AIR WAR COLLEGE

AIR UNIVERSITY

"OPERATION AZURE OSPREY:"[1] WARGAMING INTELLIGENCE,

SURVEILLANCE, AND RECONNAISSANCE

by

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A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

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19 April 2017

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Biography

Lieutenant Colonel Chris DiNote is assigned to the Air National Guard Readiness Center, National Guard Bureau, Joint Base Andrews, MD. He was commissioned in 1999 from the US Air Force Academy and has served in a variety of responsibilities as a career intelligence officer. He is a 2003 graduate of the USAF Weapons School. Lt Col DiNote's assignments include fighter squadron intelligence officer, wing intelligence weapons officer, air and space operations center chief of intelligence readiness, intelligence, surveillance, and reconnaissance (ISR) collection manager, joint air defense operations center senior intelligence officer, staff officer, and Squadron Commander. He has deployed for Operations ENDURING, IRAQI FREEDOM, and NOBLE EAGLE. Prior to this assignment, Lt Col DiNote served as Commander, 125th Intelligence Squadron, Ohio Air National Guard. In 2016 he earned a Master of Arts in Military History from Norwich University, Northfield, VT.

Abstract

In a February 2015 memorandum, Deputy Secretary of Defense Robert Work issued a call to the department and the military services to reinvigorate the use of wargaming across the defense enterprise. He connected wargaming directly to innovation in technology, as well as new operational and organizational concepts to avoid strategic surprise.[3] The secretary's guidance emphasized the urgency of this task, explaining that the United States faces an era of constrained resources and rapid global change.[4] This essay contributes to the Air Force response to this call to action, including a game design-in-progress, from the perspective of Intelligence, Surveillance, and Reconnaissance (ISR) strategic decision-making.[5] The author contends that games designed with ISR central to their play can facilitate greatly needed, yet politically difficult discussions of force allocation, risk assessment, return on investment, prioritization, transregional threats, and the insatiable demand for ISR coverage in an increasingly disordered world of contested norms.[6,7]

Contemporary military wargames are expensive undertakings. They consume great amounts of time, personnel, and resources, and depend on classified computer models and simulations. Policy-making seminar games, featuring extensive roleplay, also make significant demands on the schedule of senior leaders, and the availability of Subject Matter Experts (SMEs) and adjudicators. Rarely will either format address or inform ISR aspects of strategy in a significant fashion. Therefore, the material presented here explores the latest academic research and wargaming innovations to demonstrate the utility of low cost, fast-play, tabletop manual games as tools to experiment, innovate, train, and analyze historical, contemporary and future defense problems from an ISR-centered lens. This project also aspires to foster an officially-sponsored "gaming culture" throughout the AF ISR enterprise.

Introduction

In 2015 Deputy Secretary of Defense Robert Work called on the Defense Department to reinvigorate wargaming, recalling its powerful history in aiding the US military to navigate past eras of strategic disruption, understand emerging technologies, and successfully prepare for future conflict.[8] He outlined this requirement in context of the emerging global environment:

> Wargames are all the more important in an era of multiple strategic challenges requiring joint, multi-dimensional approaches. Today, we face the challenges of Russian aggression in Eastern Europe, managing the rise of China, checking Iran's malign influence, and remaining prepared to respond to North Korean provocations, all while waging a global counterterrorism campaign. Wargames can help us explore all of these challenges, in isolation and combination, and assess the best ways to confront them.[9]

Despite widespread wargaming activity, he noted that current efforts had little impact on the actual conduct of defense business, especially at senior leadership levels.[10] The secretary thus tasked the entire defense enterprise to rethink wargaming and fully integrate it into strategic decision-making, planning, and force structuring.[11]

This project explored the secretary's call to action through an Intelligence, Surveillance, and Reconnaissance (ISR) lens. Even though wargaming has a long history in the study of military problems spanning everything from infantry tactics to disaster response, ISR remains under-examined in both professional and commercial games.[12] While ISR provides key inputs into wargames, ISR-themed wargames are notably rare. Furthermore, the common portrayal of ISR through scripted "white card" injects ill serves ISR professionals in their own work and training. Thus, this project explored emerging scholarship and innovations in both the professional and commercial/hobby gaming sectors to conceptualize and describe an ISR-centric wargame, using manual gaming techniques of demonstrated cognitive and playful, or "ludic," value. This project examined global ISR coverage, intelligence production and force allocation, prioritization, risk acceptance, and combatant command requirements.[13] The research highlights

the potential for quick, low cost, and readily-playable manual games, developed with substantial field input, to explore these issues at all levels of the ISR enterprise. By fostering a command-endorsed grassroots "gaming culture" throughout the Air Force Global Integrated ISR (GIISR) community, the Air Force can benefit by combining the ingenuity of field airmen with the resources and expertise of its formal wargaming activities.

Thesis

Wargames with an ISR focus can offer a new perspective on defense wargaming, useful for the expanded role of wargames envisioned by Secretary Work. The game design described in this essay addresses ISR, a core mission for the Air Force as Global Integrated ISR, in the context described by extant national, joint, and service strategic documents.[14] Building on an analysis of professional and hobby wargames as well as wargaming literature, this essay proposes a multiplayer tabletop wargame, simulating the "low-strategic/high operational level of theater military strategy" (see Figure 1), but from the perspective of ISR "providers" and "distributors," rather than "consumers." The goal remains to help airmen use ISR-centric wargaming to train, contribute to operational design, and innovate solutions pertinent to the resource constraints associated with the ISR enterprise.
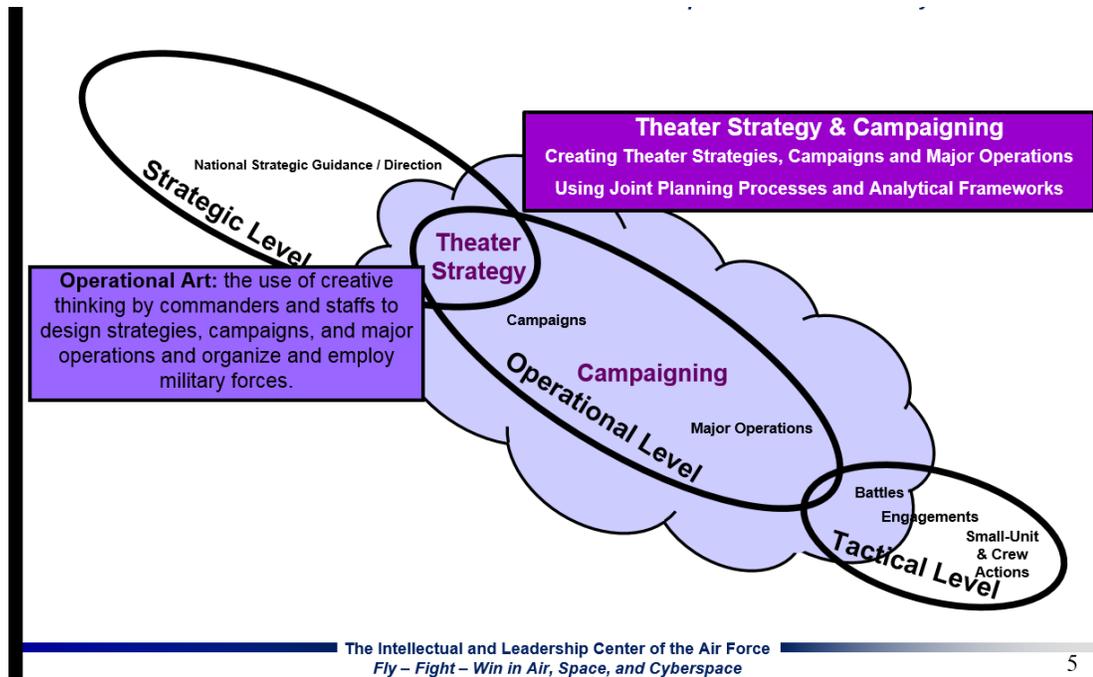
Figure 1. Theater Strategy and Campaigning[15]

The proposed game, *Operation Azure Osprey: 2021-2035,* is under development collaboratively between the author and the Air Force Wargaming Institute.[16] Its mechanics are based on the commercially available *Aftershock: A Humanitarian Crisis Game,* designed by Canadian academic Rex Brynen, and used successfully for training and research in academic, military, and government settings.[17,18] *Azure Osprey* focuses on answering national command authority (NCA) and combatant command (CCMD) priority intelligence requirements (PIRs), in support of national strategy, theater campaign plans (TCPs), operations plans (OPLANs) and concept plans (CONPLANs). As a manual tabletop game, its production reduces costs and risks associated with research, development, and implementation, but also remains adaptable to different scenarios, missions, organizations, and scales of play.[19]

The game emphasizes cooperative hidden knowledge discovery, aggressive adversaries, uncertainty, risk assessment, and cost/benefit analysis. It explores ISR allocation, transregional threats across combatant command seams, and "return on investment" as a possible replacement

for the unsustainable system of unconstrained ISR requirements.[20] ISR allocation and tasking already takes place in a game-like environment: "Tasking decisions all take place within zero-sum games. There is no reserve collection capability on hand that can be rushed during a crisis."[21] The dilemmas of ISR resource-to-task, combatant commander prioritization, and the Global Force Management "knife fight" seem tailor-made for new thinking. Room to experiment in a risk-free, apolitical environment, wisely informed by professional wargaming's limitations,[22] can enhance the training and education of ISR airmen, research and test strategies, evaluate plans, and explore courses of action, benefits historically associated with wargaming.[23]

A game like *Azure Osprey* requires much smaller commitments of time, personnel, and resources than the computer model-centric wargames airmen often support. At first glance, commercial/hobby and professional wargames serve different purposes. Hobbyists use them for entertainment mixed with self-study, often as a form of military history, as opposed to professional military preparation for future crises.[24] However, official wargaming tends to undervalue core components of what makes a game, "a game;" willing self-immersion, satisfaction and fun, driving a desire in participants to replay the game and explore other games.[25] Emerging research highlights the power of the immersive, satisfactory component that results from the experiential learning inherent to wargaming.[26] Professional and commercial game design expert Jim Dunnigan describes the motivation for playing wargames, or any simulation game, as satisfying the desire for information through experience; the experience of a gamer "massaging" information to see different shapes the information can take.[27] AFISR can enhance training and experimentation with elements of play that reward hard work and satisfy that drive for information through experience.[28, 29] Both Red Flag and Weapons School

capstone live-fly events represent some of the most difficult and stressful training evolutions in the world, but they also represent epitomes of job satisfaction; they are fun.

Wargaming ISR requires a new bridge between hobby game and defense wargame design, in the spirit of deliberate outreach efforts in the 1970s, '80s, and '90s.[30] Blending the best developments in both worlds can advance the state of the art.[31] By encouraging player-driven design efforts, this outreach supplements and augments, but does not replace, the high-end games employed by the military departments and defense think tanks.[32] With official support and engagement, ISR gaming activities can constitute a major component of the Air Force's response to the Deputy Secretary of Defense's challenge to reinvigorate defense wargaming.[33] By encouraging a lively wargaming culture throughout the GIISR enterprise, the Air Force can adapt to a resource constrained, increasingly volatile environment, one in the midst of significant technological change and violent challenges to the existing world order.[34]

Understanding Wargames and Wargaming

Historical Perspective:

Two quotes from Carl von Clausewitz's seminal *On War* shed light on the relationship between war in the real world and wargaming. First, "In the whole range of human activities, war most completely resembles a game of cards."[35] Second, "We therefore conclude that war does not belong in the realm of arts and sciences; rather it is part of man's social existence."[36] Extrapolating from Clausewitz, wargames and wargaming connect theory and analysis to actions of design and play, but value resides in the shared ludic experience of the participants, an experience that should create meaningful insights about war.

As games about war have probably existed nearly as long as war itself, the definition of what constitutes a wargame has evolved with time as well.[37, 38] The ancient Indian game of

chaturanga appeared in the sixth century Common Era, apparently as a gift from a north Indian ruler to the Persian court, and featured horses, elephants, wagons, and foot soldiers.[39] By the sixteenth century C.E., chess attained its recognizable modern form, but the game no longer modeled contemporary armies or military problems. Throughout the seventeenth and eighteenth centuries, soldiers, scholars, even clergymen attempted to expand chess into a more complex form to restore its relevance.[40] The underlying purpose of these games remained the training and teaching of commanding officers and royalty.[41]

In 1780, German academic Johann Hellwig created one of the most successful and influential attempts to substantially modify chess, with a larger board (1,617 squares), more pieces (208), gunpowder weapons, and movement-affecting terrain (mountains, forests, bodies of water). Even though this game could approximate a specific battle, he still faced the enduring design dilemma of all wargaming: realism versus playability.[42] Hellwig also introduced the term *kriegsspiel,* "the term by which games descending from Hellwig's work are still known to this day."[43] Hellwig, not a soldier himself, aimed to "serve students of warfare," but notably, also "to provide, to those who need no instruction, a pleasant entertainment."[44]

Prussian nobleman Georg Leopold von Reisswitz, created the first truly modern wargame, as a response to Prussia's defeat at the hands of Napoleon Bonaparte.[45] Herr von Reisswitz's son Georg Heinrich, a cavalry officer, produced a refined version in 1824. The improved *kriegsspiel* featured variable topographic terrain pieces on a sand table to simulate different environments, and scaled wooden blocks featuring very familiar-looking symbols to represent units. Von Reisswitz's greatest innovation came with "the fog of war," in that unlike chess, neither player had full knowledge of the other's strength, movements, or locations, unless they had made contact or observed them through reconnaissance.[46]

The younger von Reisswitz added mathematical simulation and realism by using the extensive statistics about firearm and artillery performance compiled during the Napoleonic wars. He created probability tables governing combat resolution, namely the effectiveness of fire and number of casualties.[47] The addition of a neutral umpire, to record movement orders from each side, define the scenario, and arbitrate disputes, eliminated player omniscience.[48] Moves were timed-constrained; the longer the players took to decide, the more disorder and confusion came to bear on maneuvers and fires.[49] After witnessing a demonstration, Prussian chief of staff Karl von Muffling declared "This is no ordinary game, this is a war academy. I must and will recommend this to the army most warmly."[50] The game was disseminated throughout the Prussian army, although with mixed results.

The Reisswitz *kriegsspiel* largely inspired the development of many tactical, and later, strategic wargames, across the great powers of Europe, the United States, and Japan, finding particularly receptive audiences in the naval war colleges of the late nineteenth and early twentieth centuries, through the end of the Second World War.[51] US Navy Fleet Admiral Chester Nimitz attributed success in the war against Japan largely to Naval War College games in the 1920s and '30s.[52] In a unique incident on 2 November 1944, a German army group staff "map exercise," barely underway when an American attack commenced against their segment of the Siegfried line, turned "live" when Feldmarschall Model ordered the game to continue. As the Germans ran the game using live reporting, commanders issued actual orders based on the game's proceedings: "The alerted division was thereby set in movement in the shortest conceivable time. Chance had transformed a simple map exercise into stern reality."[53]

In 1913, H.G. Wells published *Little Wars,* a game played with miniature soldier figurines, terrain, buildings, and toy cannons.[54] Wells published the game to encourage pacifism,

but set the template for the hobby wargame industry.[55] Wells corresponded with British army

officers, who expressed interest in adapting *Little Wars* into an official *kriegsspiel.*[56] The first

modern commercial wargame arrived in 1953; *Tactics,* a modern combined arms land warfare

game, by Charles S. Roberts, the founder of Avalon Hill game company. Avalon Hill held the

distinction of commercial wargaming industry flagship until the rise of chief rival Simulations

Publications Inc., and other publishers in the 1970s. According to industry lore, the first notable

"crossover" of commercial and professional wargaming occurred when RAND Corporation

contacted Roberts, expressing interest in the sources he used to create the combat results tables

(CRT) for *Tactics*, fearing a spillage of classified information. As the story goes, "the

government spent large sums of money to recreate something Roberts had developed in fifteen

minutes," based on his own extensive research of World War II. From RAND, Roberts took the

iconic "hexagon map" for his own use, an iconic feature of most tabletop wargames since.[57]

Commercial gaming attracted players and designers from the veteran and active military

communities, including Dunnigan, Larry Bond (naval reservist and designer of famed naval

wargame *Harpoon),* F-16 pilot Gary Morgan, and numerous CIA analysts.[58] Commercial

wargaming built a small but dedicated fan culture, one with a thin seam between amateur, semi-

professional, and professional designers.[59] However, the barrier between military and

commercial games remained strong until dissatisfaction with defense wargaming, in the wake of

the Vietnam War, led to a DoD-wide wargaming conference held in Leesburg, VA, with

commercial designers invited to take part. As one of the main attendees, Dunnigan actively

pushed DoD to acquire commercial game technology and systems, in particular their more user-

friendly interfaces.[60] Dunnigan and others argued that the replacement of traditional, history-

based manual wargames with computer-driven simulations of current and future events, overly

dependent on operations research (OR) and systems analysis techniques weakened the credibility of professional wargaming.[61] Dunnigan deliverd the harsh assessment that solely OR-based games proved incapable of accurately modeling the chaos and uncertainty of combat, and that OR techniques uninformed by military history biased games towards the desired outcomes of sponsors. He concluded that the politics of the Cold War led to inflation of the Soviet threat, and the original purpose of wargaming, training for combat command, was replaced by simplistic logistics exercises for future wars and to justify weapons procurement.[62]

By 1980, commercial tabletop techniques increasingly influenced military wargame design, first through game-playing troops, then through informal outreach from field personnel to commercial designers and companies. Finally, formal requests for help, principally through the Office of Net Assessment under Andrew Marshall led to greater crossflow between the two spheres of design.[63] The overlap increased as computer technology became cheaper, more powerful, and more widely available. Even as computer-based wargaming improved, professional gaming continued to include tabletop techniques in the Naval, Army, and National War College curricula. The Air Force lagged, despite promising early efforts such as *Tac Air* and *Flight Leader,* commercial games that began as official service-sponsored games.[64, 65]

Terminology and Concepts:

From this discourse between professionals and hobbyists, now including an academic dimension as well, multiple definitions of wargame and wargaming evolved from the 1950s to the present day. The cutting edge of contemporary wargaming literature, seen in all three wargaming spheres, considers advances in complexity theory, systems theory, neuroscience, social science, game theory, and literary theory.[66]
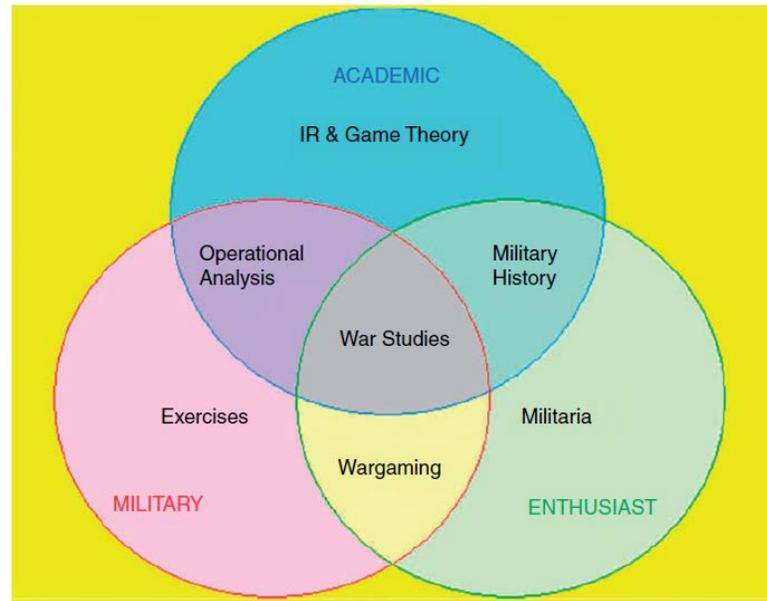
Figure 2: Philip Sabin's Venn Diagram of Wargaming Literature, Purposes, and Populations.[67]

British consultancy firm LBS offers a corrected translation of *kriegsspiel* that hearkens back to Clausewitz: "war considered using gaming mechanics."[68] Dunnigan defines a wargame as "an attempt to get a jump on the future by obtaining a better understanding of the past. A wargame is a combination of 'game,' history, and science."[69] Philip Sabin of King's College, UK, uses the phrase "military simulation games," that consist of two components: an "underlying mathematical model of reality," and an "iterative set of active decision inputs by one or more players to guide the simulated combatants…in order to maximize their relative or absolute performance" to achieve a set of victory criteria.[70]

The most commonly accepted definition comes from professional and commercial design expert Peter Perla,[71] from a 2008 update to his long-accepted 1990 version: "A wargame is a warfare model or simulation in which the flow of events shapes, and is shaped by, decisions made by a human player during the course of those events."[72] Perla emphasizes that "[t]he really decisive point is that wargames first and foremost center on human beings (players) making decisions and dealing with the consequences of those decisions as the events of the game

unroll."[73] In 2011, Perla and McGrady pushed the definition of wargaming further into the realm of human psychology: "Games are participatory narrative experiences."[74]

> We propose the idea that gaming's transformative power grows out of its particular connections to storytelling; we find in a combination of elements from traditional narrative theory and contemporary neuroscience the germ of our thesis—that gaming, as a story-*living* experience, engages the human brain, and hence the human being participating in a game, in ways more akin to real-life experience than to reading a novel or watching a video. By creating for its participants a synthetic experience, gaming gives them palpable and powerful insights that help them prepare better for dealing with complex and uncertain situations in the future. We contend that the use of gaming to transforming individual participants—in particular, key decision makers—is an important, indeed essential, source of successful organizational and societal adaptation to that uncertain future.[75]

The author of this essay offers the following definition of wargaming: "cognitive warfare, mathematically modeled and simulated by literal or abstract means, experienced both collectively and individually by its participants as a narrative story."[76]

The Utility and Limitations of Military Wargaming

> The reasons for the successes and failures of wargames of all types are as varied as the games themselves…When it works, wargaming can appear almost magical in its power to inform and instruct; when it doesn't work, it can appear almost childish in its oversimplifications and abstractions.[77]

> One must take note of what wargaming *is not,* in order to have realistic expectations.

Every expert voice on this topic states, emphatically, that the results of wargames should *never* be used as the sole basis for decisions. A wargame is *not* analysis, it is not a "technique for producing a rigorous, quantitative or logical dissection of a problem or for defining precise measures of effectiveness by which to compare alternative solutions…Its forte is the exploration of the role and potential effects of human decisions." [78] The best designed wargames, used properly, "seek to create an environment for applying critical reasoning techniques and diagnosing the characteristics of competition under the 'fog' and 'friction' of war where incomplete and imperfect knowledge prevails." Players should experience chaos and the

uncertainty inherent to real military situations; the game should strive to create a sense of stressed reality, where the players must live with the consequences of their decisions and confront the perspective of their adversaries.[79] Rex Brynen identifies other benefits, such as teambuilding, cooperation, and crowdsourced insights.[80] As often the case with Situational Training Exercises (STXs),[81] "wargames do not 'prove' anything, but they can enlighten."[82]

Air Force ISR is Underserved by Current Military Wargaming

Joint wargaming doctrine and practice says little about ISR. Joint Publication 2-0, as well as service wargaming texts, acknowledge intelligence as a supporting aspect of wargaming, involved in the design, development, planning, execution, and evaluation of a wargame.[83] Intelligence personnel roleplay the adversary as part of the "Red Team" or "Red Cell," and of course have a large role in scripting the event. Major wargames, whether Title 10 wargames, political-military policy games, or Planning, Programming, Budgeting, and Execution games, tend to be multi-day, large scale, time and resource-intensive events held for the benefit of general officers, policy makers, and their staffs.[84]

Despite these limitations, an attempt to redefine or significantly change the structure and play of these games would not improve the situation for AFISR. Discussion with subject matter experts at the LeMay Center and the AF Wargaming Institute produced a consensus that the portrayal of ISR in those games, while improvable at the margins for a more accurate, realistic depiction, suffices for those games' purposes.[85] "White card" ISR detracts from realism, but the games themselves remain generally effective. On the other end of the spectrum, small unit-level wargames are internal training events with little to no connection to the broader AFISR community.[86] This drives AFISR to a different solution, connecting the best of unit-level creativity to the resources and expertise of the formal AF wargaming system.

Early Air Force Attempts: The Difficulty of Wargaming ISR

The Air Force has made great use of computer wargames for general airpower professional military education and exercise training.[87] These games share pedigrees with high-end tactical simulations such as *Harpoon* and purpose-built air power games used both commercially and professionally.[88] These games depict ISR at a technical level; applying the right platform/sensor combination reveals targets for strike and uncovers their defenses. While present-day offerings exist, like John Tiller's computer-based *Modern Air Power,* designed for use by the Air Command and Staff College but also available commercially, this genre focuses more on historical or counter-factual campaigns. This situation applies also to tabletop board games, especially those developed to depict modern warfare such as *Team Yankee, Europe 1985,* (hypothetical Cold War scenarios), or *Phantom Leader* (Vietnam). [89] These games use intelligence to modify combat resolution, and therefore use significant abstraction and indirect simulation techniques, to allow players to focus on combat. The limited availability of open source information on ISR capabilities also makes depiction inherently difficult.

In the late 1990s and early 2000s, the Joint Staff-sponsored ISR Systems Symposium produced a classified computer wargame simulating collection assets, collection management and strike operations against various threat countries, while also serving as an educational tool for joint force senior leaders to learn ISR capabilities. Despite positive feedback, the game and symposium were discontinued due to lack of funds and sponsorship.[90] The classified nature of this game also limited its reproducibility. More recently, the AFISR Agency/A9 chartered an *AF Baseline Tabletop Execution Guide*, completed in 2014. This document provides a top-level "how to" guide for developing tabletop exercises at the unit, NAF, and MAJCOM level, similar

to the Naval and Army War College-produced handbooks, but does not provide schema for creating scenarios or game mechanics.[91]

Designing Games: "Task, Purpose, and Standard"

With these limitations in mind, *Azure Osprey* adheres to Dunnigan's two rules of design: 1). Keep it Simple, and 2). "Plagiarize," meaning, to make use of existing game mechanics before attempting to develop wholly new ones.[92] Professional wargames, regardless of their audience (corporate, civil, military, or political) comprise two broad, general types: **Educational**: teaching new lessons, reinforcing old lessons, and evaluating students, and **Research**: developing/testing strategy and plans, identifying issues, and building consensus as well as understanding. [93] Both fall under an umbrella of "decision support modeling," either to improve the ability of decision makers to *make decisions*, or helping them to make *better* decisions.[94] In professional gaming, this corresponds to the delineation between Title 10 wargames, considering actual wartime plans, and, research and experimental games, for the purposes of future acquisition and procurement decisions.[95]
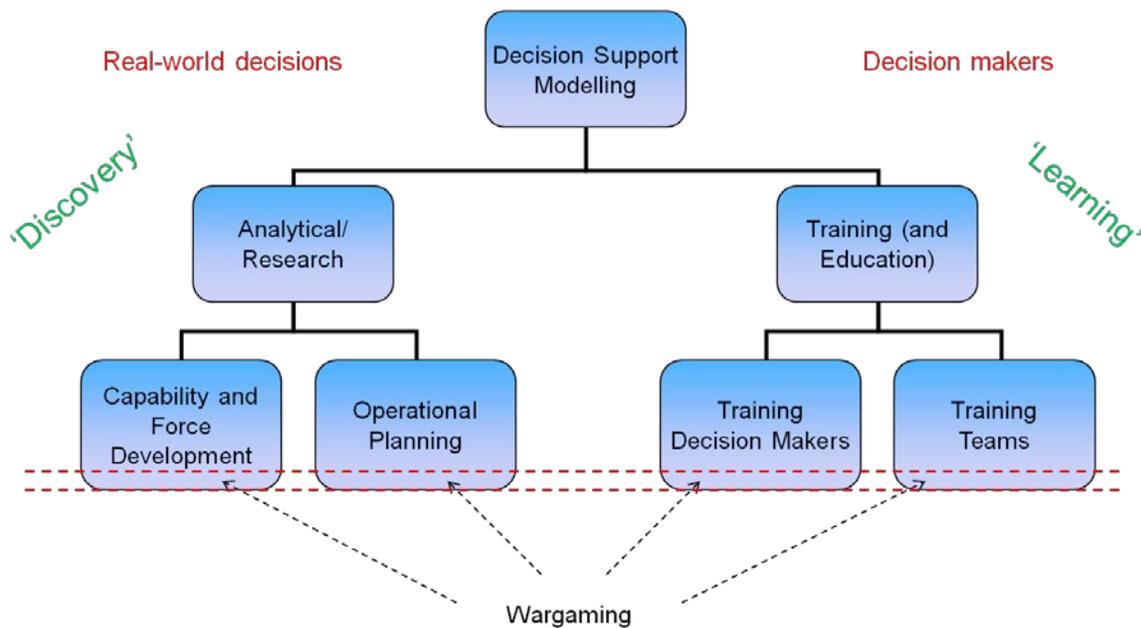

Figure 3: "Discovery/Research vs. Learning/Educational Games."[96]

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Levels of Games

The most common levels of games correspond to the doctrinal levels of warfare: strategic, operational, and tactical. In commercial designs, this often applies to the level of combat being resolved in an historical military event, such as a strategic game representing the entire Pacific war during World War II (Mark Herman's *Empire of the Sun),* an operational game simulating the Normandy invasion (*Normandy '44*), or a small unit tactical game using a single weapon system or unit such as *Harpoon* or *Advanced Squad Leader*. Hybrid games sometimes combine higher levels of decision making with lower levels of detail for combat resolution, such as a strategic-operational or operational-tactical game.[97] Professional games correspond to these terms in their level of command and scope of responsibility.[98]

Wargame Creation: Phases and Elements.

The Naval Postgraduate School describes "four phases" and "seven elements" of wargame creation.[99] The Four Phases refer to Design, Develop, Conduct, and Analyze. The Seven Elements refer to Objective and Issues, Scenario, Database, Rules and Procedures, Players, Analysis, and Methods, Models, and Tools (MMT).[100] The outputs of games can encompass qualitative, interpretative, and quantitative aspects. For example, during GEN Martin Dempsey's tenure as CJCS, he hosted tabletop National Security Seminars, essentially giant, 4-star, strategic/operational wargames whose execution uncovered problems regarding the "simultaneity" of theater operations in the seams along CCDR lines of responsibility and forces available.[101] Depending on the type and level of game desired, the design will require indirect simulation and abstraction. Generally, strategic and operational level-games require greater use of these techniques. Modelling ISR resource allocation at those levels of play requires the

sacrifice of technical detail for conceptual focus, to ensure a repeatable game, playable in one to four hour sessions, with two to four players, and executable by field personnel.[102]

Design Innovations: Card-Driven Game Engine

The Card-Driven Game Engine (CDC) simulates unpredictable human adversaries and the "black swan" effect, especially when it comes to political and social upheaval. Card draws, randomized deck building and discarding actions allow players to drive the game, and yet still face the threat of chance, fog, and friction to upset their plans, force them to react, and change priorities.[103] "The pivotal CDG concept presents a player with a decision trade space between military and political activity…The reality is than any senior decision structure can only handle some finite number of priority issues."[104] CDG limits decision maker bandwidth via an abstract simulation of political and military decision-making structures, historical or otherwise.[105]

CDG mechanics appear to originate with Avalon Hill's WWII tactical game *Up Front,* released in 1983, and loosely based on *Advanced Squad Leader.*[106] This innovation became a staple of strategic-level games after the publication of *Hannibal: Rome vs. Carthage* in 1996. CDG increases emphasis on player human interaction and deal-making over dice rolls. Premier examples are *Twilight Struggle,* a completely CDG grand strategy simulation of the Cold War with players representing the US and USSR, and *Fog of War*, a strategic-level game of the European Theater of Operations, with players as the Allies and Nazi Germany.[107] *Aftershock,* the direct basis for *Azure Osprey,* also utilizes CDG as players drive the unfolding story of disaster response in a fragile nation. Cards enable multiple forms of limited-information play, such as hidden movement, military deception, and drive a need for knowledge discovery, via ISR collection and exploitation. From December 2014 through early 2015, MSgt Alec Lloyd of the Michigan Air National Guard's 217th Air Operations Group developed the *Card Based Conflict*

Simulator, as a training tool for the conflicts in Libya and Syrian, with a Ukraine scenario

currently under development. MSgt Lloyd's game has garnered the attention of the AF

Wargaming Institute and the Joint Staff (see Appendix B).[108]

Design Innovations: The Matrix Game

The seminar-style "matrix game" breaks with several wargaming traditions, as it depends

on roleplaying and referee judgement rather than automation, charts, or dice.[109] Introduced in

1989, matrix games have grown in popularity and use by militaries, interagency groups,

businesses, nongovernmental organizations, and academia, particularly to explore the art of

policy-making. A matrix game consists of adjudicated, structured arguments; players make their

moves by arguing a case for why something should or should not happen, in dialectic fashion.

Dice rolls settle those circumstances greatly subject to chance, such as combat, or that prove

highly contentious. Thorough player background briefs, allowing players to roleplay virtually

anything from individual actors up to entire countries, are a hallmark of this format.[110]

The UK Ministry of Defense and units deploying to the Balkans and Afghanistan have

successfully used matrix games for pre-deployment training.[111] In October 2016, the Military

Operations Research Society released *Baltic Challenge*, with player factions including NATO,

Russia, the Baltic states, Russian dissidents in the Baltic States and other regional actors. [112]

Baltic Challenge complements the traditional "hex and counter" wargaming done by RAND and

similar commercial efforts by designers such as Ty Bomba (*Putin Strikes*).[113] On the *PAXsims*

website, US Army Reserve military intelligence officer CPT Christopher Davis described the use

of a matrix game centered on North Korea as an intelligence training tool.[114] USAF Academy

instructor Lt Col James Fielder, recently produced a classroom matrix game designed to teach

aspects of international relations theory called *The Narrative History of the Chocolate Wars.*[115]

Although Fielder's game uses dice to measure chance, it still requires a referee to inject and guide scenarios, adjudicate rule modifications, and assess qualitative performance metrics such as critical thinking, teamwork, and communication. *Azure Osprey* will incorporate matrix game features, such as player briefs with varying rules and victory conditions, into its design.

Operation Azure Osprey: An ISR-Centric Game

The purpose of Operation Azure Osprey is to train airmen to think strategically about ISR employment, and address the fundamental intelligence problem facing the United States: limited ISR resources and coverage, in a world with unlimited ISR requirements.

> **The United States is the only country in the world with a truly global intelligence enterprise, but even the significant resources the US government invests are not adequate to cover the world in the depth required to provide robust and reliable warning of events in every corner of the globe.[116]**

Great care must go into conceptualizing, testing, and building the Global Integrated ISR Enterprise called for in the *Air Force Future Operating Concept*, capable of performing the critical tasks given to the GIISR enterprise: *enabling superior decision speed, employing performance-optimized teams, and a balanced capabilities mix.[117]*

Beyond resource constraints, the demands of the full range of military operations dictates judicious use of time and effort. Every hour and dollar spent must demonstrate a worthwhile return on investment. ISR-centric wargaming must look beyond current doctrine and models, identifying weaknesses and vulnerabilities, and test the enterprise in every way, especially if the world of persistent disorder and contested norms described in the Joint Staff *Joint Operating Environment 2035* comes to pass.[118]

The Game Proposal

Aftershock: A Humanitarian Crisis Game,[119] is a cooperative solitaire to four player

game that tasks resource distributors (the players, representing the Host Nation, NGOs, the UN,

and a military Humanitarian Assistance/Disaster Response – Task Force) to fulfill the needs of

at-risk resource consumers (affected populations) using immediately transient and

persistent/time-scaled consumable resources. The players are bound by limitations on

availability, the throughput of distribution networks, and random events. They can cooperate,

sharing resources and coordinating strategies via collaboration "clusters" to help mitigate risk, or

they can act with more immediate, individual goals in mind.[120] The risk/reward analysis of

collaboration versus individual action is partially driven by randomized events, but also by the

differing requirements and victory conditions present in the individualized player briefs.

Resources exist in finite amounts, and only limited abilities exist to transfer them between

players or to transform them into another type of resource. Also, teams from each of the game's

agencies move about the board, collaborating with each other, distributing resources, and

performing operations such as security and rescue. The game takes place across five "Districts,"

locations in the capital city of the fictional country Carana, where at-risk cards stack up and

"mature" over the course of several turns, revealing dangerous consequences such as civil unrest,

disease, and fire, if resource needs are not met and investments not made. The districts host

differing numbers and severity of risks, however a "floating" priority card, representing "the

Media," can force a player's hand. The game lasts 7 turns, and tracks the performance of the

players as a team, and as individuals.[121]

Following an initial playtest of *Aftershock* held at the LeMay Center on Maxwell AFB,

AFWGI personnel conducted analysis and began to conceive of modifications to the game to

transform it into a global ISR-centric wargame.[122] For *Azure Osprey,* the players will represent

ISR producers and/or distributors, each with their own distinct player brief. The National

Command Authority, representing the POTUS and executive branch, can drive priorities as well

as has his or her own support requirements. The other players represent the NSA, NGA, and

CIA. Originally, the author intended the players to represent various CCMDs, but the *Aftershock*

playtest, as well as the pointed analysis of AFWGI members showed no way around the zero-

sum competition effect resident in real-world ISR allocation, in playing the game from that

perspective.[123] Therefore, the CCMDs will fill the role of the Districts in *Aftershock.* The

CCMD "districts" host requirements for various types of ISR to meet their PIRs on stacks of

cards. Failure to address these PIRs, which emulate those found in their AOR's TCP, OPLANs,

and CONPLANs, increases the risk over time of strategic surprise, attack against the US or its

interests, or disastrous failure of US policy in that region. *Azure Osprey* will simulate

USPACOM, USCENTCOM, USEUCOM, USTRATCOM, and USSOCOM. The other CCMDs

will be simulated via event cards that drive their own cost requirements in ISR resources.

Play will center around four types of broad ISR resources; immediately transient

consumables - SIGINT and IMINT; and persistent, time-scaled consumables - HUMINT and

cyber. The time-scaled resources require early decisions regarding placement, and take time to

mature and present their full effects. Reallocating those resources can cause a loss of the "take"

collected to date. Limitations regarding availability, production, and throughput of the ISR

resources will simulate the differences between time-dominant (collection driven, quickly

transferable) and content dominant (analysis driven, requiring time and effort to transform raw

data into meaningful knowledge). As in *Aftershock,* human resources (analysts, collectors) must

be "in the loop" to produce content-dominant intelligence, distribute ISR resources, collaborate,

and complete tasks. Randomized inputs from event cards, which can trigger risk cards or represent world events, will force players to decide risk acceptance in one AOR over another, intel gain/loss, cost-benefit analysis, and return on investment. The collaboration clusters represent fusion cells, tipping and cueing (exchange of resources), "dual phenomenology," allowing the conversion of one ISR resource into another, or shortening the time needed for time-scaled resources to mature. Successfully meeting CCMD at-risk cards earns I-Points and Ops Points; I-Points generating overall score, and Ops Points allowing players to undertake certain actions such as military operations to stop adversary activities, bring new and better ISR resources online, and gain favorable political events, to reduce risks. Failure to meet CCMD needs exposes the world to risk of war, weapons of mass destruction, violent extremism, and other threats. The floating POTUS Priority card replaces the "media" card, but similarly amplifies the payoff/punishment effect in a given AOR.[124]

Areas for Further Research

Game design and development comprises the next step with the AFWGI to refine, correct, and improve the initial design. Playtesting should include groups and facilitators within the LeMay Center, future Vigilance Horizons Research Task Force personnel, and students and faculty at the various schools at Maxwell AFB. USAFA cadets, with a trained facilitator on the faculty, can support remote playtesting. To provide statistically viable results, 4-5 playtest groups of 4-12 players and facilitators each, across multiple demographics, for 3-5 sessions, 2-4 hours each should suffice. A finished game can also support AF Research Lab efforts to develop wargaming concepts for Multi-Domain Command and Control.[125] Outreach is an essential follow-on action; the work of 25AF in developing online analysis applications and games seems a natural next step.[126] Outreach and collaboration with commercial wargame designers, (such as Joe Miranda, *Battle of Baghdad* and *BCT Command: Kandahar*, Mark Herman, and of course Rex Brynen, the designer of *Aftershock*), interested in attacking wargaming from an ISR perspective, can prove fruitful, given the limited attention this area has received to date.

Way Ahead: 2-5 Year Outlook and Recommendations

The type of wargame described here has the potential to best serve the AFISR enterprise if it gains acceptance and routine use in the field. Even if *Azure Osprey* does not succeed in its own right, the attempt can open dialogue and encourage collaboration between the Air Force's institutional wargaming elements with homespun efforts. In particular, the AF Wargaming Institute, the AF Research Lab, 25AF, MAJCOMs, the Weapons School, PME schools, and contract partners can encourage and enhance field gaming efforts, and adopt the "best of" for incorporation into higher-level, formal games. They can make user-generated game content readily available in an open source format. This can foster a gaming culture pervasive throughout AFISR organizations, in training, education, planning, and operations. Over time, the AFISR enterprise

will move beyond current doctrinal limits to become just as much a customer as other AF core missions. Toward these goals, the author proposes the following roles and tasks:

- AF Wargaming Institute:
  - Continues to develop, test, improve, and refine the game resulting from this research project for continued use.
  - Acquire and curate field-designed wargames, rules, scenarios, expansions, materials, and user-generated content per AF requirements and field requests.[127]
  - Host a web-based repository of this material, at multiple classification levels, readily accessible and regularly updated.[128]
  - Host tools to support field-led game design, including graphical components, databases, and templates.[129]
  - Provide expertise and assistance to field game design and playing efforts.

- LeMay Center:
  - Provide updates to Joint and Service doctrine to acknowledge wargaming *for* ISR, including theater strategy development and assessment.

- AFRL:
  - Conducts research into gaming methodologies, and tests field user-generated content as applied to AF research priorities, such as Multi-Domain C2.
  - Presents priorities and criteria to the field for games to support research tasks.

- 25AF:
  - Collects, analyzes, and evaluates field gaming reports applicable to AF ISR enterprise operations across the four ISR competencies; targeting, analysis, collections, and integration.[130]

- Develops guidance for incorporating tabletop ISR wargaming into unit training, planning, and operational activities.

- Incorporates field gaming inputs into major Title 10 wargames, exercises and POM game events to inform development of the GIISR portfolio.[131]

➤ 19th Weapons Squadron:

- Incorporates a manual wargame into the ISR weapons school syllabus.

➤ Technical Training and PME:

- Incorporates tabletop games into ISR officer and enlisted technical training to supplement map exercises and practical training events.

- Following the lead of the Naval War College, Army War College and King's College in the UK, consider adding a game design elective to Air Force in-residence PME at the Air Command and Staff College and/or Air War College levels, or at least a game design block of instruction to warfighting and operational design courses.[132]

- Add an ISR game, either a fully-realized version of the one depicted in this project or another effective design to ISR 200 and 300 courseware.

➤ MAJCOM/A2s:

- Solicit and sponsor field gaming activities in response to command requirements, intelligence problems, deliberate and contingency planning.

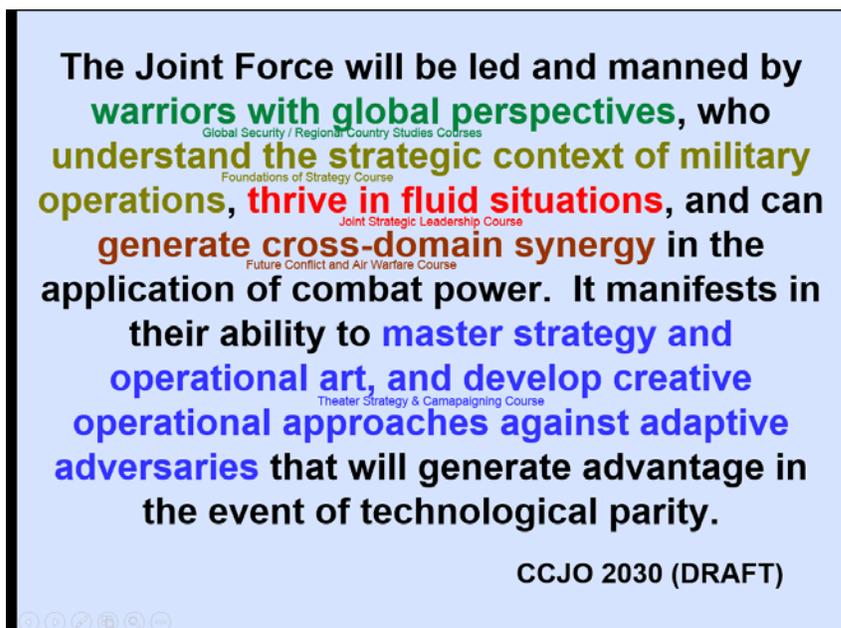- Inform MAJCOM exercises and training with inputs from field wargaming.

Conclusion

The Joint Force will be led and manned by warriors with global perspectives, who
Global Security / Regional Country Studies Courses
understand the strategic context of military
Foundations of Strategy Course
operations, thrive in fluid situations, and can
Joint Strategic Leadership Course
generate cross-domain synergy in the
Future Conflict and Air Warfare Course
application of combat power. It manifests in
their ability to master strategy and
operational art, and develop creative
Theater Strategy & Camapaigning Course
operational approaches against adaptive
adversaries that will generate advantage in
the event of technological parity.

CCJO 2030 (DRAFT)

Figure 4.[133]

The ability of the AF to thrive in the future depends on its ability to develop and foster airmen capable of operating in performance optimized teams, capable of acting autonomously and with authority, using highly honed judgement, creativity and critical thinking, to solve ISR problems in support of joint and coalition military operations. Success, whether living in the world of *Paradox of Progress* or *JOE 2035*, requires the work of airmen at all echelons, not just those on staffs, or in research centers or headquarters. Wargaming offers an opportunity to empower airmen across the force to think, experiment, and do what they do best: problem solve and pioneer new ways of doing things. Whether *Operation Azure Osprey* succeeds or fails matters little, but if it encourages additional attempts, and spurs the growth of a new gaming cultural paradigm inside AFISR, the opportunities are limitless.

APPENDIX A:

Azure Osprey's baseline scenario will consist of present-day and near future strategic concerns, mainly the "4 + 1" problem set of North Korea, Russia, Iran, China, and violent extremism. The planned game will also include context including transnational organized crime and weapons of mass destruction proliferation issues. Theater and context-specific scenarios are under consideration/initial development, such as *Sapphire Penguin* (an Arctic-based scenario focusing on USNORTHCOM, USEUCOM, USPACOM, Russia, and other regional concerns), *Cerulean Macaw* (USSOUTHCOM, USNORTHCOM-centric counter-transnational organized crime and counter-narcotics-based), and *Cobalt Crane,* (a USPACOM-based scenario). An ISR budgeting, R&D, manpower, policy, and interagency version has been conceptualized, tentatively titled *Cyan Raptor.*

A copy of the rules for *Aftershock* are attached here:

aftershock-rules.pdf

The attached graphics illustrate the post-playtest session analysis performed by AFWGI operations research specialists and ISR SMEs: charts by Lt Col Jarrett Hlavaty:

PSP2.pdf

Appendix B: The Card-Based Conflict Simulator

CBCS Rules.docx   CBCS North Africa Rules.docx   CBCS Syria Iraq Rules.docx

CBCS North Africa final.pdf   CBCS ME Large.pdf   CBCS Libya.pdf   CBCS Libya Rules.docx

CBCS Log.docx

Appendix C: *The Narrative History of the Chocolate Wars: A Short and*

Tasty Opportunity Costs Game

Fielder - Narrative History of the Chocolate Wars.docx

NOTES

[1] Title suggested by CPT L. Jaime. DiNote, USAR, for the initial global ISR game scenario.

[2] Lt Col Christopher R. DiNote, USAF, "Wargaming AF ISR: Exploring Global Coverage and Combatant Commander ISR Demands," (white paper, Air War College, Maxwell AFB, AL, 7 December 2016): 1-10.

[3] Robert Work, Deputy Secretary of Defense, to the Secretaries of the Military Departments, et al., memorandum, subject: "Wargaming and Innovation," 9 February 2015.

[4] Ibid.

[5] This essay, like its predecessor white paper completed by the author during the Vigilance Horizons ISR Research Task Force, is largely inspired by: John A. Kringen, "Keeping Watch on the World: Rethinking the Concept of Global Coverage in the US Intelligence Community," *Studies in Intelligence* 59, no. 3, (September 2015): 1-10.

[6] The popular and award-winning cooperative board game *Pandemic* served as a main inspiration for this project. The game requires a team of two to four players to make careful, often irreversible decisions regarding resource and capability allocation, prioritized threats, and risk analysis, to combat global and regional outbreaks of pandemic diseases. See Matt Leacock. *Pandemic.* Z-Man Games, 2012, as well as expansions adding bio-terrorism ("On the Brink," 2013), animal-human disease transfer ("State of Emergency," 2015), and other factors.

[7] "**The future security environment will be defined by twin overarching challenges.** A range of competitors will confront the United States and its global partners and interests. *Contested norms* will feature adversaries that credibly challenge the rules and agreements that define the international order. *Persistent disorder* will involve certain adversaries exploiting the inability of societies to provide functioning, stable, and legitimate governance. Confrontations involving contested norms and persistent disorder are likely to be violent, but also include a degree of competition with a military dimension short of traditional armed conflict." *Joint Operating Environment (JOE) 2035: The Joint Force in a Contested and Disordered World*, (Washington, DC: Joint Chiefs of Staff, 14 July 2016), ii.

[8] "Few historical periods match the dynamic technological disruption of the inter-war years of the 1920s and 1930s. During these decades, militaries the world over struggled to adapt to new inventions such as radar and sonar, as well as rapid improvements in wireless communications, mechanization, aviation, aircraft carriers, submarines, and a host of other militarily relevant technologies. Military planners and theorists intuitively understood that all these new technologies, systems, and advances would drive new ways of fighting, but they were forced to envision what future battlefields would look like with few clues to go by." Robert Work and Gen Paul Selva "Revitalizing Wargaming is Necessary to Be Prepared for Future Wars," *War on the Rocks*, (December 2015), http://warontherocks.com/2015/12/revitalizing-wargaming-is-necessary-to-be-prepared-for-future-wars/, 1.

[9] Ibid, 3.

[10] "We want to make clear that there is currently quite a bit of wargaming activity going on in the Department of Defense, and much of it is quite good. However, our review of service and joint wargaming revealed a lack of coordination within the wargaming community and the absence of any direct link between the insights gained from wargaming and the department's programmatic action. Wargame results are neither shared laterally across the defense enterprise nor up the chain to influence senior level decision-making. In other words, even if wargames are generating innovative insights and suggesting needed operational and organizational changes, the people in position to act upon them are generally unaware of the insights or their import." Work and Selva, 2.

[11] Work, "Wargaming and Innovation."

[12] An extensive history of wargaming, especially its roles in officer education as well as contemporary defense analysis can be found across the literature. Informative overviews can be found in the bibliography created during the writing of this essay, but it is by no means exhaustive. The author highly recommends The *History of Wargaming Project*, http://www.wargaming.co, as one starting point. An

extensive research bibliography is available on the blog *PAXsims,* compiled by Prof. Rex Brynen of McGill University, Canada, https://paxsims.wordpress.com/research-bibliography/ . Brynen's extensive work is in foreign policy, pol-mil, peace-studies, and humanitarian assistance games, such as *AFTERSHOCK: A Humanitarian Crisis Game. Aftershock* is used as the basis for the ISR game presented in Appendix A, currently in development as a collaborative between the author, the Air Force Wargaming Institute, and the LeMay Center Directorate of Intelligence, Surveillance, and Reconnaissance at Maxwell AFB, AL.

[13] This is an enduring concept in the literature regarding war, strategy, and play. See H.G. Wells, *Floor Games and Little Wars,* repr. 1911, 1913, Frank Palmer, (Springfield, IL: Monroe St. Press, 2016). See John T. Hanley, "Changing DoD's Analysis Paradigm: The Science of War Gaming and Combat/Campaign Simulation," *Naval War College Review* 70, no. 1, (Winter 2017): 64-103. Lt Col Jason Trew, doctoral student at Auburn University, is currently researching "the relationship between playfulness and airmindedness." He writes that "Does the image of a game imply playfulness? Is it appropriate to frame strategy as playful? There is actually some ancient precedence for this, as reported by Plato in his dialogue, *Laches.* Additionally, the literature on play is sometimes remarkably similar to strategic theory." In an article for *PAXsims,* Trew lists a series of quotes, and asks the reader to guess which were written about military strategy, and which come from scholarly works analyzing play, including of course, Carl von Clausewitz. Lt Col Jason M. Trew, "Can Strategy Be Playful?" *PAXsims,* (11 December 2016): https://paxsims.wordpress.com/2016/11/12/trew-can-strategy-be-playful/#_edn1

[14] Director of National Intelligence, *The National Intelligence Priorities Framework,* (Washington, DC: Office of the Director of National Intelligence, 2015), The National Intelligence Council, *Global Trends: Paradox of Progress,* (Washington, DC: Office of the Director of National Intelligence, January 2017), http://www.dni.gov/nic/globaltrends; Lt Gen Robert P. Otto, USAF, *Air Force ISR 2023: Delivering Decision Advantage,* (Washington, DC: Headquarters USAF, September 2013). See also, "As we plan for the future, the rapid pace of change occurring throughout the world compounds the uncertainty and complexity of the future environment. If we are to continue to succeed in our purpose, we must consider both the challenges and the opportunities we will face in air, space, and cyberspace. We must ask ourselves, 'How will future Air Force forces deliver responsive and effective Global Vigilance Global Reach—Global Power in the anticipated environment of 2035?'" Gen Mark A. Welsh, and SECAF Deborah Lee James, *Air Force Future Operating Concept, a View of the Air Force in 2035*, (Washington, DC: United States Air Force, September 2015), 2. Also, the author contributed a fictional "scene setter" for one of the AFSEA's nine alternative future environments in 2016, solicited by analysts from HQ AF/A5. The author's piece was used to illustrate a future environment called "Global Reboot," based on the RAND study-informed HAF/A5 "Purple World" setting. From the Joint Staff, "**Warfare in 2035 will be defined by six contexts of future conflict.** In 2035, the Joint Force will confront *Violent Ideological Competition* focused on the subversion or overthrow of established governments. *Threatened U.S. Territory and Sovereignty* will become increasingly prevalent as enemies attempt to coerce the United States and its citizens. *Antagonistic Geopolitical Balancing* by capable adversaries will challenge the United States over the long term and place difficult demands on the Joint Force over wide areas of the globe. Intimidation, destabilization, and the use of force by state and non-state actors alike will result in *Disrupted Global Commons* and *A Contest for Cyberspace*. Internal political fractures, environmental stressors, or deliberate external interference will lead to *Shattered and Reordered Regions*. Each *Context of Future Conflict* poses a troubling problem space for the Joint Force." *JOE,* iii.

[15] COL Christopher Wilbeck, USA, "Theater Campaigning and Strategy," (lecture, Air War College, Maxwell AFB, AL, 6 February 2017), slide 5.

[16] Game development and *Aftershock* playtesters include Air Force Wargaming Institute and LeMay Center for Doctrine personnel: Col Adam Stone, Ms. Pamela Hill, Mr. Jim Garner, Lt Col Jarrett Hlavaty, Lt Col Omar Khan, Capt Changsung Kim, and 1Lt David Arquette.

[17] Rex Brynen, *AfterShock: A Humanitarian Crisis Game,* The Game Crafter; http://www.thegamecrafter.com/games/aftershock. Multiple articles on the game's widespread use,

including after action reviews, can be found at the *PAXsims* blog, the most recent entry about a tournament conducted at McGill University, from 18 March 2017. Rex Brynen, http://paxsims.wordpress.com

[18] For an example of precedent, the combat rules and structure of the miniatures game *Harpoon* was used as the original basis for *Persian Incursion,* an "exploratory game" looking at how Israel and Iran might come to blows over Iranian nuclear capabilities, and how such a conflict might unfold at the tactical, strategic, and operational levels. The task was to create: "A stand-alone board game that explores the issues and consequences of an extended Israeli campaign to eliminate Iran's nuclear infrastructure. An investigative tool to look into a highly complex problem, from both sides, to gain a better understanding of the key points or drivers." The Admiralty Trilogy, "Persian Incursion: Adapting *Harpoon* to Explore a Real-World Security Issues," presentation, (Military Operations Research Symposium, February 2017). *Persian Incursion* is available commercially, and was reviewed on the *PAXsims* website, 16 December, 2012: https://paxsims.wordpress.com/2012/12/16/review-persian-incursion-2/

[19] See Appendix A, for proposed variants on *Azure Osprey.*

[20] The author is using concepts proposed by USAF Col Jason M. Brown during a classroom presentation to the Vigilance Horizons RTF on 19 October, 2016, proposing a new ISR lexicon and a new concept of operations for ISR: whether "Return on Investment" and "Opportunity Costs" can replace "requirements," "Measures of Effectiveness" and "Measures of Performance" as better metrics to capture ISR effects in the theater battlespace. Col Brown also explored other concepts inspiring this research project, such as time-dominant versus content-dominant intelligence production, in his article "The Data-Driven Transformation of Intelligence," *The National Interest,* (25 February 2017); http://nationalinterest.org/blog/the-buzz/the-data-driven-transformation-intelligence-19570

[21] Mark M. Lowenthal and Robert M. Clark, ed., *The 5 Disciplines of Intelligence Collection,* (Los Angeles, CA: CQ Press, 2016), 214.

[22] "In national-security war gaming there are three classes of senior stakeholders whom I call 'the three witches'—critical to the success of a game but with the power to affect negatively its quality. These comprise, first, the war-game director's superior and chain of command; second, the senior players within each game cell; and third, the sponsor of the game and that officer's chain of command. Each of these three stakeholders frequently attempts to influence the design of the war game, even during play itself. For two reasons, such attempts amount to inappropriate interference" Stephen Downes-Martin, "Your Boss, Players, and Sponsor: The Three Witches of War Gaming," *Naval War College Review* 67, no. 1, (Winter 2014), 31. See also, Yuna Huh Wong, "Irregular Warfare: The *Kobayashi Maru* of the Wargaming World," in Pat Harrigan and Matthew G. Kirschenbaum, eds., *Zones of Control,* (Cambridge, MA: The MIT Press, 2016), 533-534.

[23] RAND describes wargaming as a tool to "examine warfighting concepts, train and educate commanders and analysts, explore scenarios, and assess how force planning and posture choices affect campaign outcomes." RAND, "Wargaming," http://www.rand.org/topics/wargaming.html, (12 November 2016). For more on the history of RAND and wargaming, see Karl Mueller, "Paper Wargames and Policy Making: Filling the Baltic Gap, or How I Learned to Stop Worrying and Love the D6," *Battles: The Independent Wargame Magazine* 11, (May 2016): 53-57.

[24] Stephan B. Patrick, "Section I: The History of Wargaming," in Richard H. Berg, Robert J. Ryer, and Redmond A. Simonsen, eds., *Wargame Design,* 2.

[25] "If our game is to include the impression of its topic it must also be yet a game—it must be ludic...I have suggested three types of gaming fun…We can present puzzles (how can Napoleon defeat Wellington), we can ask the gamer to identify patterns (one defeats and entrenched enemy by combining fire and movement) and we can present narrative (placing the gamer in the same space with the same metadecisions as his heroes)." Charles Vasey, "The Amateur Designer: For Fun and Profit," in Harrigan and Kirschenbaum, eds., *Zones of Control,* 458.

[26] "We believe that wargaming's power and success (as well as its danger) derive from its ability to enable individual participants to transform themselves by making them more open to internalizing their

experiences in a game—for good or ill. The particulars of individual wargames are important to their relative success, yet there is an undercurrent of something less tangible than facts or models that affects fundamentally the ability of a wargame to transform its participants." Peter P. Perla and ED McGrady, "Why Wargaming Works," *Naval War College Review* 64, no. 3, (Summer 2011): 112.

[27] James F. Dunnigan, *Wargames Handbook: How to Play and Design Commerical and Professional Wargames,* 3rd ed., (San Jose, CA: The Writers Club Press, 2000), 107.

[28] "The need to explore, repeat, and reflect on decisions made in the context of games is critical to what we must do to learn better how to cope with a world rapidly moving beyond our range of real experiences. Improving the ability of our games to help us do this, in turn, demands that we improve our understanding of why wargaming works." Ibid, 112. Also: "For the professional, wargaming must be linked with the lessons of exercises, mathematical analyses, history, and current operational experience in a continuous cycle of research that allows each method to contribute what it does best to the ongoing process of understanding reality." Perla, *The Art of Wargaming,* 25.

[29] "What makes wargaming unique is its ability to teach players something about war and something also about themselves. These are the same characteristics that make professional wargames important research and educational tools. The designers, players, and analysts of hobby wargames have far more in common with their professional counterparts than either group may imagine or care to admit." Perla, *The Art of Wargaming,* 25.

[30] "In the 1970s the commercial wargames began to have an influence on the design and use of professional wargames. At first there was an indirect influence of the hobby games, as the troops bought and played them, which had a subtle and enduring impact. By the end of the 1970s, the military wargamers (users first, then the designers) found that the simpler techniques used by commercial wargames were more effective at simulating warfare than their own highly complex and heavily computerized efforts. A common criticism directed towards professional wargames during the 1970s was insufficient attention to historical experience in order to validate the military simulations and models…The rumblings within the professional wargaming community was one of the causes of the 1977 Leesburg conference. This was the first gathering of all the major forces in military wargaming. Two others were held, one in 1985 and another in 1991…It was obvious that the winds of change were blowing strong when Andrew Marshall, a senior official of OSD [director of the Office of Net Assessment] and one of the key sources of funding for professional wargames got up in front of the assembled multitude and stated bluntly: 'You people have never given me anything I can use.'" Dunnagin, *Wargames Handbook,* 326-327.

[31] In 1990, Professional and commercial gaming design expert Dr. Peter Perla of the CNA Corporation advising the Naval War College stressed that "the war aspects (or realism) stressed by the professionals and the game aspects (or playability) more often stressed by hobbyists need to be better balanced. This cross fertilization of hobby playability and professional realism can help both types of games improve their ability to educate and enlighten their users through the powerful medium of active and absorbing involvement in the challenge of making 'life and death' decisions." Peter P. Perla, ed. by John Curry, *Peter Perla's The Art of Wargaming,* (2011 ed., The History of Wargaming Project, 1990), 22.

[32] "Beginning in summer 2014, RAND Arroyo Center conducted a series of wargames examining possible Russian conventional aggression against the three Baltic members of the North Atlantic Treaty Organization (NATO): Estonia, Latvia, and Lithuania. Although such an attack may not be likely, Moscow's recent behavior suggests that NATO should take the prospect sufficiently seriously to at least evaluate the requirements for deterring and, if necessary, defeating Russian adventurism." David A. Shlapak and Michael W. Johnson, "Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defense of the Baltics," (RAND Arroyo Center, 2016), 16. One can compare this series of RAND games sponsored by the Office of the Undersecretary of the Army, to the "homebrewed" Baltic game discussed by Karl Mueller, a RAND analyst himself, with *Putin Strikes,* a commercial wargame designed by veteran game designer Ty Bomba and released by One Small Step games in 2016. http://www.ossgamescart.com . The Baltics are a popular contemporary topic, as the Military Operations Research Society (MORS)

sponsored creation of *Baltic Challenge,* a role-playing centric "matrix game." Maj Thom Mouat, et. al., *Baltic Challenge,* MORS Special Event, (19 October 2016).

[33] Work, "Wargaming and Innovation," 9 February 2015.

[34] Work and Selva, 2.

[35] Carl von Clausewitz, *On War*, trans. Peter Paret and Michael Howard, (1976; repr., Princeton, NJ: Princeton University Press, 1984), 86.

[36] Clausewitz, 149.

[37] Perla, *The Art of Wargaming,* 17.

[38] "Wargames are probably only slightly younger than organized warfare. Archeologists have uncovered a group of Sumerian warriors marching in miniature phalanx, and a similar group of Egyptian miniatures has been found arrayed in full panoply. It is probable that the sons of the nobility…received their initial training with such miniatures. At some point, the play associated with these miniatures became stylized. From this stylized pastime sprang the true games that we play today, often without recognizing their military origins. Chess, Go, and kindred games. As a result of their development, wargames developed along dual lines, as a means for both military training and amusement." Patrick, *Wargame Design,* 2.

[39] Von Hilgers, 166, note 82.

[40] See John Peterson, "A Game Out of All Proportions: How a Hobby Miniaturized War," in *Zones of Control,* 4-7.

[41] "Late in the in the seventeenth century, the philosopher G. W. Leibniz hypothesized that 'one could represent with certain game pieces certain battles and skirmishes, also the position of the weapons and the lay of the land, both at one's discretion and from history' in a game that might be played by 'military colonels and captains' who would 'practice it instead of the chessboard.'" Ibid, 4-5. Also see the history of wargaming as described in Patrick, Perla, Sabin, von Hilgers, Dunnigan, and John M. Lillard, *Playing War: Wargaming and U.S. Navy Preparations for World War II,* (University of Nebraska, NE: Potomac Books, 2016).

[42] Ibid, 5.

[43] The term *krieggspiel* first appears in Johann Christian Ludwig Hellwig, *Versuch eins aufs Schnachspiel gebauten taktischen Spiels von zwey und mechern Personen zu spielen* (Attempt to build upon chess a tactical game which two or more persons might play), 1780. Ibid, 5.

[44] Ibid, 5.

[45] Specifically in response to the Prussian defeat at Jena-Auerstadt and eight years of French occupation. Ibid, 7.

[46] Ibid, 7-9.

[47] "As Reisswitz put it, 'only when the player has the same sort of uncertainty over results as he would have in the field can we be confident that the *kriegsspiel* will give a helpful insight into maneuvering the field.'" Ibid, 8-9.

[48] Ibid, 9.

[49] Von Hilgers, 51.

[50] Von Hilgers relays the event through correspondence from one of Reisswitz's colleagues, and verified in the Prussian military journal, *Militar-Wochenblatt.*, 52

[51] See Dunnagin, Perla, and especially Lillard.

[52] From an October 1960 speech given at the Naval War College: "[T]he war with Japan had been reenacted in the game rooms [at the Naval War College] by so many people and in so many different ways that nothing that happened during the war was a surprise—absolutely nothing except the kamikaze tactics towards the end of the war." Lillard, 1.

[53] Perla, *The Art of Wargaming,* 54-55.

[54] H.G. Wells, *Floor Games and Little Wars,* Frank Palmer, 1911, 1913 orig. ed., (Springfield, IL: Monroe St. Press, 2016), 19-20, 52-53.

[55] E.M. Spencer, Introduction to H.G. Wells, *Floor Games and Little Wars,* iv.

[56] "They tell me – what I had already a little suspected – that Kriegspiel, as it is played by the British Army, is a very dull and unsatisfactory exercise, lacking in realism, in stir and the unexpected,, obsessed by the umpire at every turn, and of very doubtful value in waking up the imagination, which should be its chief function." Wells, 54.

[57] Patrick, 11-12.

[58] See Dunnigan, Chapter 8, "Who Plays the Games?" 300-316, especially 314-1315, of *Wargames Handbook,* and in "Foreword: The Paper Time Machine Goes Electric," in *Zones of Control,* xxiii-xxxviii. See also Patrick, 1-40.

[59] See Dunnigan, *Wargames Handbook,* 326-331. For detailed exploration of the growth of fan culture, see Jon Peterson, *Playing at the World: A History of Simulating Wars, People, and Fantastic Adventures from Chess to Role-Playing Games,* (San Diego, CA: Unreason Press, 2012).

[60] "At Leesburg, and subsequently, I urged the military wargamers to buy the interface (and wargame) technology from commercial publishers. I had already sounded out several publishers and most were quite eager to work with the military." Dunnigan, *Wargames Handbook,* 328.

[61] Ibid, 323 – 326.

[62] Ibid, 323-324.

[63] Who was quoted as telling a group of professional military game designers "You people have never given me anything I can use" at the 1977 Leesburg conference, Ibid, 326-331.

[64] Ibid, 330-338.

[65] Dunnigan, *Wargames Handbook.* 356. While praising the ability of OR to influence and provide the USAF with excellent aircraft simulators, he notes that traditional wargaming has never received much attention or support within the AF, noting that the AF was the last service to set up a dedicated wargaming center in the 1980s.

[66] 2016's *Zones of Control* features 59 essays, over 700 pages of text. The latest work of Dr. Peter Perla and Philip Sabin especially opens up these avenues.

[67] Philip Sabin, "Wargaming in Higher Education: Contributions and Challenges," *Arts and Humanities in Higher Education* 14, no. 4, (2015), 334. https://paxsims.wordpress.com/2015/04/18/sabin-on-wargaming-in-higher-education/

[68] "What Is Wargaming?" LBS Consultancy, http://lbsconsultancy.co.uk/our-approach/what-is-it/

[69] Dunnagin, *Wargames Handbook,* 1. Dunnagin's sentiments are echoed by designer Mark Herman and others at Booz Allen Hamilton, calling wargaming a "creative tool for replaying military history or trying to anticipate battles to come." Herman, et. al., *Wargaming for Leaders,* 3.

[70] According to Sabin, the mathematical model "seeks to simulate the terrain of the battle area, the deployment and capabilities of the military forces, the passage of time during the engagement, thereby providing a synetheic experimental environment that mirrors in certain respects the real range of potential courses and outcomes associated with the armed conflict concerned." Philip Sabin, *Simulating War,* 4.

[71] Dr. Perla has long been associated with the US Navy as a member of CNA Corporation (Center for Naval Analyses), Alexandria, VA. See Peter P. Perla, Michael C. Markowitz, Christopher Weuve, Karin Duggan, and Leesa Woodard, *Wargame-Creation Skills and the Wargame Construction Kit,* (Alexandria, VA, Department of the Navy, 2002).

[72] This version is adapted by Perla from his own 1990 definition, cited in Shawn Burns, ed., *Wargamers' Handbook,* (Newport, RI: Wargaming Department, Naval War College, 2013). Both the 1990 and 2008 definitions are in Perla, *The Art of Wargaming*, 279.

[73] Ibid, 279.

[74] Perla and McGrady, 113.

[75] Ibid, 112.

[76] "This is what we call a megacommunity. We stage the wargame, but it is the players who take an opening scenario designed by us to build a story about the future—how a battle might unfold, how a corporate strategy might play out over time—because they live it as a kind of virtual experience." Herman, et. al., 4.

[77] Perla and McGrady, 111-112.

[78] Perla, *The Art of Wargaming,* 157.

[79] Herman, et. al, 3.

[80] Brynen, "Gaming Foreign Policy."

[81] "STX lanes are the Army version of LARPING (Live-Action Role-Playing)." CPT L.Jaime DiNote.

[82] "Persian Incursion," February 2017.

[83] *Joint Publication 2-0, Joint Intelligence*, 22 October 2013, https://jdeis.js.mil/jdeis/index.jsp?pindex=2. See also Jeff Applegett. "Analytic Wargaming: Introduction to Wargaming, Roles, and Best and Worst Practices," lecture. (Monterey, CA: US Naval Postgraduate School, June 2015). The Naval War College *Wargame-Creation Skills and Wargame Construction Kit*, and the US Army War College Wargaming Handbook, James Markley, ed., *United States Army War College Strategic Wargaming Series Handbook,* (Carlisle, PA: Strategic Wargaming Division, US Army War College, 1 July 2015), do not discuss intelligence or ISR except where intelligence supports the wargaming process, especially during scenario development, red teaming, red celling, and role-play. ISR incorporation into games or as a mission for wargaming is not discussed.

[84] See Herman, et. al, *Wargaming For Leaders,* for multiple examples of such play, including USCENTCOM gaming for the 1991 Gulf War, and 1999 games presaging the 2003 invasion of Iraq.

[85] Multiple interview and roundtable discussions with Col Stone, Mr. Ivanovsky, Mr. Garner, and other members of the LeMay Center / AFWGI staff led to this conclusion (September 2016 - January 2017).

[86] Wargaming between units in the field, whether flying unit intelligence, analysis, collections or other components of the AF ISR enterprise is an ad hoc, personality-dependent affair, requiring dedicated effort often above and beyond normal training activity but just as time and resource intensive. Formal exercise and training events capable of generating these effects, such as RED FLAG, are exquisite, expensive, and impact only a small slice of the ISR enterprise. While staffs are supportive of field-level wargaming activities, there is no dedicated resource base to enable or sustain these activities, or develop a significant corporate memory.

[87] https://paxsims.wordpress.com/2015/04/15/gaming-air-operations-with-the-us-air-force-rotc/

[88] John Tiller and Catherine Cavagnaro, "The Development and Application of the Real-Time Air Power Wargame Simulation *Modern Air Power*," in *Zones of Control,* 221-229.

[89] There are several World War I and World War II-era airpower games, Vietnam, Desert Storm, the Arab-Israeli Wars, and hypothetical "Cold War turns hot" scenarios depicting a Soviet invasion of Europe are more popular. These games offer a technically savvy approach to ISR, but the focus is on combat.

[90] The LeMay Center IN staff possesses the likely only copy of the computer game itself, as well as a binder of symposium documentation, lesson plans, and instructor notes.

[91] In early 2016, the now-25AF/A9 attempted an ISR allocation game for the 625th Operations Center, with results unknown at the time of source's departure from 25AF. Telephone interview by the author with Lt Col James Fielder, former AFISRA/25AF/A9Y Branch Chief, November 2016.

[92] In general, game *mechanics* are not copyrightable. While a specific Combat Results Table maybe copyright material, the *concept* and *mechanics (comparing ratios of attacker to defender strength)* of a CRT are not. See Dunnigan, *Wargames Handbook,* 147.

[93] Perla, *The Art of Wargaming,* 182.

[94] LBS Consultancy, 2.

[95] See RAND's analysis of Baltic defense options with regards to recommended force posturing for deterrence against Russian aggression. "The RAND Baltic defense game began as a sandbox for exploring the shape of the problem, but soon became focused on examining the issue of what additional capabilities could serve to present Moscow with the expectation that a Baltic invasion would be a long and costly fight rather than a fast and relatively inexpensive victory…'*Is there anyone here who thinks that we have any hope of defending the Baltic states with the capabilities we have today?'* No hands are raised. We move straight into a scenario in which the United States has prepositioned heavy forces in

eastern Europe and Britain, France, and Germany have made serious investments in their armies' readiness." Mueller, 54, 57.

[96] LBS, 2.

[97] Perla, *The Art of Wargaming,* 160-161.

[98] Ibid, 162-163

[99] Adapted from Perla, *The Art of Wargaming,* 158 by Jeff Appleget, "Analytic Wargaming: Introduction to Wargaming, Roles, and Best and Worst Practices," (lecture, Naval Postgraduate School, Military Operations Research Society, June 2015), 18.

[100] Perla's *Art of Wargaming* contains useful charts describing the levels of games, similarities and differences between wargames, exercises, and campaign analyses, with descriptions of goals, focus, and primary outputs. Perla, *The Art of Wargaming,* 165.

[101] Thom Shanker, "Mapping Military Needs, Aided by a Big Projection," *The New York Times* (11 September 2012), http://www.nytimes.com/2012/09/12/us/top-general-dempsey-maps-out-us-military-future.html?ref=armamentdefenseandmilitaryforces

[102] See Perla, *The Art of Wargaming*, 158—162, and Sabin (multiple works) for discussion of indirect versus direct simulation. SPI's *Wargame Design* contains multiple designer perspectives on abstract simulation and realism, as do several essays in *Zones of Control,* especially "The Wild Blue Yonder: Representing Air Warfare in Games," "Harpoon: An Original Serious Game," and "The Development and Application of the Real-Time Air Power Wargame Simulation *Modern Air."*

[103] Mark Herman, "*Empire of the Sun*: The Next Evolution of the Card-Driven Game Engine," in *Zones of Control,* 133.

[104] Ibid, 133.

[105] Ibid, 133.

[106] Grant Kleinhenz, "The Origins of CDG? – A Review of Up Front by Avalon Hill (1983), *The Player's Aid* (29 December 2016): https://theplayersaid.com/2016/12/29/the-origins-of-cdg-a-review-of-up-front-by-avalon-hill-1983/

[107] *Fog of War* was designed specifically with the intelligence and planning aspects of the World War II European Theater of Operations as the focus, rather than direct combat. https://theplayersaid.com/2016/12/21/interview-with-geoff-engelstein-designer-of-the-fog-of-war-by-stronghold-games/

[108] *Card Based Conflict Simulator Rules, version 1.5*, and emails to the author from Alec Lloyd, MSgt, 28-29 November, 2016, 2-3 December 2016.

[109] John Curry and Tim Price, *Matrix Games for Modern Wargaming,* (The History of Wargaming Project, 2014), 5-7.

[110] See *The Falkland Wars (1982), Crisis in Crimea: A Counter Revolution (March 2014),* and *The Red Line: Civil War in Syria (August 2013),* in Ibid, 21-26, 32-42.

[111] See *Lasgah-Pol: Afghanistan (2008),* and *Chaoslavia (1993),* Ibid, 5-20.

[112] See MAJ Tom Mouat, et. al, *Baltic Challenge: A Matrix Game About NATO/Russian Posturing in the Baltic Sea,* (Arlington VA: Military Operations Research Society, 19 October 2016).

[113] Published in 2016 by One Small Step games, http://ossgamescart.com

[114] Christopher Davis, "Using a matrix game as an intelligence training tool," *PAXsims,* https://paxsims.wordpress.com/2016/03/19/using-a-matrix-game-as-an-intelligence-training-tool/

[115] Lt Col James D. Fielder, *The Narrative History of the Chocolate Wars.* Presented at the Midwest Political Science Association Annual Meeting, Chicago, IL, 6 April 2017.

[116] John A. Kringen, "Keeping Watch on the World: Rethinking the Concept of Global Coverage in the US Intelligence Community," *Studies in Intelligence* 59, no. 3, (September 2015): 1.

[117] Mark A Welsh III, Deborah Lee James, *Air Force Future Operating Concept, a View of the Air Force in 2035*, Washington, DC: Headquarters USAF, September 2015), 23-25.

[118] *JOE 2035*.

[119] Rex Brynen, *Aftershock: A Humanitarian Crisis Game Rulebook.* (PAXsims, 2015); Rulebook available for free download at

[120] See *Aftershock Rulebook,* 4.

[121] Ibid, 1 – 20, player briefs, and player aids.

[122] Playtest session, the author, LeMay Center, and AFWGI personnel, 15 March 2017.

[123] Post-game analysis sessions, graphics created by Lt Col Jarrett Hlavaty, 16 March 2017.

[124] The author cannot take credit for the game mechanics and description illustrated here: this is the work of the operations research and ISR personnel assigned to the LeMay Center and AFWGI, especially Col Stone, Ms. Hill, Mr. Garner, L Col Hlavaty, Lt Col Khan, Capt Kim, and Lt Arquette.

[125] Based on telecom discussions between the author, Wargaming Institute, and AFRL personnel on 2 December 2016. AFRL expressed a desire in using the author's proposed game design and concepts to test and research MDC2 ideas, Roy K. Morris, the author, and AFRL, telecom, LeMay Center, 2 December 2016.

[126] The work of Mr. Frank "Chip" Von Heiland in particular.

[127] Potential models for such a site include http://www.boardgamegeek.com, http://www.consim.com, and http://www.vassalengine.org/index.php. BoardGameGeek.com is an expansive online gaming community site, incorporating reviews, discussion forums, news, downloadables, and user-generated content. VASSAL is "a game engine for building and playing online adaptations of board and card games. Play live on the internet or by email. VASSAL runs on all platforms, and is free, open-source software."

[128] This action would support OSD-directed actions. "Our first initiative, currently underway, is to establish a wargaming repository to better understand and guide existing wargaming efforts and to share derived insights across the defense enterprise. This effort seeks to provide key stakeholders with a single location to access wargame results and insights as well as find announcements of upcoming wargames and table top exercises. Already, the results of more than 250 wargames have been populated into the repository." Work and Selva, "Revitalizing Wargaming is Necessary to be Prepared for Future Wars," 4.

[129] *Aftershock's* physical components and copies of the game are produced by http://thegamecrafter.com, a website dedicated to producing small press or "bespoke" games and gaming materials. Professor Philip Sabin, faculty at King's College in the UK and a consultant to the UK Ministry of Defense for wargaming efforts makes extensive use of a program called CYBERBOARD as a design tool for his "Conflict Simulations" course. Games designed for his course and playable using CYBERBOARD are documented in his book *Lost Battles,* essentially a wargame in book format for simulating battles of the Classical Greek and Roman eras. His 2012 book, *Simulating War: Studying Conflict Through Simulation Games* (New York, NY: Bloomsbury Academic, 2012) describes how to use CYBERBOARD for design and playing user-created games, and especially its graphic design tools to design physical game boards, counters, and other components. CYBERBOARD is hosted at http://cyberboard.braniac.com/descript.html. Professor Sabin's work can be found at http://www.kcl.ac.uk/sspp/departments/warstudies/people/professors/sabin/lostbattles.aspx

[130] Taking another page from the wargaming hobby community and common military practice, 25AF can solicit ISR organizations' post-game analysis reports (Battle Reports or After Action Reviews) and debriefs for further analysis and evaluation. The AF ISR Baseline Tabletop Execution Guide (2014) contains several methodologies and procedures for this, based on tabletop exercises for unit, NAF, and MAJCOM-levels.

[131] The intent here is to address Secretary Work's observation: "However, our review of service and joint wargaming revealed a lack of coordination within the wargaming community and the absence of any direct link between the insights gained from wargaming and the department's programmatic action. Wargame results are neither shared laterally across the defense enterprise nor up the chain to influence senior level decision-making. In other words, even if wargames are generating innovative insights and suggesting needed operational and organizational changes, the people in position to act upon them are generally unaware of the insights or their import." Work and Selva, 2.

[132] https://paxsims.wordpress.com/2017/01/12/request-for-feedback-teaching-wargame-design-at-the-us-army-command-general-staff-college/
[133] Wilbeck, slide 1.

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