CLOSING THE GAP BETWEEN SIMULATIONS FOR TRAINING AND WARGAMING

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ABSTRACT

The United States Department of Defense is at a crossroads with respect to simulations. Operational commanders are expecting greater analysis capabilities from the vast amount of simulations supporting their training events and exercises. Current material, personnel, and training solutions are not organized to meet this demand and will require changes. This paper describes the current environment with respect to the training and analysis communities and provides potential areas to leverage existing capabilities in a manner that will provide greater benefit to operational commanders and staffs.

1 THE PROBLEM

As noted by Bob Work, Deputy Secretary of Defense, *"I am concerned that the Department's ability to test concepts, capabilities, and plans using simulations and other techniques – otherwise known as wargaming – has atrophied."* (Work 2015).

The proliferation of simulations throughout the United States Armed Forces has supported a training revolution focused on greater fidelity and better training devices. Tank crews fire countless virtual bullets in simulators before firing a single live round. Pilots log flight hours in high fidelity simulators, reducing maintenance costs for actual air frames. Army brigade staffs plan and rehearse complex multi-domain operations on real world mission command systems. Combatant commands conduct extensive exercises with allies and partners around the world while being stimulated with the large volume of intelligence, reports, and feeds necessary to replicate those operations. Overall, the Joint Training Enterprise does a good job from the tactical to strategic level in creating synthetic training environments.

A significant gap remains, though. Commanders and their staffs, at all levels, are asking for more analytical capability from their training simulations. More and more senior leaders are asking questions about the feasibility of using the same simulations for training in an analysis capacity to inform their planning and decision-making processes. This includes wargaming and validation of existing operational plans (OPLANS) and contingency plans (CONPLANS). It's a reasonable expectation, but one that the Department of Defense has not aligned its capabilities and resources to meet.

How did we get into this situation and what can we do to converge the gap between simulations used for training and for analysis to address the function of wargaming? The challenge is that we have not properly aligned staff functions, material solutions, and personnel skillsets to enable this vision. Now is the time to seriously look at closing the gap between the training and analysis communities.

2 THE ENVIRONMENT

As noted by General Paul Selva, Vice Chairman of the Joint Chiefs of Staff, *"Wargames provide opportunities to test new ideas and explore the art of the possible. They help us imagine alternative ways of operating and envision new capabilities that might make a difference on future battlefields. When*

creatively and rigorously applied, wargames help us to think through and begin to resolve complex military challenges, foster the testing of new strategic and operational concepts, stimulate debate, and inform investments in new capabilities." (Selva 2015).

2.1   Lack of Common Lexicon

Despite the term "wargaming" being used through many Service and Joint documents, there is not an official definition of the term. For example, the Defense Modeling & Simulation Coordination Office (DMSCO) uses the (since withdrawn) Institute of Electrical and Electronics Engineers, Inc. (IEEE) 610.3-1989 definition for wargame: "A simulation game in which participants seek to achieve a specified military objective given pre-established resources and constraints; for example, a simulation in which participants make battlefield decisions and a computer determines the results of those decisions." (Defense Modeling & Simulation Coordination Office 2019) This definition tends to focus on the technical aspects.

Other organizations, such as the Naval Postgraduate School define a wargame as: "A warfare model or simulation in which the flow of events shapes and is shaped by decisions made by a human player or players." (Perla 1990) This definition tends to focus on the interactions between the human participants, which is a more classical approach to wargames.

Regardless, for purposes of this paper, we are focusing on Joint Publication 5-0 "Joint Planning" description of: "Wargames are representations of conflict or competition in a synthetic environment, in which people make decisions and respond to the consequences of those decisions." (Joint Staff 2017)

As such, the wargame must contain the following elements (Joint Staff 2017):

1. People making decisions
2. A fair and competitive environment
3. Adjudication
4. Consequences of actions
5. Iterative

JP 5-0 does a good job of detailing the Joint Planning process and mentions the possibility of including simulations in the conduct of computer-assisted wargaming, but highlights the challenges of preparation time, loading scenarios/data, and training users to properly execute the simulation. (Joint Staff 2017).

2.2   Divergent Communities

Within the Department of Defense, we've allowed multiple communities to develop and apply simulations for use to address their specific requirements. Within this structure are separate Training and Analysis communities. The training community focuses primarily on the best way to employ training aids, devices, simulations, and simulators to help units achieve their training objectives. The analysis community uses simulations to assist with concept development and to inform future decisions, such as force structure, equipping, or budget decisions.

Each of these communities have developed their own unique requirements, processes, organizations, and resourcing, often resulting in divergent investments and capabilities.The differences between simulations for training and for analysis is a nuanced argument that senior leaders are not interested in. They are looking to leverage the capabilities at hand to better inform their decisions and making their staff's products better. For most operational units below the Service Headquarters, the primary simulations those commanders are exposed to are their training simulations.

2.3   Specifics of the Training Community

Proponency for training within the Joint Staff resides within the J7 Joint Force Development. Subsequently, each Service retains authorities and responsibilities for training of their forces and have organizations

dedicated to these functions. For example, the Army's Mission Command Training Program is tasked with supporting the collective training of Army units as directed by the Chief of Staff of the Army.

Training is typically classified within three realms: Live, Virtual, and Constructive. For purposes of this paper, we are focusing on constructive simulation, as they are typically used to represent and stimulate the echelons most interested in conducting analysis, such as brigade or larger formations. Constructive simulations are defined as: simulations involving simulated people operating simulated systems. Real people can be allowed to stimulate (make inputs) to such simulations. (Defense Modeling & Simulation Office 2019)

Common examples of constructive military simulations in use include: Warfighting Simulation (WARSIM; Army), Joint Semi-Automated Forces (JSAF; Navy), Joint Conflict and Tactical Simulation (JCATS; Joint Staff), Air Warfighting Simulation (AWSIM; Air Force), and MAGTF Tactical Warfare Simulation (MTWS; Marines). While there are strengths and weaknesses to each system, their primary purpose is to provide realistic movement of forces, adjudication of engagements, and stimulation of mission command systems.

A typical Warfighter or Combatant Command/Joint Task Force Exercise is developed through the Joint Event Life Cycle (JELC), which is a deliberate planning process designed to assist an organization in meeting its training objectives. (Joint Staff J7 2018) A typical JELC is about a year long process, with larger, more complex exercises (such as United States Pacific Command's TALISMAN SABRE) taking up to 18 months. The JELC can be shortened, but typically a "hasty" exercise would still take four or more months to develop the scenario, build/test the database, test communications, and execute.

Execution typically lasts for 5 to 10 days of 24 hours operations, with the commander and staff exercising their battle rhythm (boards, bureaus, centers, cells and working groups) and reacting to the changing situation. At points throughout the exercise, observer/trainers provide feedback and coaching to the training audience, generally culminating in a formal After-Action Review (AAR) and report at the end of the exercise. Good teams identify their shortcomings and develop plans of action. Poor teams are just happy the exercise is done.

Since the exercise focuses on current operations, it's driven by stimulation of mission command systems, incoming intel reports, master scenario event list (MSEL) injects, and various other stimuli. Planner participation is typically limited since there is no way to implement or "play out" those decisions in a timely manner. Planning teams typically develop plans for the next phase of operations, but seldom see those plans implanted or tested during the exercise.

Another approach is the Table Top Exercise (TTX), where larger, strategic issues can be discussed in a deliberate framework. Typically, a scenario is presented, and participants discuss possible actions and reactions. An "Umpire" adjudicates the results of the actions and the event continues. While some units have developed rudimentary tools (such as spreadsheets or a Comparison of Forces and Means process) to assist with the adjudication, these types of events typically lack sufficient empirical results as they are heavily influenced by the professional opinions of the participants.

These types of exercises have worked well for the Services and Combatant Commands, but there are some shortcomings. For example:

- Most training simulations run at real-time to stimulate mission command systems in real-time, making it difficult to gain operational/strategic insights beyond the current operation. Likewise, it's very difficult to run multiple iterations.
- Training simulations require a "human-in-the-loop" to make key decisions. We can easily model the force flow of deploying forces to the theater, but this ends when the units reach the port. At that point, players must make decisions for onward movement and employment.
- Most of the culminating training events are tied to current operations and that portion of the staff receives most of the attention. Therefore, who trains the planners? It fails to address the need to put a planning staff through an aggressive external assessment.

- Data collection and analysis is typically limited to battle damage assessment "scorecards." (How many of their tanks did we destroy? How many of ours were destroyed?) Staffs are likely measuring the wrong metric as it relates to mission effectiveness.

2.4 Specifics of the Analysis Community

Conducting wargames and politico-military seminars and simulations is within the mission of the Joint Staff J8 Force Structure, Resource, & Assessment. Specifically, Joint Staff J8 has the Studies, Analysis, and Gaming Division (SAGD) to perform these functions and coordinate analysis efforts across the Services and Combatant Commands. Externally, this division also chairs the Defense Wargaming Alignment Group (DWAG), consisting of over 500 government officials. (Heath 2018) Similar to the training community, Services also have respective centers focused within this community, such as the Center for Army Analysis (CAA) or the Naval War College.

Examples of simulations used for analysis included Synthetic Theater Operations Research Model (STORM; Joint Staff), Advanced Warfighting Simulation (AWARS; Army), Irregular Warfare Tactical Wargame (IWTWG, Army), One Semi-Automated Forces (OneSAF; Army), and Combat XXI (Army).

Initiatives such as the Department of Defense's Wargaming Incentive Fund (WIF) seek to energize the wargaming community. One of the more recent developments in this community, was the creation of the Wargaming Repository in 2015, which as of October 2018 includes more than 750 entries detailing the results of previous wargames. (Heath 2018) Analysis of the WIF funded wargames shows that the percentage of WIF funding used to inform CONOPS/CONPLANS has been a significant portion of the program at: 50% (FY16), 40% (FY17), 52% (FY18), and 67% (FY19). This is a very positive move in the right direction to align capabilities and resources that commanders and their staffs are seeking.

This community is very proficient at addressing questions about issues such as force structure, future weapons system capabilities, force projection limitations, etc. For example, what are the impacts if the Army moved to a 3-tank platoon model? How does that impact fuel consumption/distribution? Ammunition/firing rates? Impact on respective combat power? The United States Air Force Posture Statement Fiscal Year 2020 used this approach to determine the number of operational squadrons required, based on "thousands of simulations and wargames to answer this question." (Wilson 2019)

There are two significant factors impacting the ability to expand this type of analysis/capability into more organizations. The deliberate methodology is typically time consuming as it involves extensive preparation, conducts multiple iterations (often in the hundreds or thousands), and results in volumes of data that must be reduced and analyzed. This typically requires specialized organizations with unique skill sets.

The second factor is that most analytical simulations rely on a "closed form" approach, where there is no human-in-the-loop to affect the outcome. Training simulations rely on the human-in-the-loop to influence the situation. While the first supports analysis in the traditional sense, the latter is more akin to the requirements of the operational force.

2.5   An Assessment of the Communities

So how do the two communities score compared to the elements of a wargame listed earlier? Table 1 provides an assessment of the simulation capabilities and approaches of the two communities.

Table 1: Comparing the simulations from training & analysis communities.

Wargaming Element	Training	Analysis
(a) People making decisions	High	Medium[1]
(b) A fair and competitive environment	High	High
(c) Adjudication	High	High
(d) Consequences of actions	Low[2]	Medium
(e) Iterative	Low	Very HIgh

Notes:

1. Accounts for decisions made prior to execution; limited ability to make decisions affecting outcomes during execution
2. While the user's decisions will have impacts, there's a relationship between "Consequences" and "Iterative." Since most training simulations are difficult to reset/rerun, it's difficult for the training audience to clearly establish "cause and effects."

While subjective, in general terms, training simulations excel in the "human-in-the-loop" making and implementing decisions, while the analysis community simulations excel at a deliberative, iterative approach.

2.6   The Expectation (from an Army Perspective)

Commanders expect to be able to use their existing capabilities, primarily within the training enterprise to inform the validity of their plans. These are the systems that units spend the most time utilizing. Units are looking for innovative ways to implement these devices to answer their planning questions. They are less comfortable about sending their questions away to a distant analysis center to produce a detailed report, typically months later.

The Army spends in the range of ~$30M-$50M to build a new simulation center (the size depends on the echelons and training audience). (Department of the Army 2018) This is a significant investment for the Army. A typical Mission Training Complex/Simulation Center can handle one large event a month (such as a command post exercise over a week period) and a few dozen smaller training events each year. This isn't to say that the simulation centers aren't busy; the amount of time it takes to plan, prepare, test, and execute a training event is significant.

The issue is that by the end of the exercise, many commanders and staff ask the question: "Is our plan valid?" What data has been collected and analyzed to answer that question? Typically, collective training events focus on the staff process, and while there is significant value to that approach, we are allowing a significant opportunity to better inform these staffs to pass us by.

For example, in the opening days of Operational Iraqi Freedom (OIF), V Corps planned and executed a deep strike using 11th Attack Helicopter Regiment in March 2003. The mission resulted in two downed aircraft and every airframe returning with small arms damage. (Fontenot 2004) Despite this specific type

of operations being rehearsed through simulations at a variety of Army Warfighter Exercises in the decade prior, it failed to account for an unpredictable and adaptable enemy.

Now imagine a similar training scenario where that staff was able to conduct multiple iterations of the deep strike against an expanding set of variables. Does the deep strike result in success? How does risk change when every resident in a town fires randomly in the air? What are the second and third order effects of losing that much air combat power for future operations?

These are the types of insights we should be enabling for commanders.

3   POTENTIAL SOLUTIONS

Understanding that there is no single, simple solution to change the current paradigm, there are possible actions that can be incorporated across a variety of areas, to include material development, manning, and collective training.

3.1   Material Solutions

First, units need to have a better understanding of the existing capabilities available. This could include solutions such as the Joint Staff J7's Joint Theater Level Simulation – Global Operations (JTLS-GO), which allows for some basic analysis capabilities or the Army's Division Exercise Training and Review System (DXTRS), which provides a basic environment for training staffs. Neither approach provides the level of analysis required, but they serve as a starting point for further research.

For the long term, constructive training simulations must be designed to run with fewer operators, execute faster than real time, and provide for better data collection. Future requirements documents need to very specific with respect to these areas. This will require the analysis community to assist with the development of these requirements. Leaving this requirement definition to the training community will result in more complex versions of the current simulation capabilities.

Simultaneously, the data from each simulation iteration must be captured, reduced, and visualized in a basic manner so that the user gains near instant feedback. Staffs should not have to wait for a week (or more) to gain insight into an iteration of their plan. Near instant feedback will provide a return on investment to the staff in training and encourage further wargaming.

Finally, mission command systems need to have embedded rudimentary wargaming modules. These are the systems actually used by the staff for operations. Integrated Artificial Intelligence or Semi-Automated Forces that approximate subordinate and or threat actions would be a significant leap forward for staff wargaming.

Bottom line for any solution, though, is that it cannot take a long time to setup and execute. "Any solution needs to be time sensitive. In other words, from the [Commanding General's] mouth to 'game on' in as little time as possible, otherwise other priorities are going to take precedence." (Justice 2019)

3.2   Personnel Solutions

Across Professional Military Education (PME), there needs to be a shift towards greater understanding of wargaming and Course of Action analysis, facilitated by technology, within the Military Decision-Making Process. Courses in data analytics and visualization should be incorporated into more military curriculum and planning course should stress the use of objective data and results in decision making.

Within the services, greater cross fertilization of training personnel and operational research personnel would help to broaden the understanding of the methods and capabilities from each corresponding field. This may include sending Army Operational Research/System Analysis (ORSA) officers to the Advanced Operations and Warfighting Course (second part of the Army's Command and General Staff College) or even the School for Advanced Military Studies (SAMS) to provide additional operational insight into the planning process. Or, operational officers could be permitted to transition to ORSA later in their career after serving as battalion/brigade Operations (S3) or Executive Officers. The benefit is a deeper understanding

of the planning process the commander expects. This is a change from the current model where an Army officer typically transitions as a senior captain (7-9 years in service).

Likewise, a greater number of Army Simulation Operations officers could be assigned to analysis organizations, such as one of the TRADOC Analysis Centers. While most of the FA57 positions are within the training community, this cross training would benefit both communities.

A more holistic approach would expose more members of the military to wargaming at all levels, beyond just the simulation experts or operational research analysts. This could include sending a greater number of non-OR operators to ORSA Military Applications Course with the intent of infusing operational research concepts/principles deeper into the operational force. By incorporating wargaming concepts, both manual and computer-assisted, into more educational forums, commanders and staffs will be more comfortable with the concepts and be more willing to embrace the approach. "Wargaming education should be incorporated systemically into military education, both as an educational tool and as a topic of study. After repeated exposure, students could sharpen their skills over time." (Bae 2018)

The Naval Postgraduate School's Wargaming Activity Hub has been working to increase the exposure of wargaming, both manual and simulation assisted, through an 11-week resident course and mobile training teams. This approach of having students develop wargaming approaches to real-world problems is increasing in popularity with combatant commands and partner nations.

Finally, reconsider the use of ORSAs within the headquarters staffs. Analyzing results requires a unique skillset: "It's the analyst, not the model, that produces important useful results. Improve the former before the latter." (Bonder 2002) Many ORSAs are assigned to assessments cells, capturing large amounts of reported data, and analyzing it to inform commanders on the effectiveness of current operations. A shift to include more operational analysis into determining the feasibility of course of action during wargaming would greatly assist in this area.

3.3   Collective Training Solutions

The Services and Joint Staff should relook at the current model for collective training and consider how to move from operational to strategic (long term) training events. This may involve adjusting the construct of an exercise to focus less of current operations (e.g. how many car bombs occurred today?) to a longer-term focus (e.g. what will be the impact three months from now of establishing a combat outpost in this remote village?).

This may require an exercise construct that moves from simulations running in real time for the duration of an exercise (such as over a week), to a more abstract battle rhythm. An example might be:

Table 2: Example exercise construct accelerating time

Real World Date (R-Date)	Actions	Scenario Date (S-Date)
R+0	Intelligence/Operations Update Planning Process	S+0
R+1	Planning Process (continued) Input Decisions into Simulation Simulation Runs (hyper-time; 1 month) Results provided to Training Audience	S+1
R+2	Intelligence/Operations Update Planning Process	S+30
R+3	Input Decisions into Simulation Simulation Runs (hyper-time; 1 month) Results provided to Training Audience	S+31
R+4	Intelligence/Operations Update Planning Process	S+60
R+X	…Repeat moving forward…	S+Y

In this manner, a staff could receive feedback and greater understanding of the second/third order effects of their decisions by replicating the operational environment over months rather than days.

Current Table Top Exercise (TTX) methodologies typically take a similar approach where a single turn represents an extended period of time, but those assessments are typically derived from the experiences of the participants, not necessarily derived from computer generated models. Additionally, they also lack the iterations required to gain deeper insight due to senior leader schedules and timelines for impending decisions. "There are still many 'wargames' being conducted that are little more than BOGGSATs (bunch of guys and gals sitting around a table), as evidenced by the lack of useful wargaming results from many of DoD's higher-level wargaming events." (Appleget 2015)

The specific solution on exercise design is not within the scope or purpose of this paper, but commanders, staffs, and exercise planners should consider opening the aperture to these types of simulation enabled, time-enhanced exercises while acknowledging the weaknesses of our current constructs.

4   CONCLUSION

Deputy Undersecretary of Defense, Bob Work, summed it up best in a memorandum to the Department of Defense in 2016. "When done right, wargames spur innovation and provide a mechanism for addressing emerging challenges, exploiting new technologies, and shaping the future security environment." (Work 2015)

Commanders are looking for ways to better leverage the simulations within their grasp to inform their planning and decision-making process. The current disconnect between the use of simulations for training and analysis is one that can be reduced through creativity, changes to the current training paradigm, and smarter investments in material, manning, and training.

ACKNOWLEDGEMENTS

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