Next Generation Logistics Ships (NGLS): Refuel

Naval
Postgraduate
School

Abstract

The purpose of the project is to conduct independent research to determine the optimal types and quantities of next generation logistics ships (NGLS) required to meet future intra-theater survivable logistics demand. This research addresses these requirements through the logistical lens of refueling. Capabilities and limitations have been identified via top-level requirements necessary to meet the future joint naval concepts of distributed military operations, littorals in a contested environment, and expeditionary advanced base operations. Research in support of the NGLS force analysis is centered on capacity, capability, employment, and distribution. This research assumes that commodities will be required both afloat and ashore in contested regions. The project uses elements of literature review and modeling to determine the optimal type and quantity of platforms capable of meeting the forecasted demand. This research recommends an optimal solution focused on minimizing the number of resupply missions within the contested regions. The project expands on potential information and bias gaps that may have been overlooked by the project sponsor at Office of the Chief of Naval Operations (OPNAV) N4.

NGLS Family of Vessels: LAW, PSV, & FSV

Methods

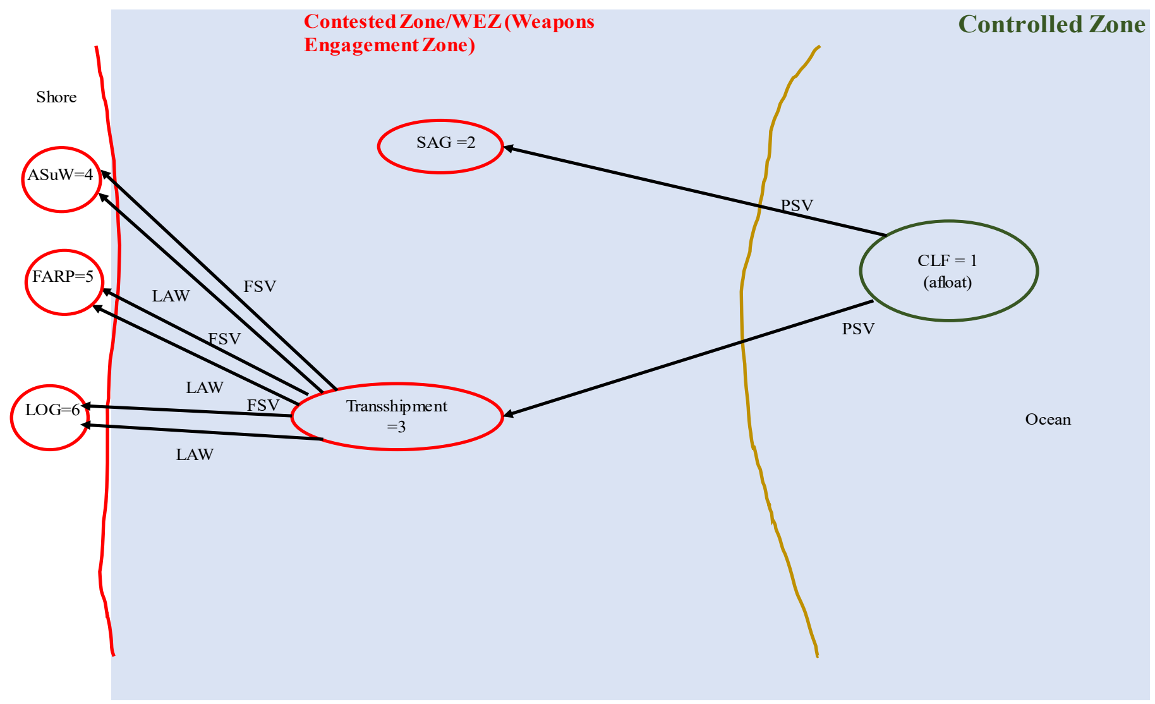


Figure 1

Node	Fuel Demand per Resupply Event
SAG1	18,250
SAG2	18,165
ASuW	100
FARP	6,300
LOG	100
Units: bbl (1 bbl = 42 U.S. gallons [159 L])	

Table 2

Vessel	Threshold (T) Total Capacity	Objective (O) Total Capacity	Threshold (T) Delivery Capacity	Objective (O) Delivery Capacity
PSV	18,000	28,000	5,260	10,520
FSV	950	1,400	950	1,400
LAW	2,100	2,100	1,700	1,700
Units: bbl (1 bbl = 42 U.S. gallons)				

Table 1

In collaboration with our advisors, Dr. Apte and Dr. Doerr, we developed a transshipment model with an objective function designed to minimize the number of deliveries necessary to support an aggregate resupply event. The end state goal was reduction of mission risk through the minimalization of deliveries within the WEZ. Figure 1 gives a visual representation of the model. The threshold (T) and objective (O) capacity of JP-5 fuel for each vessel is depicted in Table 1. Total capacity represents the maximum storage capacity of the vessel; delivery capacity represents the maximum amount of fuel that can be transferred within the operational delivery time window. The demand requirements of each node were calculated per a single resupply event. A SAG has two variations: SAG1 is comprised of three DDGs and one LCS, while SAG2 represents three DDGs and one FFG(X). Only SAG 1 demand is represented in the model since it is the greater of the two and the variance did not result in a material difference. The ashore nodes of ASuW, FARP, and LOG node remain constant. Demand at each node is represented in Table 2. The figures listed in Table 2 are for a single resupply event, and in order to forecast maximum operational tempo, the model is built to service all demand simultaneously.

Results

Results are presented in four main categories: 1) deliveries with (T) capabilities- constrained, 2) deliveries with (O) capabilities- constrained, 3) deliveries with (T) capabilities- unconstrained, and 4) deliveries with (O) capabilities- unconstrained. As stated previously, (T) specifications establish the lower bounds of acceptable performance, whereas (O) specifications set the upper bounds. Our findings show that the number of deliveries vary significantly based on the TLR level and the constraints of the environment.

- As shown in Figure 2, the maximum number of deliveries, 12, occurred when the vessels were modeled at their (T) capabilities and bound by a time constraint. The minimum number of deliveries, seven, occurred when the vessels were modeled at their (O) capabilities and not bound by an operational time constraint. The difference between the max and min results equates to an approximate 42 percent decrease in number of required deliveries.
- As stated previously, delivery requirements vary substantially based on the combination of TLR capabilities and the operating environment. These changes measured as the difference in delivery capacity between scenario are depicted in Table 3. For example, the PSV's delivery capacity increased 432% from 5,260 bbl at (T) constrained to 28,000 bbl at (O) unconstrained ((28,000 - 5,260) / 5,260 = 4.32). Conversely, the FSV and LAW experienced a lesser 47% and 24% delivery capacity improvement from the lower to upper bound.

The summary findings in Figure 2 and Table 3 provide OPNAV with valuable planning and forecasting information. Figure 6 is instrumental in identifying the upper and lower bounds of deliveries across all scenarios, whereas Table 7 highlights the variances in TLR trade space based on the operating environment.

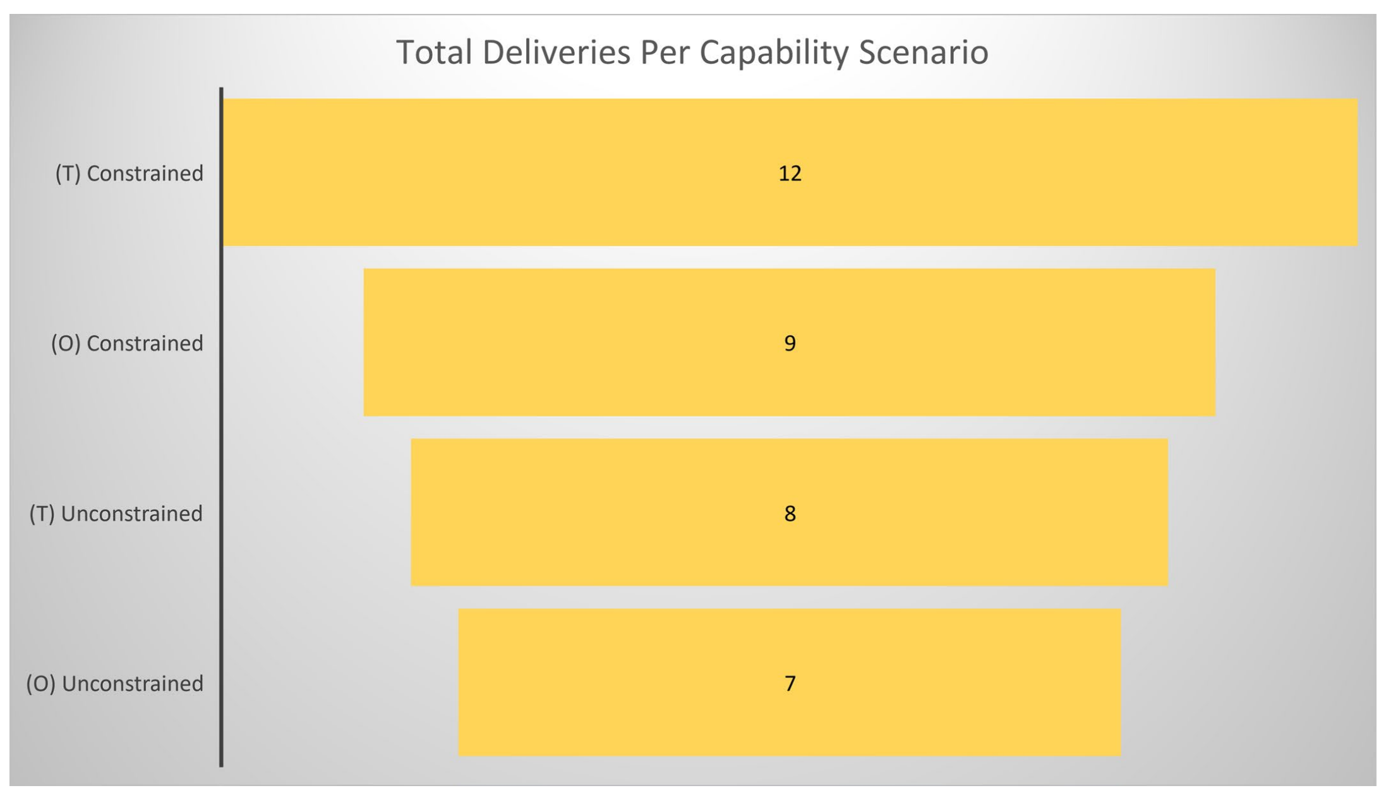
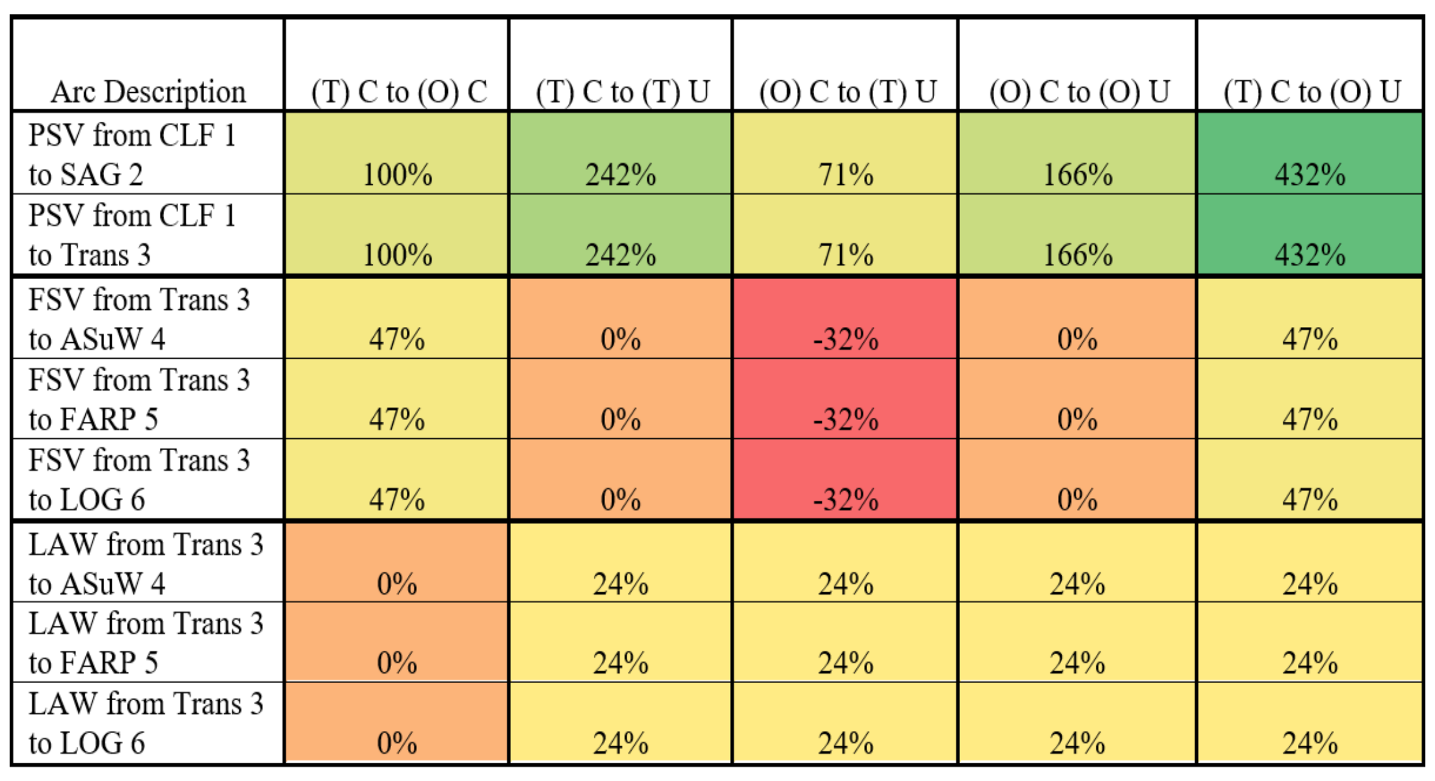


Figure 2



Arc Description	(T) C to (O) C	(T) C to (T) U	(O) C to (T) U	(O) C to (O) U	(T) C to (O) U
PSV from CLF 1 to SAG 2	100%	242%	71%	166%	432%
PSV from CLF 1 to Trans 3	100%	242%	71%	166%	432%
FSV from Trans 3 to ASuW 4	47%	0%	-32%	0%	47%
FSV from Trans 3 to FARP 5	47%	0%	-32%	0%	47%
FSV from Trans 3 to LOG 6	47%	0%	-32%	0%	47%
LAW from Trans 3 to ASuW 4	0%	24%	24%	24%	24%
LAW from Trans 3 to FARP 5	0%	24%	24%	24%	24%
LAW from Trans 3 to LOG 6	0%	24%	24%	24%	24%

Table 3

Acquisition Research Program
Graduate School of Business & Public Policy

www.acquisitionresearch.net

Barry Loseke, Captain, USMC
Kevin Yarnell, Captain, USMC

Advisors: Dr. Aruna Apte
Dr. Uday Apte
Dr. Ken Doerr