that are typical in professional research design modified to accommodate the USN’s applied research requirements. Most of our war games investigate questions related to executing maritime concepts of operations and plans in a joint, multi-domain, coalition environment. While we regularly design and execute war games for joint military operations planning courses, our primary responsibility is to investigate challenges identified by the Navy’s CNO and fleet commanders. Hence most of our war games are classified and as analysts, we are required to work with our war game teams to ensure that we can draw implications



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from play that inform strategy, operational design, and organizing, manning, training, and equipping the force.

### Approach

Each fiscal year the CNO's staff asks fleet commanders to submit war game proposals. The WGD reviews these proposals and makes recommendations to the CNO's staff about which proposals are best suited to war gaming and will contribute to the USN's analytic agenda. Once the CNO decides on a war game plan, the WGD develops a schedule for the fiscal year and assigns a team to execute each of the war games in the schedule.

A WGD war game core team includes a director, analyst, designer, developer, knowledge manager, and logistician.<sup>7</sup> As the war gaming process unfolds, a lead adjudicator is integrated into the core team. The analyst provides the framework for designing and developing a war game, builds a data collection and analysis plan (DCAP), and a team to execute the plan (DCAT). The analyst leads the team in collecting data on players' decisions and decision making processes during play, analyzes these data, and drafts war game reports for peer review. Peer reviewers typically include war game team members, members of the WGD including the Chairman of the WGD and his deputy, and command staff.

The WGD's analytical war game research process, which is depicted in Figure 2, includes seven phases: tasking, design, development, testing, rehearsal, execution, and reporting. All WGD war games begin with analysis and integrate analysis into each phase of the war gaming process. However, as the following sections describe in more detail, analytic goals and tasks differ across the phases.

The WGD's disciplined approach to analysis makes it possible for other war gamers to replicate or repeat a war game, to iterate on some aspect of a war game in subsequent research, and to understand how war gaming and war game findings fit in a broader military operations research agenda that includes other research methods such as modeling and simulation, experiments, and exercises.<sup>8</sup>

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<sup>7</sup> For detailed descriptions of the NWC WGD's war gaming methodology, see McHugh (1966) and Shawn Burns Ed. *War Gamers' Handbook: A Guide for Professional War Gamers*. U.S. Naval War College. 2015.

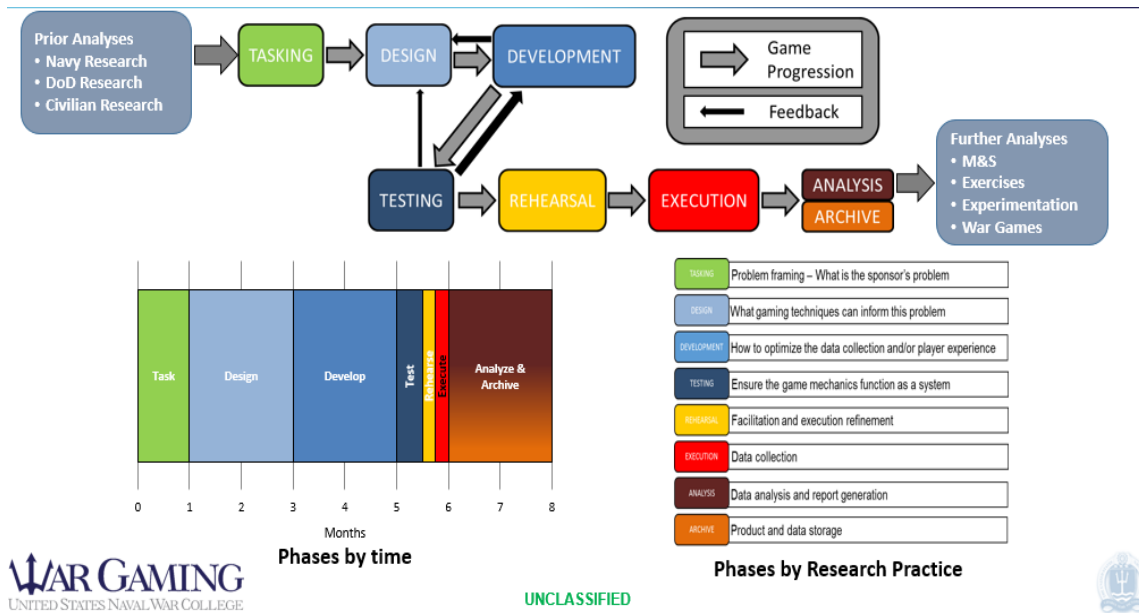
<sup>8</sup> By "replicate" we mean that another equally capable research team could duplicate the analysis using the same data and obtain the same insights or findings. By "repeat" we mean that the same game design could be played again by another research team or the same research team with the same players or another group of players. By "iterate" we mean that a new game could be designed and played that would represent the next step in a series of inquiries with respect to the war-fighting challenge. For a more comprehensive discussion of how the WGD situates itself in military operations research, see Margaret M. Polski, "Back to Basics: Research Design for the Operational Level of War," *Naval War College Review*, Forthcoming Summer 2019, Vol. 72, No. 3, and War Gaming Department Working Paper WGD\_20181, U.S. Naval War College, Newport, RI. April 2018.



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**Figure 2: U.S. Naval War College War Game Department Research Design Process**

Source: Author's extension based on Shawn Burns Ed. "War Gamers' Handbook: A Guide for Professional War Gamers." (2015)

### War Game Analysis and Tasking

The overall team goal in the tasking phase is to reach agreement with the fleet commander about the problem, purpose, and objectives for the war game. At the end of the phase, which includes an initial planning conference (IPC) with the commander and relevant staff, the WGD executes a final proposal and schedule for the war game.

Working from the preliminary war game proposal and prior knowledge, the analyst begins building a "literature review." The literature review, which often continues through the development phase of the war gaming process and even in post-game analysis, involves identifying and reviewing the results of other relevant studies, exercises, experiments, and war games to inform the problem, purpose, and objectives for the new war game. The analyst asks the following questions when conducting this review:

1. What are current policy, strategy, and operational design challenges in the commander's area of responsibility (AOR)?
2. What does the USN know now about warfighting challenges in the AOR based on previous research, what is the extent of the available evidence, and what is the quality of the evidence? What don't we know or what haven't we previously studied?
3. What doctrine, concepts, plans, instructions, and assumptions address operational challenges in the AOR and how well are they supported by evidence?



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Based on the literature review, the analyst helps the war game team draft an initial statement of problem, purpose, and objectives for the war game, which is then discussed and refined in the IPC. WGD analysts typically participate in planning conferences with the war game director, designer, commander, and staff. The text box provides an example of a war game framing statement.

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**Problem:** *We need to refine our maritime planning products in light of changes in the adversary's capabilities*

**Purpose:** *Challenge existing planning framework assumptions in order to identify warfighting strengths and weaknesses*

**Objectives:** *1) Specify ways of employing capabilities to execute the planning framework; 2) Identify the scale and scope of risk to force and mission; 3) Develop a deeper understanding of the nature of the fight if the planning framework is executed.*

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### War Game Analysis and Design

The team goal for the design phase for an analytical war game is to develop a design document, which serves as a framework for how the war game will be developed and executed.

As the WGD team moves into the war game design phase, the analyst continues to build the literature review, develops research questions or hypotheses to guide war game design, selects a primary analytic approach, and begins to draft the DCAP.

Immediately following the IPC, the analyst works with the team to develop a set of research questions or hypotheses (or both), and maps them to the war game problem, purpose, and objectives. This mapping provides the blueprint for war game design, development, execution, data collection, analysis, and reporting. We use classic war-fighting factors (time, space, and force) and functions (command and control, intelligence, fires, protection, maneuver, sustainment, and cyber) to systematically identify warfighting challenges potentially associated with the problem, purpose, and objectives for the war game. Figure 3 provides an example of a research logic map.



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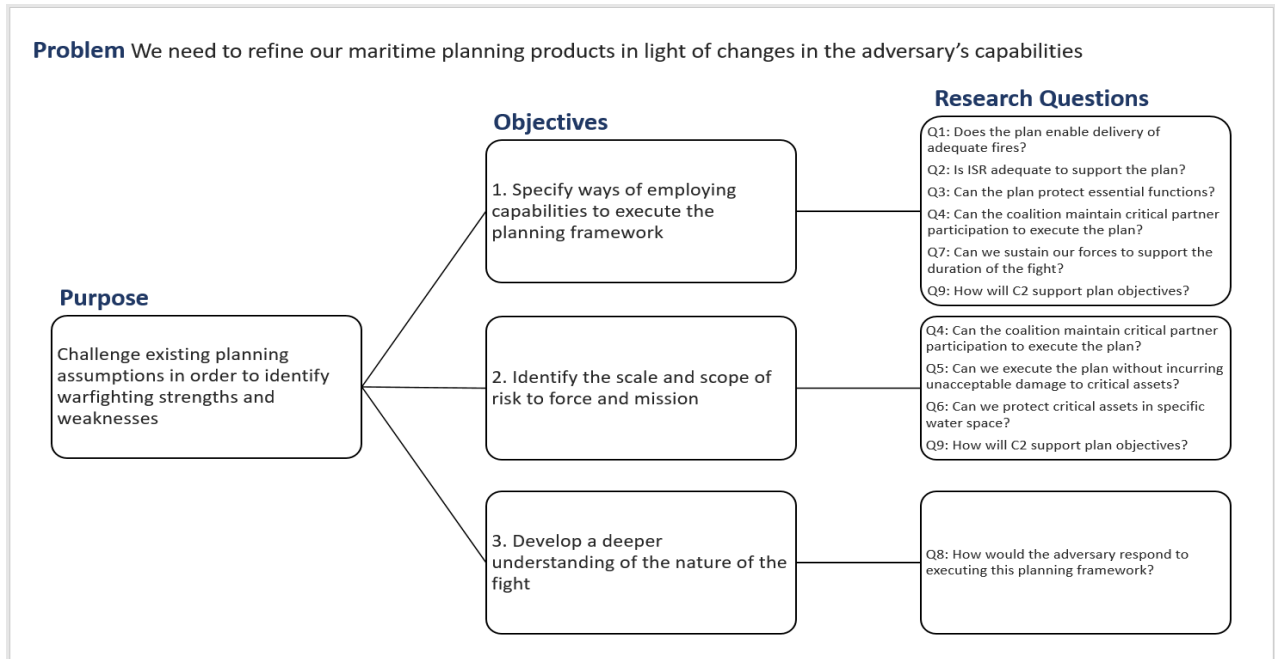


Figure 3: Research Logic Map

The process of developing a research logic map includes selecting a primary analytic approach. WGD analysts use one of two primary approaches depending upon the nature of the research challenge: inductive or deductive. An inductive approach is well-suited to problems that have well specified assumptions, such as a concept or plan. A deductive approach is well-suited to problems that require investigating unexplored territory such as how to fight using a particular capability or identifying critical issues associated with particular warfighting functions.

Using an inductive approach, an analyst identifies critical warfighting questions or assumptions, (re)states them as hypotheses, collects data on war game play, and then determines whether these data support, do not support, or provide ambiguous support for the hypotheses. For example, Figure 3 illustrates the research logic for investigating a joint planning framework and identifying considerations for a maritime support plan. Using an inductive approach, research question number one could be restated in the form of a hypothesis: H1: The plan does not enable delivery of adequate fires.

Using a deductive approach to understanding maritime support planning considerations, an analyst could formulate research questions such as those illustrated in Figure 3, collect data on war game play, and then look for patterns in the data that logically shed light on the research questions. A deductive approach allows the analyst to mine the data to discover interesting insights that go beyond the research questions. By contrast, an inductive approach requires the analyst to focus data analysis rather single-mindedly on the research hypotheses.





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In our experience, both inductive and deductive approaches to war game data analysis are useful and the best approach includes elements of both. For example, an inductive analysis can address the hypotheses but it can also include interesting insights from war game play that were not contemplated in the research design. Similarly, a deductive analysis can be very focused in the way it addresses the research questions.

After developing a research logic map, the analyst begins drafting the DCAP, which incorporates other research findings related to the war game and describes how the data collection and analysis team (DCAT) will collect, analyze, and report on data generated from war game play. The DCAP, which we discuss in more detail in the next section, includes the following elements:

- Background or context for the war game including prior research findings
- Problem
- Purpose
- Objectives
- Research questions or hypotheses
- Player and data collector requirements
- Analytic strategy
- Type and structure of data to be collected
- Data collection and analysis processes and tools
- Bias mitigation strategies and caveats

In addition to guiding design, development, adjudication, and reporting activities, the research logic map helps define requirements for player expertise. For example, the research logic map depicted in Figure 3 requires a war game design that encourages the players to think critically and specify in detail how they would coordinate across task forces, coalition partners, and other entities to achieve the end states envisioned by the planning framework. In addition to the commander, command staff, and coalition partners, the war game research logic requires players with experience and expertise in how the adversary fights; strategy; planning; joint, coalition, and maritime warfighting in all domains; maritime law enforcement; national policy and law; international law; public affairs; and strategic communication.

### **War Game Analysis and Development**

The WGD team goal for the development phase of an analytical war game is to create an engaging, playable war game that will rigorously address the problem, purpose, objectives, and research questions. All of the war game products, processes, and technology are conceptualized and prototyped in this phase.

In the development phase the analyst continues to build the literature review and DCAP. This requires close consultation with the designer and the developer to specify the type of data war game play will generate, how it will be generated, and by whom (or what). The analyst must take a keen interest in information flows, inputs provided to players, formats and templates for player submissions, the organization of the sequence of player activities, the adjudication process, and the structure of after action sessions.



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A key role of the analyst in the development phase is to ensure that the team collects and analyzes data on war game play that can address the research questions or hypotheses as unambiguously as possible. A WGD analyst's primary concern in the development phase is rigor. Measures of rigor include validity, or the extent to which the way the war game is designed and executed generates findings that actually measure what the team intends to measure; reliability, which refers to whether the team's measuring procedures used in the same way will produce the same measure; and replicability, or the extent to which another analyst could duplicate the analysis using the same data and reach the same conclusions.<sup>9</sup> Achieving rigor in war gaming includes taking steps to minimize bias and error in war game procedures, and ensuring that procedures are as simple as possible.

In the development phase, the analyst is principally focused on two components of the DCAP: 1) the type and structure of data that will be collected in the war game, and 2) data collection and analysis processes and tools.

### *Data*

From an analytical perspective, the usefulness of a war game to a commander ultimately depends upon the quality and structure of the data generated in play. If play does not generate the data an analyst needs to provide rigorous insights that can inform command decisions including those associated with doing further analyses, it is a dreadful waste of time and resources.

Figure 4 illustrates the way we think about war gaming, data collection, and analysis. The commander is responsible for making decisions about how to address threats in a particular part of the world. These threats, and the trade-offs associated with alternative courses of action give rise to any number of dilemmas. As war gamers, we help the commander focus on and critically investigate one of these dilemmas. In the example we have been using thus far, our commander is presented with a planning framework for a joint warfighting plan and s/he must provide guidance to staff who are tasked with developing a maritime component plan that will support the joint plan objectives.

Continuing with our example, as analysts, we help the war game team and command staff identify some of the most critical assumptions of the joint planning framework from a maritime perspective in terms of warfighting factors and functions. Then we raise questions about these assumptions based on what we know about operating in the area. Once there is consensus about the research focus, we work with the war game team to design a war game that will generate the data we need to address our questions as rigorously as we can.

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<sup>9</sup> Our definitions of validity, reliability, and replicability are drawn from King, Keohane, and Verba (1994). Campbell and Stanley, who are concerned with experimental design, distinguish "internal validity" from "external validity." Findings have internal validity if we can say that the experimental treatment made a difference in a specific experimental instance. External validity refers to the extent to which findings can be generalized across other populations, settings, treatment variables, and measurement variables (Donald T. Campbell and Julian C. Stanley, *Experimental and Quasi-Experimental Designs for Research*, Rand McNally College Publishing Company (1963). For a general primer on research design and planning, see Paul D. Leedy and Jeanne Ellis Ormrod, *Practical Research: Planning and Design*, Ninth Edition, Pearson (2010).

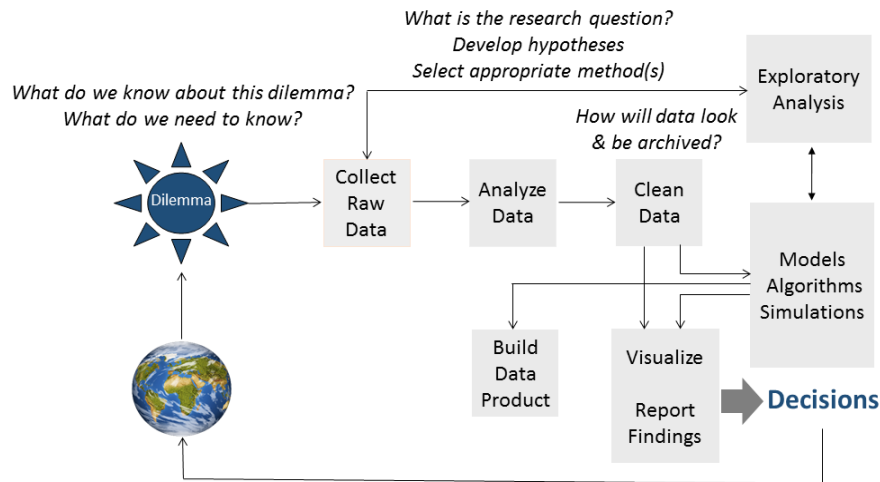


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In the development phase the analyst and the war game team are thinking through the type and structure of the data we will collect from players and how we will collect these data (collect raw data), how we will analyze them once collected, and how we will clean and organize the data so that we can identify patterns (visualize) and communicate findings (report). The value of our data and our ability to use modeling, simulation, or artificial intelligence (algorithms) to help us visualize or use our data (build data products) is linked to the type of data we collect, the structure of the data, and the tactics we use to “interrogate” and archive our data. This brings us to a discussion of tools and technologies.



**Figure 4: Conceptualizing Data Collection and Analysis Planning**

Source: Margaret M. Polski (2018) “A Warfighter’s Guide to Analysis,” War Gaming Department Working Paper WGD\_20181, U.S. Naval War College, Newport RI. April 2018

War gaming generates a great deal of data but not all are needed for analysis. Crawling through vast amounts of data is not only inefficient, it can send the unwitting analyst down rabbit holes that lead to incoherent reporting. Our rule of thumb is to collect the minimally inclusive sufficiently exhaustive (MISE) amount of data required to rigorously address our research questions and hypotheses.

### *Using Tools and Technologies*

WGD analysts have access to a number of computer-based tools and technologies that help us collect, analyze, clean, visualize, and build data products. For example, when we war game in our own facilities at the NWC, we use a custom-designed war gaming platform that automates collection of data generated by player moves, requests for information, survey responses, player communications, adjudication, and situation updates.



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Automating data collection helps to reduce the potential for bias related to errors, omissions, and misinterpretations. It also improves the efficiency of data collection and analysis processes. In other words, properly done, automated data collection generates cleaner data, which reduces the need for additional cleaning processes.

WGD analysts also have access to a number of analytic tools that help us crawl through and interrogate our data more efficiently and with less human bias. For example, we use Atlas.ti, Analysts' Notebook, and custom-developed forms of artificial intelligence to visualize and identify patterns in our data. Similarly, we use commercial and custom-developed software tools to build data products and archive our data for future use.

In order to use our tools properly and to begin the process of developing new tools, WGD analysts use the development phase of a war game to specify data collection requirements. Table 2 provides an example of this type of specification.

**Table 2: Data Collection**

DATA SET	TYPE OF DATA	STRUCTURE	SOURCE
Briefings	Text and Images	Structured & Unstructured	Players
Commander's Intent	Text	Structured	Operational Cell Leads
HHQ Guidance	Text	Structured	HHQ Cells
Operations Directives	Text, Numbers, & Images	Structured	Operational Cells
Survey Responses	Text	Structured	Operational Cells
Situation Updates	Text & Images	Structured	Control Cell
Open Session Comments	Text	Structured & Unstructured	Players
Data Collector & Analyst Notes	Text & Images	Structured & Unstructured	Players & Control Cell

### War Game Analysis and Testing

The WGD team goal for the testing phase of an analytical war game is to integrate all of the individual pieces of the war game that were created in the development phase and make sure that they 1) effectively and efficiently achieve the war game purpose and objectives, and 2) generate data that will allow us to address the war game research questions.

In the testing phase the analyst continues to build the literature review and DCAP and begins to test and refine analytic tools using sample data sets. A key role of the analyst in this phase is to identify potential sources of bias in the war gaming process and develop strategies to mitigate and control.<sup>10</sup> By bias, we mean those things that can distort or contaminate war game play, data, or analysis such

<sup>10</sup> One could write an entire book on ensuring rigor in war gaming. In the space of this chapter we can only provide an overview of the way we think about and treat some of the more common issues.



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that the design is not fully executed, and the validity and reliability of the findings of the war game are significantly compromised.

Potential sources of bias in war gaming include the relative independence of the war game team, the way players are recruited, the sample of people selected to play in a war game, war game materials and presentations, participant bias, adjudicator bias, analyst and data collector bias, errors, omissions, and events. Some examples of bias include:

- **Independence:** Some or all of the war game team were involved in creating the products the war game is designed to investigate
- **Recruiting Players:** Someone deliberately recruits specific players and instructs them to shape or direct war game play
- **Sample:** Numbers are small, or the type of players selected and assigned to play in particular billets do not have the knowledge, skill, or experience to play in a plausible way
- **Materials, Presentations, and Facilitation:** War game materials, presentations, facilitator, or observer behavior provides clues about what players could or should do
- **Participants:** Participants do not have to respond to the actions of an aggressive adversary, they do not consistently follow the rules for play, or senior leaders or observers interject in ways that skew play
- **Adjudicators:** Adjudicators fail to adjudicate a player move, or interact with players as they are making decisions about their move
- **Data Collectors:** Data collectors analyze, interpret, misunderstand, or change what players actually do or say
- **Analysts:** Analysts “mine” data to confirm a particular perspective and fail to seek contradictory evidence
- **Errors, Omissions, and Events:** There are estimation or calculation errors in data, data are lost or omitted, or events occur that distort play

Every operations research method encounters bias: war gaming is no exception. Bias cannot be completely eliminated, but analysts are obliged to do what they can to identify sources of bias, mitigate, and acknowledge the impact on findings when it cannot be mitigated. For example, all participants – including the war game team – bring bias to the game. One of the principal values of war gaming is the ability to identify and confront warfighting assumptions and biases. The analyst’s objective is to make sure that we are in fact identifying what we aim to identify and dispassionately reflecting upon the implication of these assumptions. Table 3 provides an example of how one might think through bias issues.



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**Table 3: Sources of Bias and Mitigation Strategies**

DATA SOURCE	CAPTURE METHOD	PRODUCTS	PRIVACY	POTENTIAL SOURCES OF BIAS	MITIGATION STRATEGIES
Players' decisions, decision making processes & moves; facilitators; control cell	Game inputs in game tools; data collectors' notes; analysts' notes	Game scenario; commander's guidance, operating directives, situation updates; notes, images & diagrams	Closed access	Sample selection; participant bias; analyst & data collector bias; adjudicator bias; errors, omissions, unexpected events	Providing written instructions and "scripts;" aggressive red cell; monitoring & facilitating play; triangulating analysis across multiple data sets; fact checking; machine analysis
Players' demographic data, perceptions, and observations	Survey; structured interviews; inputs in game tools	Survey responses; interview notes	Closed access	Sample bias; player bias; analyst bias; estimation errors and omissions	Structuring player recruitment & selection; triangulating analysis across multiple data sets; fact checking; machine analysis
Players, facilitators, & control cell discussion comments	Player inputs in game tools; analyst & data collector notes; facilitator notes	Machine files; notes, images & diagrams	Mix of open & closed access	Sample bias; player bias; analyst & data collector bias; errors, omissions, & events	Data collector training & supervision; triangulating analysis; fact checking; machine analysis

### War Game Analysis and Rehearsal

In the rehearsal phase the WGD team puts a group together to practice or rehearse the war game. The goal is to discover and make critical refinements before execution. The analyst participates in the rehearsal with a focus on testing surveys and other data collection tools, running analysis tools on sample data, and identifying player issues that could interfere with or bias data collection or analysis.

In the rehearsal phase the analyst finalizes the DCAP, the data collection team (DCAT), and briefing materials for the DCAT. As a part of this process, the analyst confirms the schedule for data collector training and cell assignments. Data collector orientation is usually scheduled either the day before the war game begins, or during the first morning of the war game.



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Data collectors are critical members of a WGD war game team. The WGD recruits and assigns a minimum of one data collector for each war game cell, depending upon the number of people in the cell. Data collectors observe and take notes on player activities, behaviors, and events in an unbiased way, focusing on collecting facts about the context of war game play rather than analyzing or interpreting player perspectives or behavior. Data collectors' products are used to analyze war game play and develop insights that may inform readiness, operational design, strategy, policy, or organizing, manning, training, and equipping the force.

WGD data collector orientation includes the following elements:

- **Role**, responsibilities, and products
- **Job description** and expectations
- **Procedures**, tips, examples, templates
- **Background** on the war game including the research logic map and war game guides

### War Game Analysis and Execution

During the war game, the analyst, who is part of the white or control cell, is monitoring data collection, adjudication, and control cell activities to ensure that s/he will have the data needed to address the war game research questions.

WGD analysts have two different preferences with respect to analysis and execution. Some prefer to do “dynamic” in-game analysis, which involves doing preliminary, high level analysis during war game play and detailed technical analysis after the game is executed. Others prefer to do “ex-post” or post-game analysis, deferring most analysis until after the war game is completed.

Regardless of our preferences, our reporting requirements, which we discuss in the next section, require that we must all do some in-game analysis. In our analysis we hone closely to the scientific method using primarily qualitative techniques to identify all the data relevant to addressing our research questions or hypotheses, categorizing data, interpreting data, and deriving interesting implications for senior leadership.

### War Game Analysis and Reporting

In the final phase of our war games, the analyst pilots the ship. This phase is focused on a final technical analysis of war game data, reporting on analytic findings, and archiving war game outputs.

WGD analysts support three reporting requirements: 1) a brief “sounding” email from the commander to the CNO; 2) a “quick look” report; 3) and a final research report. As the war game comes to a conclusion, we provide the command staff with preliminary analysis that helps them support their commander in sending a sounding email to the CNO immediately following the conclusion of the war game. This email reports that the war game has taken place, describes the purpose of the war game,



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and provides a summary of execution, warfighting insights, and insights related to the commander's analytic agenda.

Following the sounding, the analyst drafts a brief 5-10 page report on the war game for the commander and staff based on a "quick look" at the data. This report, which is due 10 calendar days from the conclusion of the war game, includes principal findings and preliminary observations with respect to the research questions. It describes the commander's intent for the war game, the design, and who participated. The report briefly summarizes war game play, lists issues that require further analysis, the way forward, and caveats.

The analyst has 60 days from the conclusion of the war game to release a final research report, which the commander receives and endorses either with or without comment. Working with the team knowledge manager, the analyst organizes and archives all of the war game documents, data products, analyses, and reports on a department share drive using a standard file structure. This convention helps the WGD build and sustain its stock of war gaming knowledge and practice.

Unlike the sounding and the quick look reports, the final war game report is primarily written for a research audience. It includes an abstract and executive summary, which are condensed summaries of insights for immediate action by Navy leaders, a detailed technical analysis of the war game, and a technical appendix that contains key data products. Following is a typical outline for the final report.

Abstract

Executive Summary

Overview of the War Game

Research Plan and War Game Design

- Research Questions and Hypotheses
- War Game Design
- Data Collection and Analysis

Analysis

- Background of the War Game
- War Game Play Overview – A Summary of What Happened
- War Game Play – Move by Move Analysis
- Flag Officer After Action Review
- Participant Survey Results
- Caveats and Biases

Conclusions

Technical Appendix Index





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### Summary

As analysts in the U.S. Naval War College War Gaming Department we have the good fortune and privilege to build on over 130 years of analytical war gaming practice. We stand on the shoulders of some truly great strategic thinkers who developed a capability that has helped the U.S. Navy prepare to fight and win when called to do so.

This paper provides a brief overview of how we approach analysis when we war game, which is summarized in Figure 5. From this overview, three key points emerge:

1. By definition, an analytical war game requires that analytic activities are integrated into all phases of war gaming: An analyst’s work begins before the tasking phase and continues after the war game executes until a report is produced, disseminated, and archived
2. Most analytic activities are not confined to a single phase and are not performed sequentially: they continue to evolve and are performed in parallel fashion across war gaming phases
3. War-fighting is a complex challenge that is very difficult to investigate hence the best analysts are humble skeptics who are willing to acknowledge the limits of their work.

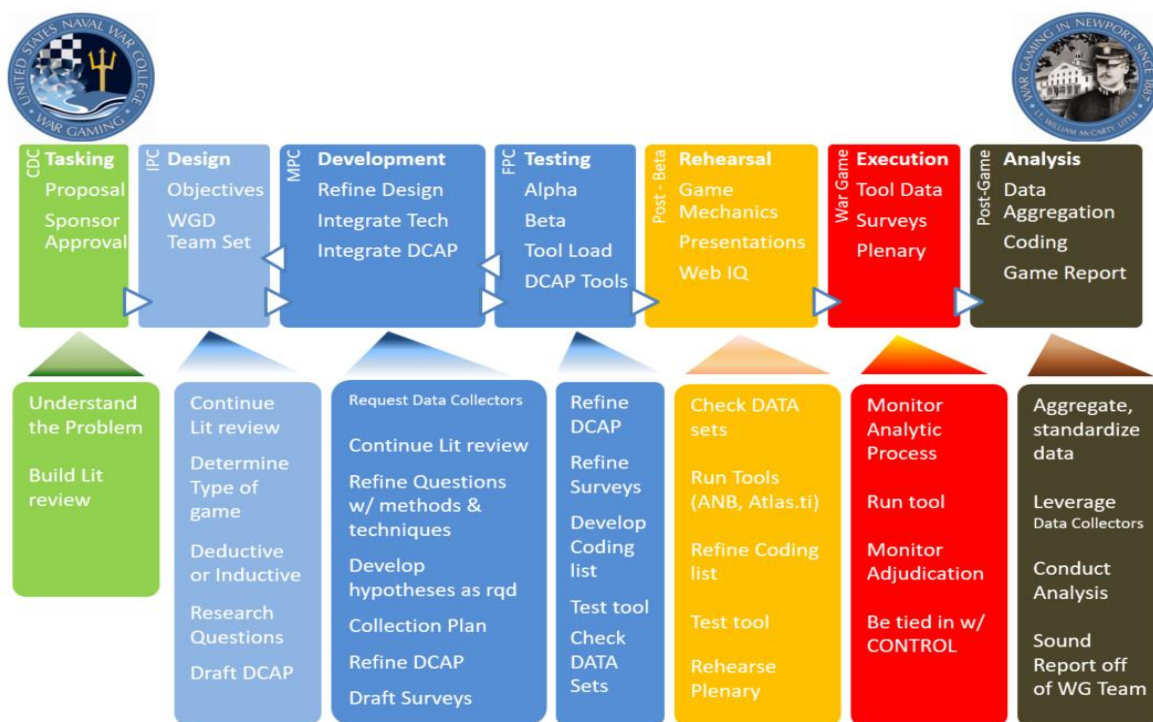


Figure 5: Nesting Analysis in War Gaming

Source: Jon Scott Logel (2018) “Analysis Up Front: Planning and Managing War Game Analysis,” Presentation for the NWC International War Gaming Course, June 2018



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Operations research communities are rife with - and often thrive upon - controversy and competition. Every war gamer we know has been called upon to explain or defend their methods in comparison to other, more formal methods of investigating warfighting problems such as modeling, virtual simulations, exercises, and experiments. However, our most interesting war-fighting challenges, such as jointly fighting peer and near peer adversaries in a global political and economic system with four domains, are messy and difficult to investigate. No method, including war gaming, can generate perfect analytical rigor: these are ideal standards, not minimum thresholds.

While WGD analysts work hard to ensure that our war games produce findings that senior leaders can rely on along with other analyses to ensure warfighting readiness, we know that our analyses have strengths and limitations for decision-making. We believe that all military operations researchers including war gamers ought to acknowledge the limits of their analyses and provide estimates of rigor in their briefings and reports: If there is nothing else that you take from this paper, we urge you to consistently estimate the rigor of your analyses. The text box provides an example of how we handle this in our war gaming reports.<sup>11</sup>

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<sup>11</sup> See page 5 and footnote 9 for definitions of validity, reliability, and replicability. By “reasonable person” we mean that a reasonable person would be able to use the findings to make decisions or take action that could address the purpose and objectives of the war game.



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### Estimating Analytic Rigor

*“War gaming data and analyses are subject to a number of biases. The population sample for war games is neither complete nor random. War game teams recruit players to participate based on past participation, their current position in command organizations, at the commander’s invitation, or by appointment by their commands. While we direct data collectors to capture all information that is relevant to addressing the research questions or hypotheses, errors and omissions are common in data collection and difficult to measure. Some war game players attempt to shape discussion and to withhold input. Swarming or “group think” is a common group dynamic in war games. Finally, self-reported survey responses often contain estimation errors, with respondents both over-estimating and underestimating.*

*The findings and recommendations we draw from our analysis reflect our interpretation of war game data. We base our interpretation on our professional experience as analysts, researchers, and joint professional military educators in the naval community. We offer them as one, well-informed perspective. The following table provides our estimate of the rigor of our findings.”*

FACTOR	ESTIMATE
<b>EXTERNAL VALIDITY</b>	<b>Medium:</b> We based our analysis on input from a selected sample of the types of individuals who are likely to make assessments or decisions in a similar situation and not a random sample of the entire population.
<b>RELIABILITY</b>	<b>High:</b> We based our analysis on players’ assessments and decisions as expressed in their directives, observations of player behavior and comments by multiple individuals in three different fora, or comments directly contributed by participants.
<b>REPLICABILITY</b>	<b>High:</b> We believe that if another equally capable analyst analyzed these data using the same procedures s/he would arrive at similar conclusions.
<b>REASONABLE PERSON</b>	<b>High:</b> There is a high degree of consistency in the observations and statements we collected, which a reasonable person could use to inform decision making and action.