

LITMUS Wargame Executive Summary

1. Purpose.

The purpose of this memorandum is to provide analysis findings and key takeaways from the development and execution of the LITMUS Wargame involving integration of Human-In-The-Loop (HITL) decision-making.

2. Analysis background.

The LITMUS Wargame initiative resulted from a desire by the U.S. Navy to explore the use of the existing LITMUS agent-based combat simulation to provide Red team and Blue team players with a virtual wartime environment similar to commercial video game software. The LITMUS wargame provides players the opportunity to control air and surface naval assets in simulated engagements. Through this construct, LITMUS executes a tactical scenario and provides simulated real-world information back to the user. The objective of the wargame was to assess the capability of the LITMUS to provide players a realistic simulated naval experience.

3. Analysis purpose.

In order to assess the utility of LITMUS for analytical wargaming, six tactical questions related to a simulated tactical scenario in the South China Sea were examined:

- What is the best employment of the Zumwalt Destroyer (DDG-1000)?
- When and what do blue and red (US and Chinese forces) launch to gain ISR and targeting?
- What are typical flight profiles for airborne assets in this scenario?
- At what times do combatants change EMCON status or modify formations?
- How are MDUSVs employed?
- If BLUE has a choice, do they attack the RED surface action group (SAG) or the logistics group?

Wargame data collectors monitored the wargame and assessed the ability of the LITMUS wargame environment to provide useful insight into the tactical questions. Additionally, data collectors captured players' recommendations for user interface enhancements and software development requirements to enhance the wargame's realism.

4. Analysis Details:

CAPT Jeff Kline provided the scenario for the LITMUS wargame. It is based around a fictional South China Sea scenario in 2030. In short, Natuna Besar, Indonesia has been occupied and surrounded by Chinese forces. American and allied forces plan to both attrite the enemy Chinese naval forces and deny resupply to the island to force a withdraw by the occupying forces without the need to conduct an amphibious assault of Natuna Besar. This last option would involve numerous casualties and therefore is a last resort.

The Data Collection and Management Plan (DCMP) focused data collection on four phases of the wargame (Figure 1). The Initial Brief and Questions phase queried all participants if they had any questions about what was asked of them after review of the player read-ahead packet and in-brief. The Familiarization phase captured players' initial impressions of the game and user interface. Data collectors focused their efforts on recording the players' questions and the requested user controls not yet present in the wargame environment. The Wargame phase consisted of players executing the wargame as RED and BLUE players with the South China Sea scenario objectives. This phase allowed data collectors to capture in-game player recommendations and answers to the proposed tactical questions during the real-time conduct of the wargame. Finally, the Post-Wargame phase offered players the opportunity to summarize their impressions of the wargame, provide surface warfare officer insight into the tactical questions, and recommend prioritization efforts for the software developers.

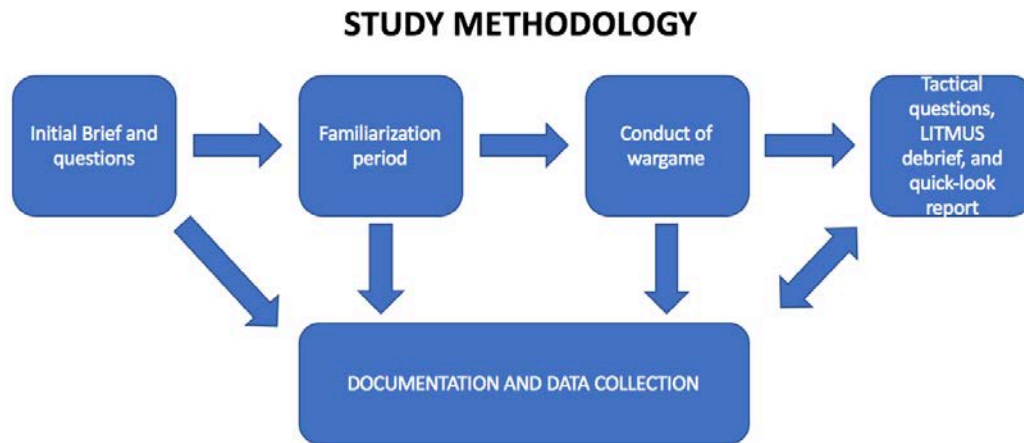


Figure 1: Study Methodology. There were four different phases throughout this wargame. All periods collected data that furthered the study goals and objective.

5. Key Constraints, Limitations, and Assumptions.

Constraints:

- The wargame utilized the LITMUS program as the primary analytical adjudication tool
- The scenario was based upon the fictional South China Sea 2030 environment

Limitations:

- LITMUS did not utilize classified sensor and weapon capabilities; however, further LITMUS developments will provide the capability in the future
- Wargame players were Surface Warfare Officers with adequate knowledge of surface doctrine, but limited knowledge of air warfare doctrine.
- Wargame players had limited knowledge of the capabilities and employment strategies for the MDUSV

Assumptions:

- LITMUS software programmers assisted in scenario development and user interface enhancements
- Sensor, weapon, and ship capabilities were not doctrinally accurate and were programmed from unclassified source data to allow for focus on the primary wargame objective of LITMUS assessment

6. Findings/Recommendations.

The LITMUS Wargame has the potential to become an extremely useful tool for the U.S. Navy. Despite wargame shortcomings with the current LITMUS user interface and limited tactical analysis due to the unclassified nature of this proof-of-concept demonstration, the players were impressed with the simplistic and fun nature of the software. Additionally, the players are excited to see the LITMUS wargame development continue and be used throughout the fleet for junior officer professional development and as a training tool that doesn't require extensive setup and resource requirements.

LITMUS Software Improvements (High Priority):

- LITMUS and UNITY user guide. The developers should make it a priority to create and maintain a user's guide for the LITMUS program. This should contain both important scenario development steps and how to operate the system during a wargame environment.
- Selection of multiple agents. At this time, LITMUS does not allow for the user to select multiple agents at the same time. Therefore, it is very difficult to set up a formation of ships or aircraft and direct them to perform a specific mission. In order to direct a group of ships to perform a certain mission, the user must individually direct them, which takes much more time and introduces potential for error. The recommended fix is to allow multiple ships to be selected and change their individual data together, such as the EMCON status. This could take the form of a command window, which would allow a group of ships to be selected, grouped into a formation, and given commands together.
- Currently, LITMUS uses preloaded target precedence to select what asset should be engaged. While the user fires the weapon systems, there is no capability for the user to select the enemy unit to engage. The recommended implementation is an interface where the user selects the firing unit, the unit to be engaged, the weapon system, and the number of salvos.
- Indicating range on client machine and compass improvement. The server has the ability to display the range from one entity to another. However, there is no such capability on the client machines. It is strongly recommended to provide either a scale or a grid reference (latitude and longitude) on the client machines to make range estimation much easier. As a follow-up to this topic, the compass should have a "North" indicator for reference.
- White cell control over game. At this time, the white cell cannot perform injects into the game without the interface crashing. There needs to be a capability for the white cell to provide injects to the scenario, such as destroying an entity or bringing an entity back to life. Also, the white cell should be able to interact with the ships while the game is ongoing without crashing the system.

LITMUS Software Improvements (Low Priority):

- Selection of team at UNITY startup. At this point in the development, the clients are able to select and control all entities in the game, regardless of the side they play (Chinese or United States). The game treats each side interchangeably. Therefore, while the Wargaming team can tell each side to only control their specific ships, there is way to control this feature on the user interface. Therefore, the developers need to integrate a “side selection” tab before initializing the user interface. This should only allow the specific client to view the ships on their side. This will be very important in future developments of LITMUS.
- Defensive and offensive firing. Currently, the system offers two types of firing options to the user: automatic and manual. The automatic firing will engage an enemy entity whenever it is within range and the friendly ship has sufficient weapons. The manual firing waits for the user to actually fire. Part (3) above discussed the need to allow users to select targets for engagement. As an add-on point, the system should only allow for automatic firing for defensive actions, such as when a friendly ship is shot upon by an enemy ship. For all offensive situations, the program should only allow manual firing.
- Message box with updates. Currently, the user interface does not update the users with important actions that occur in the game. For example, having a message box display updates such as aircraft launch, destroying an enemy ship, or missile launch would greatly improve user awareness and flexibility during wargame play.
- Ship selection tab. The participants highly recommend modifying the ship selection tab on the right side of the user interface. They recommend two different options. First, remove the tab completely. Second, have a drop-down menu displaying ships, aircraft, or missiles. This would decrease clutter and improve overall awareness during gameplay.
- Chat capability from each client to white cell. It would be beneficial to allow computer chat directly from each client to the white cell. This will prove important when the players are not in the same room and therefore have difficulty communicating. Also, this allows instantaneous communication from white cell regarding scenario changes, such as increasing the time speed.
- Display waypoint tracks on client and server machines. The participants found it difficult to remember the track and waypoints they gave each ship. Therefore, it would be useful to display waypoint tracks for both the client and server machines.
- Pop up update of ship. The participants desired a pop-up notification when hovering over a friendly entity that showed a small amount of information, such as EMCON status, heading, and speed. This feature would allow the agent bar on the right to be removed and clean up the user interface.

Tactical Insights:

- How is the Zumwalt (DDG-1000) deployed?
 - The blue force utilized the DDG-1000 together with other units in the SAG. However, the blue side normally deployed the DDG-1000 to the front of the ship formation to utilize its improved stealth characteristic. However, this was limited by LITMUS’ capability to deploy the ships in a formation. Ideally, the wanted to deploy it at the front of the SAG formation. During the seminar discussion, the participants reinforced how the DDG-1000 should be employed at the front of a formation (approximately 15 miles in front of a formation) where it may utilize its stealth as an advantage, since this is one of the primary advantages it brings to the fight.

- When and what do blue and red (US and Chinese forces) launch to gain ISR and targeting?
 - The participants utilized their air assets primarily for ISR. Since both blue and red had fixed wing assets, these were primarily utilized at the beginning to find the enemy assets. For the blue, both F-35s from the LHA-6 and the MH-60s from the DDGs were used to provide increased levels of ISR while the ships stayed in EMCON A. Blue used the fixed wing to project ISR further than the helicopters could go. In addition, the DDG-1000 utilized their advanced sensors and their helicopter to provide ISR after air platforms were launched. Finally, the MDUSV was utilized, but its capability to provide ISR was somewhat limited due to the sensor configuration inside of the scenario in LITMUS. Red utilized their J-20s to make large, box-shaped patrol routes where the red player thought the blue forces were operating. In addition, he used smaller patrol routes with his helicopters to conduct ISR. Due to issues with LITMUS, targeting was only conducted with surface combatants and not with aircraft; this feature is being worked on by the developers. Participants reinforced the F-35s importance in gathering ISR during the post-wargame discussion because it may distribute real-time updates to all ships in the operation.
- What are typical flight profiles for airborne assets in this scenario?
 - Due to LITMUS' inability to analyze the flight profiles, this answer is rather limited. The players were unable to control the altitude or flight profile of the airborne assets inside of the user interface. Some of the aircraft were flying at appropriate altitudes, while others were flying at surface level. As stated in point two above, Red utilized a box-shaped patrol route for their J-20s to identify the ship locations. However, further development of LITMUS' user interface need to be conducted to fully analyze this question.
- At what times do combatants change EMCON status or modify formations?
 - The participants changed EMCON status for two major reasons in this scenario. First, aircraft often turned on emission for short intervals to identify targets in their area of operations and gain situational awareness for all friendly units. Ships also emitted in short intervals to gain situation awareness. Blue emitted primarily with their DDG-1000 due to its increased stealth.
- How are MDUSVs employed?
 - MDUSVs were used to provide both deception and radiate to identify enemy assets. During the wargame, players would move the MDUSVs away from their SAG in an off-axis manner and radiate along a given azimuth. This provides deception so the enemy thinks there are more ships present in an area than in reality. In real life, using link 16, an MDUSV may provide information about the area of operations to ships that are not emitting.
- If BLUE has a choice, do they attack RED surface action group (SAG) or the logistics group?
 - In this scenario, the blue force always attacked the red SAG first before the logistics group. This was partially due to the attack guidance built into the user interface of LITMUS, as participants could not select the targets they would engage (it was automatically selected by the system). In addition, the red logistics group was much further away than the red SAG; for both iterations of the wargame, the blue forces attacked the red SAG first.