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# Team 9: Logistics Battle Command Model

Baez, F.; Shockley, J.; Aylward, M.

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## TEAM 9 MEMBERS

MAJ F. Baez
*U.S. Army Training and Doctrine Command Analysis Center - Monterey, USA*

J. Shockley
*U.S. Army Training and Doctrine Command Analysis Center – Fort Lee, USA*

M. Aylward
*Marine Corps Combat Development Command - Quantico, US*

## INTRODUCTION

Several joint and service concepts recognize that the future Joint Force may need to be supported from the Sea Base. Furthermore, the future Joint Force envisions routine delivery of supplies and equipment from the Sea Base by unmanned aerial assets. Currently, unmanned aerial systems (UAS) provide an array of aerial sensors and a means of delivering munitions to distant targets with no risk to operators. However, there is very few cargo UAS developed and deployed on operations that are able to distribute commodities. Since they could contribute to improving force protection and enable the reduction of inventory for certain commodities, there is merit in developing the capability further. To address this required capability, the Marine Corps Combat Development Center (MCCDC) is exploring various options for future USMC needs for aerial logistics to support sea based distributed operations, essentially, to identify the system design requirements for future cargo UAS.

## IDFW18 OBJECTIVES

This working group overall objective for IDFW18 was to explore the use of the Logistics Battle Command (LBC) model, a new battle command simulation developed by TRAC-Monterey, combined with experimental design techniques to identify significant factors and provide insights for the assessment of various options for future USMC needs for aerial logistics support. Essentially, the intent was to determine the types of operational insights that LBC can provide—specifically, in terms of quantifying the impacts of cargo UAS capabilities on sea based distributed operations.

Particularly, the specific objectives of Team 9 sessions during IDFW18 included:

1. Implement the scenario in LBC.
2. Choose the input parameters and measures of effectiveness (MOE).
3. Develop the experimental design to examine factors of interest to issues of analysis.
4. Execute model production runs.
5. Analyze the simulation output.

## LBC MODEL

The LBC model is a low-resolution, object oriented, stochastic, and discrete event model programmed in Java and incorporates Simkit. LBC functionality includes planning and decision support features to enable a simulated sustainment decision maker to monitor the LCOP, forecast demand for most classes of supply, and initiate and adjust missions to distribute supplies and perform sustainment functions. LBC model uses network architectures to represent the distribution pipeline to summon sustainment planning and execution representing the end-to-end flow of resources from supplier to point of consumption.

LBC model uses nodes and arcs to represent the different networks of the distribution system. LBC model accomplishes this through three layers of network representation are the transportation, communications, and planning networks. First, the transportation network links LBC model to the physical area of operations representing the geographical distribution of supplies, and allows for dynamic route planning. Second, the communications network represents an arbitrary complex communications network of the distribution system linking leaders and soldiers to all applicable stakeholders including the LCOP. Last, the planning network represents the data of the distribution system information network.

Due to time constraints of IDFW18 and for simplicity, the vignette for this effort was implemented in LBC taking advantage of some LBC functionalities, essentially implicit representation of the transportation network and planning network.

## VIGNETTE

The vignette modeled is one of sea based distributed operations in support of maneuver forces. These operations support persistent sustainment deliveries of class I, III, and V from the Sea Base to forward operating bases. The vignette assumed a 30 day operation with random consumption of the aforementioned classes of supply. The vignette built on LBC was designed to assess the ability to support maneuver forces given two different alternative or platforms to deliver commodities.

The two alternatives of interest are: ground convoys (base case) and cargo UAS (cargo UAS case). The base case represents ground resupply convoys of all commodities required by maneuver forces to increase their stock levels to the desired level of three days of supply (3DOS). Conversely, the cargo UAS case aerial represents aerial resupply missions of a single type of commodity required by the maneuver forces to increase its stock level to the desired level of 3DOS.

## MEASURES OF EFFECTIVENESS

The second objective addressed was the development of MOEs. The three primary MOEs of interest developed are velocity, capacity, and rate. Velocity is expressed as the mean time to resupply maneuver units which includes requisition time and receiving resupply for each option of delivery platform. Capacity describes the limits of capabilities that can be supported from the Sea Base and is driven by the functional limitations of each option of delivery platform. Rate represents the rate of the resupply mission that flow from Sea Base for each option of delivery platform. These MOEs were derived directly from the concept specific attributes listed in the Joint Logistics (Distribution) Joint Integrating Capabilities (JIC) (2006) and Seabasing JIC (2005).

| | | | | | |
|---|---|---|---|---|---|
| **low level** | | **1** | **5** | **150** | **0** |
| **high level** | | **12** | **12** | **4000** | **1** |
| **decimals** | | **0** | **3** | **0** | **3** |
| **factor name** | **DP** | **Platforms Available** | **Platform Endurance (hrs)** | **Platform Payload (lbs)** | **P(Successful Resupply)** |
| | 1 | 4 | 12 | 3278 | 0.375 |
| | 2 | 2 | 6.75 | 3519 | 0.563 |
| | 3 | 2 | 8.063 | 391 | 0.25 |
| | 4 | 3 | 9.375 | 1353 | 1 |
| | 5 | 9 | 11.563 | 1834 | 0.125 |
| | 6 | 12 | 7.188 | 1594 | 0.813 |
| | 7 | 8 | 6.313 | 4000 | 0.313 |
| | 8 | 7 | 11.125 | 3038 | 0.938 |
| | 9 | 7 | 8.5 | 2075 | 0.5 |
| | 10 | 9 | 5 | 872 | 0.625 |
| | 11 | 11 | 10.25 | 631 | 0.438 |
| | 12 | 11 | 8.938 | 3759 | 0.75 |
| | 13 | 10 | 7.625 | 2797 | 0 |
| | 14 | 4 | 5.438 | 2316 | 0.875 |
| | 15 | 1 | 9.813 | 2556 | 0.188 |
| | 16 | 5 | 10.688 | 150 | 0.688 |
| | 17 | 6 | 5.875 | 1113 | 0.063 |

**Table 1: NOLH Design**

## DESIGN OF EXPERIMENTS

A Nearly Orthogonal Latin Hypercube (NOLH) design was constructed (See Table 1) to develop several experiments based on a range of inputs for five factors. The factors considered are platforms available for resupply missions, platforms endurance, platform payload, and probability of successful delivery of goods. For simplicity, the factors were considered continuous and integer.

## RESULTS

Examination of the data sets revealed that the simulation did not provide meaningful insights to address the issue of analysis. One clear observation is that it would be required to utilize the three networks of LBC (i.e. transportation network, communications network, and planning network) in order to refine the vignette, which in turn would provide a better level of abstraction of distributed operations in accordance with the two JICs aforementioned. In addition, is recommended to explore additional factors for the assessment of cargo UAS and their impact on operational logistic support.

## CONCLUSIONS

The work accomplished throughout IDFW18 was valuable. Team 9 participants developed a scenario, MOEs, and DOE to measure the impact of cargo UAS using LBC to support of MCCDC research. Further, throughout the working week substantial revisions and expansions of LBC were accomplished to improve the functionality and usability of the model as a data farming and analysis tool for the operational vignette of interest.