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War Gaming Research Forum Proceedings

Adjudication Approaches

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Adjudication Approaches

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From the President

ON BEHALF OF ALL THOSE who for the past year have devoted considerable time and effort in preparation for this inaugural War Gaming Research Forum, it is my privilege to present these Proceedings. As I highlighted in my opening remarks, the purpose of this gathering was to facilitate information-sharing among civilian institutions of higher education, civilian industry, and Department of Defense organizations that use war gaming as an experiential or analytic research method with an ultimate goal of enhancing warfighting effectiveness.

This Forum, focused on adjudication approaches, supports the U.S. Chief of Naval Operations' effort to promote mutual awareness, and where it makes sense, relationships among the Navy organizations that conduct research. This effort is referred to as the Analytic Master Plan, or AMP. Within the CNO-directed warfighting integration umbrella, this Research Forum is focused on war gaming, one of the Navy's analytic research lanes, or "pillars" that comprise the AMP. The other pillars include Intelligence, Studies, Experimentation, Exercises, Test & Evaluation, Emulation, and Modeling and Simulation. The purpose of the AMP is to provide unity of effort across the enterprise, coordinating and integrating previous, current, and future analysis, to fulfill the highest priorities of the Chief of Naval Operations. Ultimately these analyses inform force design, employment and operational concepts.

As President of the Naval War College, I have the honor of serving as the War Gaming Pillar Lead, and it is my intent to foster greater communication and collaboration within the War Gaming Pillar, across the other pillars of the AMP, and more broadly the DOD war gaming community. Supporting that intent, this inaugural Research Forum provided war gamers, analysts, and military leaders an opportunity to share different perspectives on the purposes of adjudication and different methods of conducting war gaming adjudication.

Members of the U.S. Naval War College's (NWC) War Gaming Department - among them Captain Mike O'Hara, Shawn Burns, Walter Berbrick, Dick Wilbur, Joe Mroszczyk, and Ben Peterman - originally conceived the idea for this type of forum. They wanted to bring together analysts, scholars, and military officers on a

Departmental and Joint level to discuss current adjudication approaches in wargaming and technologies used to store, share, and retrieve war games results.

This document captures the many war gaming adjudication perspectives we heard and is accessible through the AMP Digital Platform web site known as the Naval LIFT Platform. This site also permits interested parties in the DOD to view the recorded sessions and further develop these ideas for future efforts.

We are called to consider both the obstacles and best practices in war gaming. As we approach our important work with a sense of urgency, I encourage you to review these Proceedings. It is our hope that this Forum, like the many others to come, will stimulate further research and closer cooperation among those who are attempting to understand ways to improve not just war game adjudication, but war gaming as a whole. We also hope that these Proceedings will be of value to those who were unable to attend the Forum.

SHOSHANA S. CHATFIELD
Rear Admiral, U.S. Navy
President, U.S. Naval War College

Executive Summary

Introduction

The Naval War College hosted the inaugural *War Gaming Research Forum* on February 2, 2022. The unclassified event was held virtually due to challenges associated with the ongoing COVID-19 pandemic. The *Forum's* purpose was to facilitate the sharing of war gaming information among Department of Defense and civilian institutions of higher education. This inaugural *Forum's* theme was "war gaming adjudication approaches" with a goal of learning different perspectives on the purposes of adjudication in war gaming and different methods of conducting adjudication. Approximately 40 people participated in the *Forum* from the following organizations: Naval War College, Naval Postgraduate School, Center for Naval Analyses, Army Futures Command, Navy Warfare Development Command, Navy Undersea Warfare Center, Marine Corps Warfighting Lab, Brown University, and others.

Summary of Presentations

The inaugural *War Gaming Research Forum* kicked off with welcoming remarks by RADM Shoshana Chatfield, the President of the U.S. Naval War College, as the War Gaming Pillar Lead for the CNO's Analytic Master Plan. RADM Chatfield greeted the delegates on behalf of the Naval War College and reviewed the aims of the Forum. In concluding her remarks, RADM Chatfield expressed gratitude to the faculty for having had the vision to spearhead a significant war gaming forum on adjudication approaches and to the many organizations and experts who took part.

RADM Chatfield was followed by Professor David "Bart" Sampson, who provided a brief overview of the Naval – LIFT Platform, an unclassified and classified digital platform repository for capturing various inputs of Naval research activities under the umbrella of OPNAV N7. The crux of the Naval – LIFT Platform is summarized by Prof Sampson's opening comments: "As we sit here today, research across the Navy enterprise is siloed." He noted that the lack of standardization makes it challenging to locate and leverage data and collaborate to solve complex problems. To meet this challenge, OPNAV spearheaded the digital platform over a year ago, which is being codified via the AMP process and vision and lays out requirements for the digital platform. It is designed to gather and store data that's discoverable, usable, and facilitates collaboration among relevant organizations across the Navy enterprise. Each pillar has its own space, through the dashboard feature, leadership and staff.

Each AMP research organization pillar is responsible for posting analytic products and project milestone descriptions to help OPNAV understand the totality of research being conducted across the Navy research enterprise, and help researchers make connections and inform their own work and research. As Prof. Sampson highlighted, "this helps us move from a silo world to an integrated, collaborated world." Prof. Sampson concludes his remarks with a call to action to begin populating the Naval – LIFT Platform with analytic products and descriptions of upcoming events.

Thus, the stage was set for the keynote address by Dr. Reid Pauly, who drew attention to the use of nuclear weapons in war games and some of the limitations and benefits of using war games to study matters of political science. He found that US policymakers are reluctant to use nuclear weapons, often citing ethical and policy reasons associated with "no-first use." He concluded by applauding the use of war games as a method to study complex problems, but cautioned against using the outcomes of war games in a predictive manner.

The third speaker was Mr. Charles Starkey of Group W. His remarks centered on the application of the Synthetic Theater Operations Research Model (STORM) as a war gaming adjudication tool to model operational and tactical actions within and across domains. Subsequently, Dr. Craig Koerner of NWC's Halsey Alfa Advanced Research Project highlighted the focus, composition, and approach of Halsey Alfa and Bravo, and, more specifically, how tactical interactions are adjudicated, and the role students play. Dr. Jeremy Sepinsky of CNA then spoke on the value and evolution of matrix gaming while recognizing its limitations in adjudicating ISR and operationalizing the effects of cyber and space actions.

Following the lunch break, Mr. Pete Pellegrino's talk on adjudication processes and pitfalls could very well be summarized by his concluding thoughts: "If you are focused on the adjudication output rather than player decisions, you've got your eye on the wrong ball." This sentiment was echoed by Dr. Will Startin of NWDC, who talked about the Fleet-360 war game, which aims to increase warfighting effectiveness at the operational level of war. LTC Tom Flounders' remarks summarized the Operational Wargaming System (OWS) in Army Futures Experimentation while CAPT Phil Dupree (USN, Ret.) highlighted the "imperfect taxonomy" guiding selection of adjudication approaches at Marine Corps Warfighting Laboratory. The final lecture by Dr. Jeff Appleget, and CAPT Jeff Kline (USN, Ret.) highlighted key strengths and weaknesses of the various adjudication approaches used at the Naval Postgraduate School.

Themes

The following themes were derived from *Forum* presentations, discussion and chat from both the presenters and attendees. These themes highlight the approaches and challenges of adjudicating deterrence and escalation, and ISR and C-ISR

Deterrence & Escalation Management

Researchers interested in deterrence and escalation issues face challenges with respect to data collection. They generally lack access to elite decision-makers and their deliberations during international crises to understand how they interpret signals from adversaries, send signals themselves, and how they manage escalation in the conflict. War games, however, allow researchers to observe these deliberations and understand how policy-makers make decisions in various conflict scenarios. Further, war games allow players to deal with consequences or dilemmas, which are both functions of the game design and the interaction among player decisions or moves, adjudicated by the White Cell. While the real power of war games lies in the player deliberations and range of possible outcomes identified rather than the adjudicated outcomes, adjudication plays an important role in these games because of the signaling and messaging implications of actions.

Deterrence war games are challenging for adjudication, especially when it comes to determining what players are trying to deter and whether their actions had any impact on adversary choices. Adjudicating and measuring the effects of signaling efforts may be required in games examining deterrence, but there are methodological challenges in determining how to do this. Further, one cell's signals of escalation or de-escalation that are intended to be obvious are misinterpreted or missed by players in other cells. Adjudicators can use moves sheets and post-move surveys to capture player perspectives regarding their own signaling efforts, their intent with certain moves, and their perception of their adversary's signaling efforts to inform their adjudication. Adjudicators also face challenges in terms of gauging effects on public opinion, which can often feature prominently in deterrence and signaling games. Understanding the impact of various actions and information operations on public opinion and decision-making, however, is difficult to adjudicate, in large part because of the lack of game rules or adjudication tables on the impacts of information operations.

Rather than relying upon adjudication to determine the success or failure of signaling efforts, analysts can use surveys in order to conduct cross-cell comparisons. Survey methodologies, especially when used to analyze deterrence issues, offer their

own challenges in a war gaming environment. They can lack sufficient granularity or can potentially bias players in terms of the options they should be considering.

Despite the challenges associated with war gaming deterrence issues, war games offer researchers unique insights into elite policy makers deliberations and decision-making, the various factors that contribute to escalation dynamics, and how decisions affect outcomes. While much of the data and findings from these war games are likely to remain classified for a significant period, having the data available in archives will be helpful to future researchers.

ISR and C-ISR

There are numerous challenges associated with adjudicating ISR and C-ISR and their effects on operational and tactical forces. Furthermore, classification restrictions further challenge ASW adjudication. While kinetic actions are (relatively) easy to adjudicate, adjudicating and modeling the operational and tactical effects of ISR and C-ISR actions are not. The biggest challenge noted consists of adjudicating highly complex interactions, such as the ISR and C-ISR.

Developing models to understand these effects warrants careful study and collaboration. There has been some progress and success with modeling and simulating ISR and C-ISR tactics, primarily for the purpose of updating the various COPs in a game. The same efforts include visualization of real-world satellite locations, allowing players to use real world tools for satellite vulnerabilities. Despite the successes, the numerous challenges remain, as there is no all-encompassing solution and there are very real limitations to the effectiveness of ISR and C-ISR actions in a game. Further exploration and experimentation are required to broaden the availability of effective ISR and C-ISR tools for use in war games.

Conclusion

Organized via Zoom under Covid-19 restrictions, the *Forum* was limited to unclassified discussions only. Despite these challenges, approximately forty researchers from more than ten war gaming organizations participated, contributing to the discussion through ten presentations, in-stream chat discussions and pre- and post-email input to War College organizers. Based on the positive response to the event from participants, the NWC's War Gaming Department intends to organize regular fora going forward; in-person events would allow for classified discussion and information sharing. War Gaming Pillar member representatives are encouraged to submit topics for future forums to War Gaming faculty/staff listed in Appendix B of this report.

Keynote: *Wargames and Nuclear Use*

Dr. Reid Pauly, Assistant Professor of Political Science, Brown University

Abstract: Professor Pauly discusses the reluctance of American policymakers to use nuclear weapons in historical political-military wargames. His research highlights the advantages—and challenges—of using wargaming for political science research on strategic deterrence. His remarks are based on two recently published articles: "Would US Leaders Push the Button?: Wargames and the Sources of Nuclear Restraint," published in International Security and "Wargaming for International Relations Research," co-authored with Erik Lin-Greenberg and Jacquelyn Schneider and published in The European Journal of International Relations.

Summary of Remarks

Dr. Pauly began by thanking the Naval War College for the opportunity to share his work on nuclear use in war games. To frame his talk, he posed the overarching question: why have nuclear weapons not been used since 1945? To generate new knowledge on the topic, he drew upon historical archives on early cold war game data. The first step in his research journey began with theory testing, with the goal of "being clear what the theory is." Dr. Pauly noted that there is a logic of deterrence but acknowledged scholars' and practitioners' interchangeable use of self-deterrence and nuclear taboo. Instead of testing them in silos, Dr. Pauly decided to look at the logic behind the decision to use or not use nuclear weapons.

Dr. Pauly began with the logic of deterrence, citing Winston Churchill's expression of deterrence:

> *"We have reached a stage in this story where safety will be the sturdy child of terror, and survival the twin brother of annihilation."*

He subsequently highlighted the practical military considerations surrounding nuclear weapons use, citing quotes from former Secretary of Defense Dick Cheney and former Chairman of the Joint Chiefs of Staff General Colin Powell. As General Powell remarked:

> "*The results [of our analysis of nuclear strike options] unnerved me. To do serious damage to just one armored division dispersed in the desert would require a considerable number of small tactical nuclear weapons... If I had had any doubts before about the practicality of nukes in the field of battle, this report clinched them.*"

Dr. Pauly followed up with the logic of precedent, which states that nuclear powers don't want to use nuclear weapons today because it would trigger further nuclear proliferation and ultimately additional use of nuclear weapons by others in the future.

Dr. Pauly referenced the fourth precedent of reputation, noting that decision makers are willing to forego a marginal military benefit of nuclear weapon use in exchange for not paying reputational costs. He referenced a quote by former Ambassador George Ball, expressing this logic in a 1983 article, saying:

> *"Any nation that first broke that taboo by using the H-bomb would suffer universal condemnation."*[1]

Dr. Pauly's final logic centered on ethics, underscoring that people and states believe that using nuclear weapons is inhumane and unethical.

Dr. Pauly turned to the various methods used to study the logic of nuclear weapons use. He emphasized that most scholars to date leverage survey research, with some findings suggesting that the American public accepts using nuclear weapons even on cities. He noted that nearly 20 percent of the American public supports the use of nuclear weapons compared to 80 percent support for conventional weapons use. If asked in retrospect, support for nuclear use increases tremendously.

While these studies are beneficial to understanding public approval, they do not shed light on which leaders might support nuclear weapons use or the extent to which they are restrained based on one of the logics explained. Rather than administering surveys to current leaders, Dr. Pauly relied on historical archives of war games conducted during the Cold War. He noted that the study of strategy and tactics through war games began at the U.S. Naval War College and migrated to think tanks and civilian organizations. Scholars, like Thomas Schelling, designed war games to study this theory of nuclear deterrence and escalation, removing role playing, which left little room to advance the understanding of the impact of perceptions.

In 1961, Schelling was asked to run classified war games for various organizations, including the CIA, MIT and others. The basic game design consisted of Red vs. Blue and a moderated control team that updates the scenario after player plans submitted. As Dr. Pauly highlighted:

> *"These games offer a rare opportunity for a civilian like me to study the behavior of elite policymakers in the simulation."*

Players included former National Security Advisor George Bundy, former Assistant Secretary of Defense John Cotton, and many others. Player discussions were captured and reviewed, especially for the open-ended, non-descriptive, pol-mil games that allowed nuclear considerations. In less than half of all games conducted

[1] George Ball, "The Cosmic Bluff," *The New York Review*, July 21, 1983, https://www.nybooks.com/articles/1983/07/21/the-cosmic-bluff/

between 1968 and 1972, there was an asymmetric advantage where one team had better capability and capacity. The documents Dr. Pauly reviewed included primarily the playbooks players used for gameplay and final reports the respective game teams generated. Analysis of player decisions across games indicate that elite, high-level policymakers were reluctant to use nuclear weapons, regardless of whether the use of nuclear weapons would be advantageous and despite control explicitly asking the players whether they would use them in the situation. He found that the logic driving player decisions on nuclear use derived mostly from deterrence, practicality, and reputation.

Dr. Pauly noted that there are examples where players suggested the use of nuclear weapons, only to be laughed at or ignored by other players. For example, players in Vietnam scenarios rejected the use of nuclear weapons against Chinese forces. Other data is a little more ambitious, citing an Iran scenario where players came close. In the India-Pakistan scenario, players operated under the assumption that the U.S. would not use nuclear weapons first. In games involving a nuclear arm state vs. a non-nuclear armed state, players chose not to use tactical nuclear weapons on forces of a non-nuclear China, citing U.S. "no first use" policy.

One of the few war games where players decided to use nuclear weapons, as Dr. Pauly noted, involved the Soviet Union as the Red team. In this scenario, Red players decided to use nuclear weapons "because they could not think of anything else—had we had more time to discuss we might not have used them." In this case, the Red team had submitted a pre-emptive strike order as a contingency, but they were never given the chance to give the order. One *Forum* participant in believed that the use of nuclear weapons in this scenario could have been a result of game mechanics, suggesting that the control cell should have asked the Red team whether they wanted their contingent order to execute, based on the fact that the contingent order had been proffered well before the situation at hand. "Much easier to draft a contingent order than to actually give the order," he said.

Dr. Pauly ended his remarks highlighting that U.S. policymakers are reluctant to use nuclear weapons, often citing ethics. Several participants shared this view, with one noting, "it appears players did not want to be seen as a 'war-monger' among their peers seemingly after game play ended." Dr. Pauly reinforced the idea that immersive and competitive games are useful for political scientists to study policy decisions and group dynamics, especially since U.S. policy is most often made in group settings. Looking forward, he called for advancements in capturing player data, including speech and biometric data, to improve war game analysis and adjudication.

BrainSTORM - Using STORM for Wargame Adjudication

Mr. Charles Starkey, Group W

Abstract: Overview of the BrainSTORM process for using the STORM joint campaign model as the engine of a point-and-click UI wargame (SpeedSTORM) and the adjudication data developed to support it.

Summary of Remarks

Mr. Starkey described the purpose of BrainSTORM, and how BrainSTORM adjudicates interactions between ground forces and multidomain operations, including air and maritime force interactions. He noted that the Synthetic Theater Operations Research Model (STORM) is a multi-sided, stochastic simulation of air, space, ground, and maritime planning and execution. It includes full logistics, maintenance, ISR, and weather impacts. Originally a DARPA project, STORM aims to help policymakers evaluate military strategy and capabilities, force structure, and operation effectiveness in a joint warfighting context. Mr. Starkey noted that BrainSTORM aims to understand how Human and AI teams might be more innovative than human experts alone. BrainSTORM's Tool Suite presents AI-derived advice to help users bridge the gaps between art and science applied to operational design, planning, and execution. He noted that this tool supports development of phased movements and unit-level orders that implement a Course of Action (COA).

In the turn-based adjudication war game mentioned, the tool enables tactical adjudication modeling within and across domains (ground, air, and sea), allowing the user to activate layers of information on demand, develop orders to constructive elements with point-and-click interaction, and set priorities by mission type and location. Players submit moves and receive feedback interactively with the opponent and STORM. He emphasized that data inputs are derived by players, which include weapons, sensors, and P_k tables. The standard checkpoint time is 12 simulation hours.

The interactive model added to STORM in 2017 allows for interactive orders on each turn and restart coming from either point-and-click UI or agent training software. It initially was comprised of ground unit orders (order a unit to a node, with a motion plan). Air (allocate to mission and target/CAP prioritization) and Navy (order a unit to a patrol area, with a motion plan) were later added. Initially, ground combat adjudication maxed out at 10 vs 10 brigades with logistics support, and the model was capable of adjudicating 30 days of combat within seconds. Brigades are comprised of individual equipment and weapons while logistics support moves resources on individual vehicles from supply nodes to consumers using an automated STORM logistics planner functionality. Despite the addition of air and sea domains, Mr. Starkey noted the challenges of adjudicating surface engagements due to the

number of engagement possibilities, each with different P_k, as well as the added complexity associated with cross-domain interactions between forces.

Ground-to-ground adjudication is modeled in STORM using the Attrition Calibration (ATCAL) methodology developed by the U.S. Army Center for Army Analysis (CAA). ATCAL Phase I generates calibration coefficients from hi-res model engagement outcomes. Inputs into the model include expenditures and losses by killer or victim for a notional 48-hour engagement in a given set of conditions. The output is comprised of a set of calibration coefficients. ATCAL Phase II calculates engagement outcomes of two sets of opposing forces, producing attrition and munitions expenditures on the back end.

To this end, Mr. Starkey's team ran a 30-game tournament, comprised of 3 turns or rounds of 10 games involving an expert war gamer vs. a human with AI recommendations. In turn one, the human lost 94 aircraft to the Centaurs one. The human moved assets back to defend the carrier, making it vulnerable within the adversary's weapons engagement. Mr. Starkey ended his brief highlighting the challenges of adjudicating ISR and C-ISR and their effects on operational and tactical forces, and the classification restrictions and knowledge limitation of ASW adjudication.

Halsey Alfa Wargaming

Dr. Craig Koerner, NWC Halsey Alfa Advanced Research Project

Abstract: USNWC's Advanced Research Projects (ARPs) "Halsey Alfa" and "Halsey Bravo" use move-step war gaming at the tactical/operational level of war to discern the character of near future conflict. Within a well-defined strategic background, and iterating over 2-3 baseline scenarios, NWC student officers' game all warfare areas with transparent assessment tools to help derive "Best Red" and "Best Blue" CONOPS for the given missions. Results, especially empirical regularities of "what works and what doesn't," are briefed to the highest levels of DoD.

Summary of Remarks

Dr. Koerner began his talk by stating that NWC's Halsey Alfa and Bravo programs are trying to replicate the interwar period, conducting iterative war gaming focused on single countries. The Halsey Advanced Research Program has approximately 15 full time students from the College of Naval Warfare senior level course (SLC) and the College of Naval Command and Staff intermediate-level course (ILC): five students enrolled per semester, with two-thirds of students as veterans with experience in the program. Halsey Alfa, established in 2003, focuses on employing U.S. Navy forces against a near-peer maritime competitor in the Pacific Theater. Halsey Bravo was established in 2007 to understand how U.S. Navy forces can defeat an asymmetric maritime threat in the Middle East theater. As Dr. Koerner, emphasized:

> *"We are trying to find out what works best for both sides—both Red and Blue."*

Both Halsey programs focus on highly complex scenarios within a one to three-year horizon. Using real world geography and capabilities is critical to enforce realism, and to prevent players from feeling like "it's not a real game". The Halsey programs use war gaming to identify:

- Best Red and best Blue practices, with insights from multi-game regularities of combat outcomes & human decision-making
- Long-term trends from iteration
- Warfighter consequences of execution in decision-making

As Dr. Koerner noted:

> *"We get a long-term iteration out of these games. As a result, you can see certain recurring patterns. Certain things work and certain things don't … We can tell you a whole lot of things can get you killed very quickly … And not everything is known. We don't always know enemy is operating."*

To this end, the road to war free-played among a few scenarios does not have to be realistic, but plausible enough for students to examine operational and tactical decisions to ultimately accomplish the mission. This move-step, continuous free-play approach provides students the time to think and evaluate their decisions without being constrained by time or a running clock. Both Blue and Red players are independent and unconstrained by doctrine; allowing higher creativity and lower predictability. Faculty serve in an advisory role for students serving as Blue, Red, or White players. Players do not have individual roles, but submit plan *and e*xecute COA decision as a team.

Halsey adjudication uses the F2T2EA construct to evaluate Red vs Blue outcomes. Dr. Koerner emphasized that while the results of kinetic actions are (relatively) easy to evaluate, adjudicating and modeling the operational and tactical effects of ISR and C-ISR actions as well as human factors, such as staffing shortages or span of control, remains a difficult challenge. For example:

> *"What happens when a staff, a real-world headquarters, is saturated with things going on all over the place and some unit that really is very vulnerable slips through, not seen because of the confusion of war, the confusion of planning? The answer is that we really don't know, that's incredibly hard to model."*

Classification may also limit the depth and breadth of "realism" and viability of student generated decisions explored during games. For example, because the Halsey programs game at the Secret level, higher classifications may offer more detail and accuracy of enemy intentions and capabilities.

The semi-rigid adjudication style uses adjudication tables that are updated and derived from various sources at different classification levels. They include:

- Empirical Data (Real-World Ops Analysis, Exercises, Experiments, OT&E Reports, TACDEV events)
- Campaign Analysis Reports (J8 SAGD, OPNAV N81)
- Intelligence Community Assessments and Data
- Master Combat Assessment Book derived from previous Halsey student games

Dr. Koerner underscores the importance of assessing every shot, with some adjudicated as single shots while others are aggregated. Most of the adjudication tables used are excel based with equal access by all player teams. Players will submit their move sheets in Microsoft Word and KMZ files. Player out briefs, including White Cell assessments and feedback, are captured and delivered via Microsoft PowerPoint. Dr. Koerner concluded by reinforcing the sources that comprise Halsey adjudication tables and noting that Halsey Alfa games are exportable to the Fleets, allowing Fleet

Commanders and their staffs the opportunity to learn from the outcomes and decisions made by Halsey student games.

Dr. Koerner's presentation sparked participant discussions on relationship between models and war games. The military relies on both combat simulations and war games to inform decision-making, which are typically separate from one another but can be used in conjunction. Wargames can provide useful data that can be fed into detailed models that can provide quantitative analysis to decision-makers. Participants agreed that the goal of adjudication is to create plausible - vice predictive - outcomes to facilitate follow-on player planning & decision making. While the level of gaming (tactical, operational, and strategic) influences the type of adjudication used, however, participants cautioned the danger in believing that war games can accurately model the outcomes of complex operational warfare "to the point where the model provides an answer which is qualitatively superior to a SME-based (or at least informed) product."

Leaving the Matrix Behind

Dr. Jeremy Sepinsky, Lead Wargame Designer, Gaming and Integration Team, CNA

Abstract: Encouraging a discussion between experts on the outcome of player activities will create a supportable narrative that is accurate enough for most of the appropriate uses of wargame data. The "Debate Style" method presented here can be used to encourage that discussion.

Summary of Remarks

Dr. Sepinsky begins by stating that his work is not new, but observations complied from conversations from WGD and CNA experts about matrix gaming and how it can evolve into a style of adjudication. The content of this presentation was informed by countless hours of wargaming and debate with the CNA Gaming and Integration Team.

War games provide a shared narrative that can be scoped, grounded and shared. The accuracy of that narrative is important because it drives player decisions, which is why games are not predictable. SMEs will compromise in making decisions about potential outcomes. Dr. Sepinsky further underscores that this brief's underpinning thinking is sandwiched somewhere between the Halsey Model and Mr. Pellegrino's talk about violence between SMEs, which may cast doubt on assertion number 3, discussed below. He notes that CNA conducts 10-20 war games a year across the joint force, with 60 percent for the Joint Staff and the Office of the Secretary of Defense and 40 percent for the Navy.

Many different games styles and methodologies exist for creating tailored data sets or tailored answers to wargame questions. According to Dr. Sepinsky, "Matrix-Style" or Narrative-based games are most useful:

- With small numbers of players – large games challenge Matrix-style adjudication
- When adjudication transparency is needed – Everyone gets to hear the debates, no "black box"
- With exploratory topics – no one actually knows the parameters that would go into the adjudication models anyway (Future Technology, new concepts)
- At finding new connections – discovering unique relationships that aren't already built into models
- When tempo and interest preclude details – sometimes you don't have time to build a model
- When telescoping tactical to strategic – adjudication models have a harder time adapting to dynamic wargames than people

- When a better answer isn't available – when "good enough" is the best you can get

Dr. Sepinsky highlights three assertions, beginning with the idea that wargames exist to create narratives. He suggests that wargames exist principally to enable players to construct compelling shared narratives of possible events that can be used to scope, center, ground, or transmit their understanding of a situation. The narrative makes wargames powerful and the "synthetic experience" of created through game play consist of both the individual relationship players have with the narrative they construct and the common experience they share. This "shared" narrative allows for players to interact, share competing ideas, and generate new knowledge or insights not previously considered.

Dr. Sepinsky's next assertion concludes that human error dominates wargames accuracy. He suggests that the accuracy of that shared narrative is dominated by the inability of people, players, to predict their own future decisions. He implies that effort spent improving the accuracy of high-fidelity models does not substantively improve the accuracy of the resulting narrative. As Dr. Sepinsky noted:

> *"Even if the players in the wargame are the actual decisionmakers in real life, they may not make the same decisions in reality that they would in the wargame."*

He further suggests that generating likely future outcomes in war games depends more on accurate assessments of player decisions, rather than the outcome of kinetic engagements.

Finally, he argues that people will create a shared narrative. In adjudication, subject matter experts will contribute their own knowledge, debate with their colleagues and counterparts, and eventually compromise to define plausible outcomes. As Dr. Sepinsky noted:

> *"Humans are social creatures – we trade and we compromise toward common goals."*

The level of confidence in these outcomes increases based on the both the quantity of experts and their level of knowledge on the warfare area adjudicated. This enables the adjudication cell in a game to identify and weigh likely outcomes much more robustly than relying solely on dice rolling. To underscore this point, he noted that:

> *"Like any article or story, the degree to which you believe it should be correlated with the degree to which you trust the authors."*

Players debate the intent of their operations and defend their decisions, further contributing to the narrative created. Dr. Sepinsky underscored that these decisions should be open, transparent, and known to all players. His concluding remarks center on the challenges and limitations of matrix gaming, most notably mismatched move submissions, lack of detail submitted, and priority of moves submitted. This is mostly attributes to limited player knowledge, reinforcing the importance of selecting the right players for the game. The biggest challenge facing adjudicators today consists of adjudicating highly complex interactions, such as the ISR and C-ISR.

> *"ISR is one of the biggest problems we have now. For example, what are the operational and tactical effects of taking down a satellite constellation?"*

Developing models to understand these effects warrants careful study and collaboration.

Free Adjudication and Subject Matter Experts: SME-on-SME Violence in War Games

Mr. Pete Pellegrino, Lead, War Gaming Adjudication, NWC War Gaming Department

Abstract: This presentation looks at how the U.S. Naval War College uses SME-based or free adjudication, and techniques used to reduce dueling opinions – SME-on-SME violence – in the play process.

Summary of Remarks

Mr. Pellegrino began his talk by underscoring that there is no "NWC way" of adjudication, but rather different approaches and a critical a design consideration. "Just as you select players and determine order of battle to serve the purpose and objectives of the game," he says. He focused on how the Naval War College War Gaming Department approaches adjudication for the major analytic war games, which depends greatly on subject matter experts.

Mr. Pellegrino cited Frank McHugh's definition of wargaming, emphasizing the "pre-determined rules, data, and procedures." He noted the importance of providing players with awareness of the adjudication rules and so they know how to play. He defined key terms - control, white cell, and adjudication - that often get used interchangeably. For example, control oversees the entire operations including senior members of game team and sponsor, including peripheral issues that emerge dealing with senior flags, keeping the rain on track. The White Cell interacts with players, but they are not players. This is because the NWC …Doesn't construct a war game with every level of command, rather focusing often on fleet commanders or TF commanders. These surrounding layers of people provide inputs to help players make decisions, but they are non-player characters, which are working for the benefit of control and helping adjudication.

The adjudication cell strives to make adjudication as transparent as possible so that players fight each other not adjudication. They provide results of their decisions and how they change the environment (e.g., how close they are to victory conditions, limitations of capabilities, etc.). The lead adjudicator applies the rules, whether they are implicit rules which are from SMEs or explicit because we wrote them down. The two sets of experts, players and adjudicators, will most likely not interface. Adjudication and players may not meet, but the SMEs within adjudication will argue and debate their views and get back to the players what has changed.

The biggest restraints imposed on large games at NWC is time. In a typical 5-day game, the first day is largely dominated by welcoming and game structure briefs to the players while the last day is typically reserved for plenary and out-briefs. Two

moves per day equates to two hours of adjudication time. This is normally in the middle of the day, so results cannot be delayed or the next move will not start on time. One move per day may give adjudicators more time, but you run the risk of player and SME fatigue. Adjudication is also dealing with a large volume of orders. Mr. Pellegrino provided the recent example of Global 14B, in which there was an average of 683 discrete orders submitted per move to adjudication. Adjudication had to convert those to feedback, which turned into 214 orders feedback. The adjudicators are trying to take all of the orders, from multiple sides, and make a coherent narrative. Humans are pretty good at assessing patterns and identifying a plausible outcome.

For typical NWC war games, adjudicators are co-located in one space, sometimes grouped by warfare area, arranged as if they were the next layer down from the players, or by country or region. Due to the classification requirements of some of the games NWC runs, there are circumstances where adjudication is necessarily divided as required to adhere to classification boundaries which accomplishing game objectives.

For games like Global 14B, NWC utilizes an internal game tool, similar to an email system with maps, to pass orders from players and adjudication. The tool workflow and data management can be sorted by domains. Orders can be spread out across time to understand what is going on in the battle space. This initial sorting and sequencing of orders can take up as much as a third of the time allotted for adjudication for a given move, but adjudicators are then able to assess and determine Blue and Red interactions. In doing so, adjudicators try to maintain procedures to talk through necessary steps that leads to an output. These are tailored to what the players get to know and what version of the truth is provided back to the players. Little pieces, versus a complete comprehensive view, are passed back to players, highlighting the reality that no single command has the entire view of the battlespace.

The information that flows back to the players comes in the form of a SITREP, which the players will pick apart. As Mr. Pellegrino noted, the players are usually unhappy because they think the adjudicators don't know what they are doing. This is where the friction begins. The adjudicators have all the information and players only have their portion, but players push back because what they received goes against their expectations. It is this that Mr. Pellegrino refers to as "SME on SME violence," because both sides are convinced that the either side doesn't know how to make the game work. In actuality, each game includes people with different levels of expertise. This results in different outcomes because their experiences are different. And sometimes the players disengage because either the game isn't reflective of reality and therefore is viewed by them as a waste of time.

What is reality? It's what we experience, whether a live event or years of active duty or research; human brains pattern match. As Mr. Pellegrino noted:

> *"We are decent practitioners of our craft in peacetime conditions against a war time theory. 'If this was real it would go like this.' I'm not sure anyone can really tell me how to repel 20 bombers from sea. It is not like we have a vast body of experience to lean on. Yet that's what underlines a lot of our expertise."*

Mr. Pellegrino went on to explain that war gaming is fundamentally the interaction of opposing decisions, the tension between competing forces attempting to impose the will of one upon the other. Adjudication is the mechanism by which the outcomes of those interactions, 'the moves,' are determined. Adjudication is, at its core, simply the application of rules and the management of information – i.e., what happened and who knows it – that serves as the input to the next series of player decisions and moves. These rules are either explicit, embodied in written instructions, checklists, combat result tables, or encoded in formula and computer algorithms; or implicit, based on the personal experience and knowledge of warfare practitioners or subject matter experts (SME).

As Mr. Pellegrino pointed out, SME based adjudication is still rule-based; however, the rule set is an internal one constructed from personal experience, and expertise and experience can vary dramatically. Like all humans, players and adjudicators are affected by cognitive biases and logical fallacies, especially when dealing with unfamiliar situations.

NWDC 360 War Game Adjudication

Dr. Will Startin, NWDC 360 War Game Designer

Abstract: Navy Warfare Development Command has executed classified distributed "360 war games" since 2012. We present an overview of the 360 war games, the philosophy behind our adjudication methods, and an example of tactical adjudication.

Summary of Remarks

Dr. Startin began his presentation with discussing what is meant by 360 in their gaming. 360 is meant to refer to the fight across warfare areas all at one time. Their war game aims to reinvigorate the tactical DNA, so it's a multi-warfare area. It was built in a distributed approach, with several commonalities with Halsey groups' and adapted as a play by email game, with little facilitation required. NWDC 360 war games are intended to inform near-, mid- and far-term planning vice policy or strategy.

The 360 games have several defining characteristics including replay, with 2 sides, and white is considered as a third. One side is a sitting strike group or Fleet commander with a commander and staff and Red is a professional staff responsible for emulating real world tactics and capabilities. 360 uses real world geography, capabilities and weather. It allows players to use real world coordinates and doctrine and tools into game input. Each team plays team as planning team, using the planning process to generate intentions and actions. The teams play at their own pace via email, having two weeks to generate a move and NDWC has two weeks to adjudicate.

The adjudication process takes both sides' inputs at the same time and roll plays subordinate forces being directed by players, including adjudicate and Higher Head Quarters (HHQ). 360 isn't really a 2-player game; white cell is a player and NWDC's approach acknowledges this, and they have incorporated checks and balances to account for this. With two weeks to plan and execute, there normally are two to four moves but recent games have been limited to just two moves. Dr. Startin noted that since NWDC runs different games for fleet commanders, ESGs and CSGs, and with the timelines associated with move submission, their games have been fairly resilient to the restrictions associated with the COVID-19 pandemic.

Dr. Startin went on to discuss the philosophy of the NWCD 360 adjudication process, noting "we ask ourselves how do we know if an adjudication method is sound." Adapting the Halsey model at NWC, NWDC relies heavily on Peter Perla's definition of a war game, which states that:

> *"A war game is a warfare model or simulation in which the flow of events shapes, and is shaped by, decisions made by a human player or players during the course of those events."*[2]

Focusing on the first part of the definition, NDWC believes that professional adjudication should be the mechanism for the game simulation, based on a suitable model of warfare. Dr. Startin noted that a simulation is am method for implementing a model over time, and he used the example of the Hasbro game *Risk* and how it simulates the movement of the model over time which is similar to sequential gaming. Next, Dr. Startin highlighted that decisions in the game have to shape flow of events in the game. The rigid productive deduction process is critical for the players to stay engaged in the game, and as Dr. Startin noted:

> *"There has to be some enforcement of causality. The decisions the players make have to affect the events in the game and the events in the game have to influence the decisions the players make on the next turn."*

The last part of Peter's definition talks about human decision-making – human players. It's the layered decisions being interpreted by rules and models, combined with the scenario context that are designed specifically to generate conversations and make decisions which creates the narratives and achieves game objectives. Dr. Startin summarized the NDWC 360 adjudication philosophy as follows:

> *"Professional adjudication should be credible, logical, self-consistent, and supportive of the game's objectives and data collection and analysis plan."*

If any parts are missing in adjudication process, that can cause problems. Dr. Startin acknowledged that there is an inherent increased difficulty in keeping players engages and invested in the game with the distributed model.

Finally, Dr. Startin went on to discuss how 360 adjudication works. It similar to other games, which are played at various levels of classification. Player receive situation updates and can submit forms to adjudication, which are relating Higher Head Quarters (HHQ), subordinates, other countries, etc. The Blue and Red cell are planning in parallel and have a 2-week deadline, with limited exceptions available to account for real-world issues that would impact this deadline. The White cell will review orders to understand what they say and determine the commanders' intent, seeking clarification as necessary from the player cells. As long as the intent is understood, the White cell is able to adjustment what the subordinate forces are doing, based largely on SME understanding of doctrine and intent, and sometimes

[2] Perla, P. P. (2008). So a Wargamer and a Black Swan Walk into a Bar . . . *Phalanx*, *41*(4), 26–30. http://www.jstor.org/stable/24910301

computer models. A lead adjudicator will review decisions and whether it was done fairly and properly to ensure decision are defendable so they can explain, and how we arrived at conclusions. The intent is not to predict actual outcomes, but rather to walk through a process that can explain to players the assumptions and source documents that informed the interactions and outcomes. This is all to enable a conversation to help the players understand the model.

Dr. Startin noted that NWDC utilizes various visualization techniques and models to assist with adjudication and understanding of the tactical picture, including models to capture IRS and C-ISR, the detect to engage sequence and weapons employment and defensive measures. He also acknowledged that they have yet to find a satisfactory tool to automate the interpretation of player intention. There is hope that in the future, advancements in AI and ML will enable more robust automation, but they want players to play as close to how they would in the real world.

Lastly, Dr. Startin closed by discussing the utility of the outputs from the NWDC 360 games, including post move updates, Action Officer/ Operational Planning Team debriefs, executive debriefs, after-action reports (AAR), post-game surveys, and various annual reports. These outputs benefit the players by providing a better understanding of their forces, the adversary tactics and capacities, and stretches of Blue in contact to Red. Of particular benefit to NWDC are the AAR which serve as a feeder to the annual report, which is a longitudinal analysis, focused not on what happened, but rather the understanding in the White cell of the capabilities and what the most important factors for both sides are for success. Dr. Startin noted that relying too much on models can lead you down a rabbit hole, but also pointed out that there are some games where the objectives and purpose of the game benefit from models.

Overview of the Operational Wargaming System (OWS) in Army Futures Experimentation

LTC Tom Flounders, Directorate of Concepts, Futures and Concepts Center, Army Futures Command

Abstract: The Directorate of Concepts' (DoC) Future Study Program (FSP) wargames explore, support/deny, and demonstrate the viability of central and supporting ideas of future concepts -when examined with projected future capabilities- against future threats, and in future environments.

Summary of Remarks

LTC Tom Flounders provided Forum attendees with an overview of the operational wargaming systems used for Army Futures experimentation at the Army Futures Command's Futures and Concepts Center, including "…who we are and what we do, how and why we use the USMC's Operational Wargaming System (OWS), and how the Directorate of Concepts (DoC) adjudicates war games via the OWS." LTC Flounders explained that the DoC uses the OWS system because it provides DoC a well-constructed tool to examine a wide range of military problems within a construct that allows for detailed analysis of player actions and operational outcomes.

In its war gaming, the DoC is focused less on the experiential aspect of its games but rather on player products and actions, and the qualitative data they generate to understand future warfare. Since his office does concept experimentation, it looks at testing hypotheses.

> *"Since we're doing concepts experiments, we're really looking to interrogate hypotheses and scope and frame problems."*

And, as the actions of potential adversaries impact U.S. allies as well, DoC games are classified FVEY releasable. In addition, all DoC war games include Joint Force participation, focusing on specific Blue v. Red interactions at the CJTF level, and OWS is built from the ground up as a Joint fight. OWS game play demonstrates the inherent Jointness that Army concepts must support.

> *"If you don't play with the Joint force, you will lose."*

DoC war games are supported by MITRE personnel and make use of the Vassal open-source digital war gaming engine to support distributed war game play and adjudication. DoC's goal is to distribute OWS in Vassal on the Army Persistent Experimentation Network (APEN). They have a new cyber module, which has identified shortcoming they are working through. The air and naval concepts,

however, work well to get points across to the Joint community. DoC, USAF and USMC are actively working together to improve gameplay, rules, and forces.

DoC leverages a semi-rigid, rules-based, open adjudication that provides a baseline of rules with SMEs in technology, concepts, and adversary intention and capabilities. Adjudication is done by a facilitation/adjudication team, typically comprised of five professionals. There are two facilitators (one for Blue and Red each), who are trained up on the game and on the rules of the system. There is also a Blue team player who helps players understand how their plan will get translated into OWS and executed in Vassal. DoC war games include a minimum of two Vassal operators who operate the virtual version of OWS: they're experts on force structure that's been built and the way that the enemy works to help the players get from the white-board plans to orders input into the system. Lastly, there is a product manager who directs players to fill out game products such as orders templates, rounding out the facilitation/adjudication team. LTC Flounders noted that the facilitation/adjudication team does not include the analysts, who are usually an additional four professionals who capture discussion on actions, outcomes, and rationale.

LTC Flounders noted that similar to the Navy, the Army hasn't faced a peer competitor in many years. DoC aims to design games where players see cause and effect of their actions happen in real time and understand player rationale and changes and how they would do things differently. The rules for the games are dense, but more turns generate more data, so it's important strike that balance. In the near-term DoC uses those rules, and factors to overcome that. DoC is not looking to limit freedom of action and is especially interested in letting the players solve the problem given to them. They want the players to try and "win" and solve the operational problem they've been presented. By doing that, DoC can get different perspectives for current plan and concepts.

To effectively translate and capture the implementation of future technologies into the game, DoC goes through great efforts to analyze future technologies and their impacts on Blue and Red counters, determine how game rules need to change due to the future environment, capabilities and geography. DoC also builds an experiment-specific Event Data Collection and Analysis Plan (EDCAP) to get after this level of understanding and representation. Players fight a future conflict with a future force structure, so DoC intentionally simplified the conduct of the game so players can focus on employment of the future capabilities rather than fighting the game and the rules. The games also physically separate player cells to more realistically capture the differences in communication and in game play and to analyze how the cells act when they are separated.

DoC uses a 10-step model for an OWS turn, including planning, naval movement, air movement, information operations and cyber, ISR and SOF, air combat, multi-domain strikes and naval combat, ground movement and combat, sustainment and regeneration, and assessment. This process generally takes around six hours. It is in the ground movement and combat step where DoC realizes the greatest gain, and where the majority of time is spent in each turn.

DoC uses a two-map model, with one map at a larger hex scale to show air and naval combat, and a second map at a smaller, more tactical hex scale for the ground combat. The intent is to be able to look at both maps to capture a more wholistic picture of the fight, and more importantly, getting to the fight. There is a difference between a discrete missile hitting a discrete ship versus the same missile shooting at a land force. Integrating the science side of the rules helps DoC understand the causality of the interactions that take place and provides rigor to the analysis. DoC games are always sponsored internally, which is a benefit because requirements are known, but it can be problematic because there is a singular focus. OWS helps DoC maintain the course and keep the experiments moving in the same direction.

LTC Flounders closed by discussing the threat the Army faces on the ground alone. IF you look at the organization of the army then compared to now, it's a different problem. This group army doesn't exist today. DoC spends a lot of time trying to analyze the individual interactions between battalions, brigades, and aviation units to give players a firm foundation for their gameplay, and OWS provides a great venue to do this.

Purpose Driven Adjudication

CAPT Philip Dupree, USN (Ret.), Marine Corps Warfighting, Laboratory (MCWL), MCB Quantico, VA

Abstract: MCWL is engaged in an evolutionary process to improve its professional wargaming capabilities. To guide that evolution, MCWL expanded its toolset, and created a taxonomy to define wargames by their purpose. This imperfect taxonomy maps a game's purpose with a requisite depth of adjudication; hence, purpose driven adjudication.

Summary of Remarks

CAPT Dupree began his talk by highlighting the evolution of war gaming at MCWL, recognizing the need to adopt new technologies, especially large-scale modern visualization devices like Command PE that foster greater immersion for players. He underscored the need to manage expectations of leaders and game sponsors and to guard against not overselling the outcomes of war games.

> *"Leaders want to predict actions and acquire quantifiable outcomes. And war games cannot predict future actions, but inform decisions."*

Because every variable in war games cannot be controlled for, the value of games is not in the predictability, but the decision-making. This starts with the problem, purpose, and objectives. CAPT Dupree highlights MCWL's "imperfect" taxonomy of games, which focus on four types of war games: discover, explore, research and test.

Purpose	Input		Player Action	Output	Adjudication Depth
	Capability	Concept			
Discover	Unknown	Unknown	Discuss	Observations	Illustrative
Explore	Vary	Vary	Postulate	Hypothesis	Illustrative
Research	Vary	Lock	Iterative	Theory	Comparative
	Lock	Vary			
Test	Lock	Lock	Decide	Recommendation	Granular

MCWL Imperfect Taxonomy

Discover games normally take the approach of debate style war games that look for observations. Explore games enable players to examine new capabilities and concepts, like Expeditionary Advance Base Operations (EABO) and Marine Littoral Regiment (MLR) and the new platforms that go with this. In this case, players are asked to make time, space, force allocation decisions, and generate hypotheses. While it is difficult to model future capabilities, explore games provide a venue for how they can be employed in conflict. Research games are most pursued, where variables are changed. This allows for iteration—many games played over a period of time by recent Marine Corps graduates, similar to the Halsey approach. In these games, adjudication models and tables for capabilities must be represented accurately to

enable players to look for comparative results (e.g., high-end vs. low-end capabilities employment). Finally, test games are purely based on player decisions and are looking for solid recommendations. These require very granular adjudication. These are rarely played at MCWL and the scale and scope have to be small.

CAPT Dupree continued by highlighting several games MCWL has conducted, including the purpose and insights derived from each game. *Littoral Maneuver* was a discover game that aimed to understand how the Marine Corps could operate and maneuver in the littorals to add value to the Joint Forces Maritime Component Commander (JFMCC) during a campaign. In this game, players built out light, medium, and heavy craft, looking at the strengths and weaknesses of these capabilities against a live Red opponent. Players first sought to understand the ISR picture for battlespace awareness. This game attempted to discover new insights for future investments.

Ender's Shadow was an explore game played at the Secret level. Stage 1 was setting the environment, making sure players had a digital sand table. Adjudication conducted Monte Carlo simulations of various things including the naval strike missile and row boats to ensure they behaved according to their capability specs. Control then set up an iterative game with graduates from the Marine Corps School of Advanced Warfighting (SAW), enabling players to form a hypothesis on what an MLR would be capable doing alone and when paired with other capabilities. The game was able to identify unique missions the MLR could be well suited to conduct which hadn't previously been considered.

Ender's Rise was a research game, which was focused on how the MLR would maneuver and persist in the environment. CAPT Dupree noted that this game focused on the OODA (observe, orient, decide act) loop process, and in particular, the orient aspect. As CAPT Dupree noted,

> *"As Red doing an OODA, Blue is reacting to it by: when Red is trying to observe, Blue is trying to conceal or reveal. When Red is trying to orient, Blue is trying to disrupt that orientation or deceive them. When Red is deciding whether or not to engage, Blue is deciding whether they hold what they got, or to do something different. And then when Red does something like attack, do you try to escape from under the attack, or do you try to seduce the attack with a deception if you employed one?"*

This was a new adjudication model and the game team had to create a "Q-score" for the quality of the orientation that Red had on Blue, and that Red would have to describe. Red also had to describe what they were attacking and specify the aim points, and depending on the Q-score, each target was evaluated independently.

In closing, CAPT Dupree underscored that the level of knowledge required by adjudication depends on the style of game. On one end of the spectrum, discover and explore games require illustrative adjudication where you have subjective inputs, and all you need are plausible outcomes, and are able to illuminate potential next steps. Research games focus on comparisons, requiring well framed/contextual inputs, and provide probable outcomes to illuminate a plausible theory. Lastly, test games required very rich theoretical inputs that leads to deterministic outcomes and qualified quantification. MCWL does not typically provide deterministic outcomes and qualified quantification in war games, and this is the point where MCWL would hand the analysis over to modeling and simulation or experimentation experts. CAPT Dupree highlighted that occasionally, MCWL will have discrete test numbers (quantities of weapons used, quantities required to attrite a particular target, etc.), but:

> *"Without the qualification of 'this is the context of the game, this is how tightly the experiment was controlled,' if you will; without the prose, the textual preamble for the quantification, it's meaningless."*

Naval Warfare Studies Institute Wargaming Adjudication

Dr. Jeff Appleget, and CAPT Jeff Kline USN (Ret.), Directors of Wargaming, Naval Postgraduate School, Monterey, CA

Abstract: As an educational institute, NPS introduces students to war gaming in an elective course, involving students in the planning, execution, adjudication and analysis of its war games. The war games themselves are conducted to support the analytical needs of their non-NPS sponsors, and make use of a variety of adjudication processes tailored to each game.

Summary of Remarks

Dr. Appleget opened his remarks by noting that NPS has executed war games for nearly 40 years. Today, the war gaming team consists of two faculty and a variety of NPS students, including both U.S. and international officers. The type of games played at NPS fall into three main categories: analytical, educational, and experiential. Some say there is a fourth one – entertainment. Dr. Appleget noted that most games played at NPS are analytical. The war gaming course is an example of using students to engage with and teach U.S. and international officers. Since 2009, NPS has executed 92 games from a variety of sources, including for the Taiwanese CNO who wanted to look at the use of emerging technologies and concepts. NPS games work on real-world problems to inform sponsor analytical research questions, enabling the students to meld their academic and real-world experience. Dr. Appleget also noted that he, along with his colleague, Dr. Robert Burks, wrote *The Craft of Wargaming* in 2020, which aims to help improve DOD's ability to design and execute war games.

Adjudicating interactions in war games is important for providing feedback to players, a crucial part of both keeping their attention and informing analysis. Students are reminded that war games do not generate statistical data, which is better geared for simulations. NPS does not maintain a standard set of adjudication methods, models, and tools (MMTs). Rather, the game objectives and key issues drive the war game design and adjudication. Typically, war game adjudication models are not re-used because the adjudication tool is purposefully built for each game.

Dr. Appleget noted that seminar games are usually adjudicated by a facilitator and panel of experts based on specialized knowledge in areas such as region or warfare domains. Hobby games often combine dice with combat results tables, many of which can be modified to add realism and complexity. System games are usually adjudicated by some form of mathematical MMTs, such as dice, spreadsheet, mathematical models, and computer simulations. Matrix games can have several forms of simple adjudication, including consensus, umpired, weighted or mean probabilities, and voting.

In the NPS war gaming course, students are introduced to seminar games--where they interact with one another--and games of risk, where players' interactions come through the game board. One seminar game played was borrowed from the Canadians and was further enhanced by NPS over many years, enabling students an opportunity to assume a player role experience. The Undersea Constellation Game was a 2-sided game involving a SCS Palawan island scenario. Students played two Blue cells at the same time so that they could compare the results of game play with and without Undersea Constellation capabilities. Students underscored the importance of collating, documenting and archiving feedback data between adjudication and blue and red cell players to support post-game analysis. Distributed Lethality was a closed, planning seminar adjudication game where SMEs from the white cell adjudication team determined potential Blue and Red player interactions for seminar adjudication. Each team had the opportunity to discuss their actions and potential reactions from the adversary. This game used a hybrid adjudication model whereby actions submitted were reviewed by the adjudication cell and then used to facilitate an open discussion among Blue and Red players. This was a unique game for NPS in that it is one of the few they have reused, largely due to the effectiveness of the game, and especially as a series.

Next, Dr. Appleget describes the strengths and weaknesses of various adjudication methods. Facilitation adjudication games depend on strong facilitators with good skills and knowledge of the topic, which can be difficult to obtain on a persistent basis. Regarding SME panel adjudication, Dr. Appleget noted:

> *"If they can't come to a conclusion very quickly, they can easily take your game, as far as time goes, way off the rails. So, one of the lessons we've learned is if you're going to bring a SME panel in to do adjudication, you might want to play test them with the game before you bring them in for real, because that's a time factor you have to make sure is built into the game."*

Consensus adjudication games must be carefully moderated by a strong facilitator or game director to ensure the "loudest voice in the room" does not dominate the outcome. Combat simulations are hard to build in war games because of time required to acquire and integrate data, especially in real-time. They've learned that for the purpose of many games, the numbers don't matter as much as keeping the players moving down the path of the war game. Simple models use dice, which can eliminate ambiguity but can also be viewed as inappropriately random. Combat Results Tables (CRTs) provide the appearance of being less random, but can become complex really quickly, which often require "rule lawyers" to explain the game rules to players. Spreadsheet models provide the appearance of being more precise, and while they can start simple, they can become very complex and cumbersome. Finally, federated combat simulations adjudication allows you to try many simulations

together, giving the appearance of greater fidelity. This type of adjudication is prone to failure at many levels, but it can be good for training, not necessarily analysis.

CAPT Kline finished off the presentation, noting that most students that play in NPS war games have backgrounds in operations research or defense analysis, with strong appreciation for models and simulations. Spreadsheet models include random research equations to adjudicate ISR, binomial distributions for missile raids, and salvo equations for missiles exchanges, as well as Lancaster equations for ground combat interactions. NPS decision aids in related warfare areas games include Joint Defender, focused on Theater Ballistic Missile Defense, and Replenishment at Sea (RASP)/ Most recently, the NSWC Dahlgren-developed Modeling and Simulation Toolkit (MAST) was used as an agent-based simulation in war gaming format.

Closing Remarks & Way Ahead
Conclusions and Recommendations
Areas of Study?

Looking ahead to future iterations of this *Forum*, we hope to be able to make several changes, the first being that we hope to host the evet in-person, vice the distributed, digital format used for this first event. There is also a good chance that future fora will touch on classified issues, which will understandably limit the attendance to those appropriately cleared, but will also enable important discussions to take place at the right level to continue to push the boundaries of war gaming in support of DoD. Where able, however, we will attempt to keep discussions at the lowest classification level.

For future fora, we see potential benefit from focusing on ISR and Counter ISR, as well as signaling and deterrence. Things we intend to focus on will likely include the following war gaming questions:

- How do you design it?
- How do you analyze it?
- How do you adjudicate it?

Given the importance of these missions and tasks to our national security, we see it as critical to make the most out of these gatherings of experts in the war gaming community to explore and identify the best ways to address them.

Appendix A: Speaker Bios

Dr. Reid Pauly is an Assistant Professor of Political Science and the Dean's Assistant Professor of Nuclear Security and Policy at the Watson Institute for International and Public Affairs at Brown University. He writes and teaches on coercion and nuclear weapons proliferation, nuclear strategy and wargaming, and international secrecy and deniability. His work has been published in International Security, International Studies Quarterly, The Nonproliferation Review, The European Journal of International Relations, War on the Rocks, The National Interest, and Foreign Policy. He has a Ph.D. from the Massachusetts Institute of Technology, Security Studies Program, and has held fellowships at Stanford University and the Harvard Kennedy School.

Mr. Charles Starkey is a software engineer with 20 years' experience in DoD modeling and simulation. He developed the STORM model wargame adjudication data for the DARPA BrainSTORM project to explore artificially intelligent COA development in the Synthetic Theater Operations Research Model (STORM).

Dr. Craig Koerner is a research professor in the Strategic and Operational Research Department within CNWS at the Naval War College, where he is technical director of the Halsey Alfa group for military operations research and war gaming. He specializes in the study of conventional warfare between high technology powers from World War One onwards; his current research centers on the character of warfighting in the near future to 2030. He was previously a game designer for the "Digital Pearl Harbor" cyber-attack wargame. He has contributed to numerous classified studies on military operations and technology. He holds a Ph.D. in economics from the University of Chicago, and was a senior economist at RCF Inc. before coming to the war college.

Dr. Jeremy Sepinsky is CNA's lead wargame designer. He has designed and facilitated dozens of wargames at Navy and Joint Commands, as well as for the Office of the Under Secretary of Defense – Policy and the Joint Staff. His wargames help strategic decision makers understand the broad context of actions, as well as the tactical impacts and requirements that those decisions elicit. Mr. Sepinsky's recent wargames covered broad topics such as logistics, personnel organization, command and control, cyberspace operations, space operations, national strategy, international emulation, technology planning, special operations, and homeland defense. Prior to joining CNA, Sepinsky was an assistant professor of physics and astronomy at the University of Scranton. He holds a Ph.D. and an M.S. in physics and astronomy from Northwestern University, and a B.S. in astronomy and astrophysics from Villanova University.

Mr. Pete Pellegrino is a Senior Military Analyst with Valiant Integrated Services supporting the War Gaming Department, Center for Naval Warfare Studies as Lead Game Designer and Adjudicator. Mr. Pellegrino is a former squadron commander with 22 years of service as an EA-6B Naval Flight Officer, and served as the Game Division Director for the War Gaming Department from 2004 until his retirement from active duty in 2007. While assigned as

military faculty, Mr. Pellegrino also taught war gaming design and strategic game theory electives.

Mr. Pellegrino attended the British Joint Services Command and Staff College and received his Master's Degree in Defense Studies from King's College London, and received his undergraduate degree from Pennsylvania State University. While Mr. Pellegrino supports the full range of War Game Department projects, his primary research and game design efforts are focused on the department's support of the Chief of Naval Operation's Title 10 organize, train and equip requirements, principally through the Global War Game series. He writes and lectures on the use of game design as a problem-solving framework, and adjudication techniques. He also has a keen interest in war gaming during the inter-war period, and conducts lectures and walking tours on the college's gaming history.

Dr. Will Startin is the lead for 360 wargaming at Booz Allen Hamilton. Currently, he supports Navy Warfare Development Command (NWDC) N7 Department of Training, Exercises and Wargaming as chief wargame designer. Dr. Startin proposed a distributed system for conducting advanced naval wargaming in 2010, and developed the first NWDC 360 wargame using this concept in 2012. Prior to his contract support at NWDC, Dr. Startin was a member of the Maritime Operations Center (MOC) Project Team at Commander, Second Fleet. As a part of his duties on the MOC Project Team, he served as a Man, Train and Equip subject matter expert for the MOC training team (MOC-TT). Previously, Dr. Startin was the Center for Naval Analyses (CNA) Field Representative to Commander Second Fleet, where he conducted analyses of Second Fleet Joint Force Maritime Component Commander processes and defense support of civil authorities / disaster relief operations following Hurricane Katrina. While at Second Fleet, he co-authored the first Maritime Headquarters (MHQ) with MOC Enabling Concept paper, as well as the MHQ with MOC Concept of Operations in 2006. Prior to Second Fleet, Dr. Startin was CNA Field Representative to Tactical Training Group, Atlantic (TTGL) where he supported carrier strike group staff training. While at TTGL, he applied Larry Bond and Chris Carlson's Harpoon tactical miniatures game with naval officers in a series of classified scenarios to identify ways that strike group and legacy carrier battle group employment could differ in combat scenarios. Prior to his tour at TTGL, Dr. Startin deployed in 2001 with Carrier Group Seven and the John C. Stennis Battle Group as CNA Field Representative. Dr. Startin has a B.A. in Physics, Astronomy and Astrophysics from Harvard College, and a Ph.D. in Physics from Syracuse University.

LTC Tom Flounders is a Functional Area 59 Army Strategist currently assigned as a Wargame Designer in Army Futures Command Directorate of Concepts. Tom is part of the design team responsible for planning, design, development, and execution of the Future Study Program, the Army's Title 10 Wargame.

Captain Philip "Dirt" Dupree USN (Ret.), is a game designer supporting the Marine Corps Warfighting Laboratory, at MCB Quantico, VA. Dirt served as a Naval Flight Officer, flying in the EA-6B Prowler in both the Marine Corps and the Navy accumulating over 3000 hours and 8 combat tours including command of an expeditionary Prowler squadron in Afghanistan in 2009. His exposure to professional wargaming began at Navy Global in 2011

and continued through his retirement in 2017 where he served on the OPNAV N3/N5 staff providing process improvements and oversight of CNO's wargaming efforts. He has been in his current position as a MCWL wargame designer since June of 2018. Major wargame designs include MAGTF Warrior 2018 (III MEF logistics), Expeditionary Warrior 2019 (OIE), Ender's Shadow 2020 (Force Design), Naval Services Game 2020 (Fires) and Expeditionary Warrior 2021 (Operational Logistics), et al.

Dr. Jeff Appleget is a retired Army Colonel who served as an Army Operations Research analyst at the Center for Army Analysis (2 years) and the TRADOC Analysis Center (10 years, serving tours at TRAC-Monterey, TRAC-White Sands Missile Range, TRAC-Fort Leavenworth, and TRAC Headquarters). He holds a PhD in Operations Research from the Naval Postgraduate School, an MS in Operations Research and Statistics from Rensselaer Polytechnic Institute and a BS from the U.S. Military Academy. He coordinates NPS research projects with the Joint Warfare Analysis Center (JWAC), and is the NPS program lead for a Cooperative Research and Development Agreement with Lockheed Martin Space Systems. He teaches the Wargaming Analysis, Combat Modeling, Statistics, and co-teaches Modeling and Simulation of Societies in Conflict and Survey Research Methods courses at NPS. He also develops and teaches week-long Wargaming and Modeling and Simulation courses, with the most recent Wargaming course conducted at Offut AFB for STRATCOM, and the most recent Modeling and Simulation course conducted in Dushanbe, Tajikistan for the Tajikistan government in support of the U.S. Partnership for Peace Training and Education Center.

Captain Jeff Kline, USN (Ret.), attended the University of Missouri, School of Engineering, graduating with honors in Industrial Engineering, and received his Navy commission through the Naval Reserve Officers Training Corps program in 1979. His initial sea tour was in USS MOOSBRUGGER (DD-980) serving as Gunnery Officer and Navigator. Jeff's following sea tours included assignments as propulsion officer in USS RANGER (CV-61), Combat Systems Officer in USS JOHN L. HALL (FFG-32), Operations Officer for Tactical Destroyer Squadron 32, Commanding Officer of USS AQUILA (PHM-4), Commanding Officer of USS CUSHING (DD-985), and Deputy Operations Officer of COMSIXTHFLT. His shore tours include Marine Corps Landing Force Training Command, Pacific as an instructor in Naval Gunfire and Supporting Arms, Naval Postgraduate School as a student in Operations Research graduating with honors, and Office of the Secretary of Defense as a Naval Analyst. Jeff is also a 1997 honors graduate of the National War College in Washington D.C.

Jeff is currently a Professor of Practice in the Operations Research department and is the Director of the Wayne P. Hughes Jr. Naval Warfare Studies Institute. He teaches Joint Campaign Analysis, systems analysis, executive risk assessment and contributes to maritime security education programs offered at NPS. Jeff supports applied analytical research in naval warfare, maritime operations and security, theater ballistic missile defense, and future force composition studies. Jeff was a member of the 2017 Chief of Naval Operations Fleet Design Advisory Board. He has also served on several Naval Study Board Committees. His NPS faculty awards include the 2019 J. Steinhardt Award for lifetime achievement in Military Operations Research, the Navy's Superior Civilian Service Award, 2011 Institute for Operations Research and Management Science (INFORMS) Award for Teaching of OR Practice, 2009 American Institute of Aeronautics and Astronautics Homeland Security

Award, 2007 Hamming Award for interdisciplinary research, 2007 Wayne E. Meyers Award for Excellence in Systems Engineering Research, and the 2005 Northrop Grumman Award for Excellence in Systems Engineering. He is a member of the Military Operations Research Society and the Institute for Operations Research and Management Science.

Appendix B: U.S. Naval War College Forum Committee and Support

RADM Shoshana S. Chatfield
President, Naval War College

CAPT Michael O'Hara, PhD
Chair, War Gaming Department

Dr. Shawn Burns
Forum Director

Prof. Ben Peterman

Mr. Dick Wilbur

Dr. Walter Berbrick

Dr. Joe Mroszczyk

U.S. Naval War College Forum Support

Mr. Dave Bolender

Mr. Carl Knott

Mr. Chuck Croteau

Ms. Charla Fiorey

Ms. Patricia Andraka

Mr. Dean DePalma

CDR Gary Ross

IC1 Patrick Davis

OS2 Gentry Duran

OS2 Keith Johnson

IC2 Matthew Vance