



Modeling Contested Logistics in Distributed Operations

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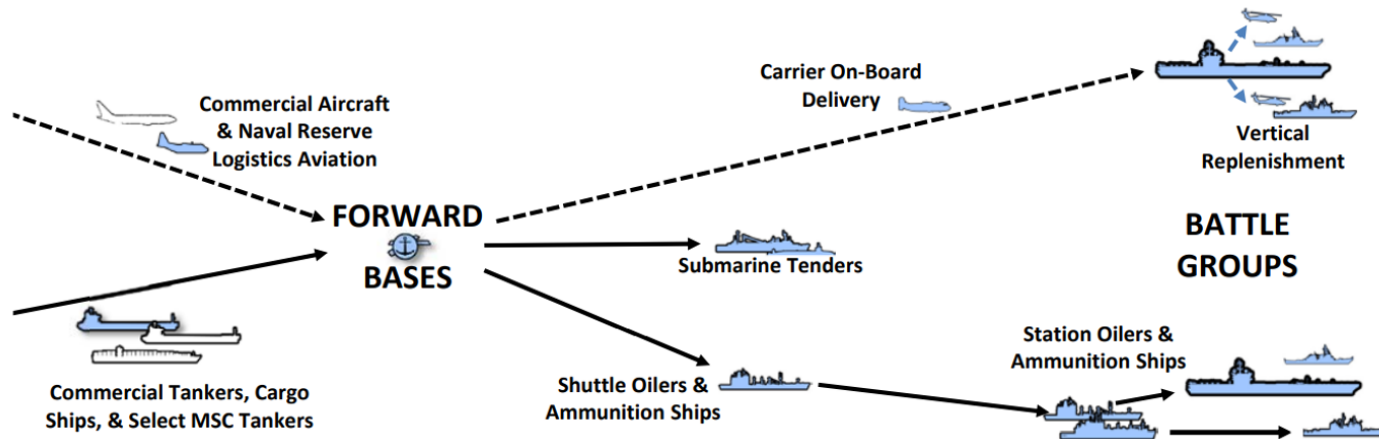
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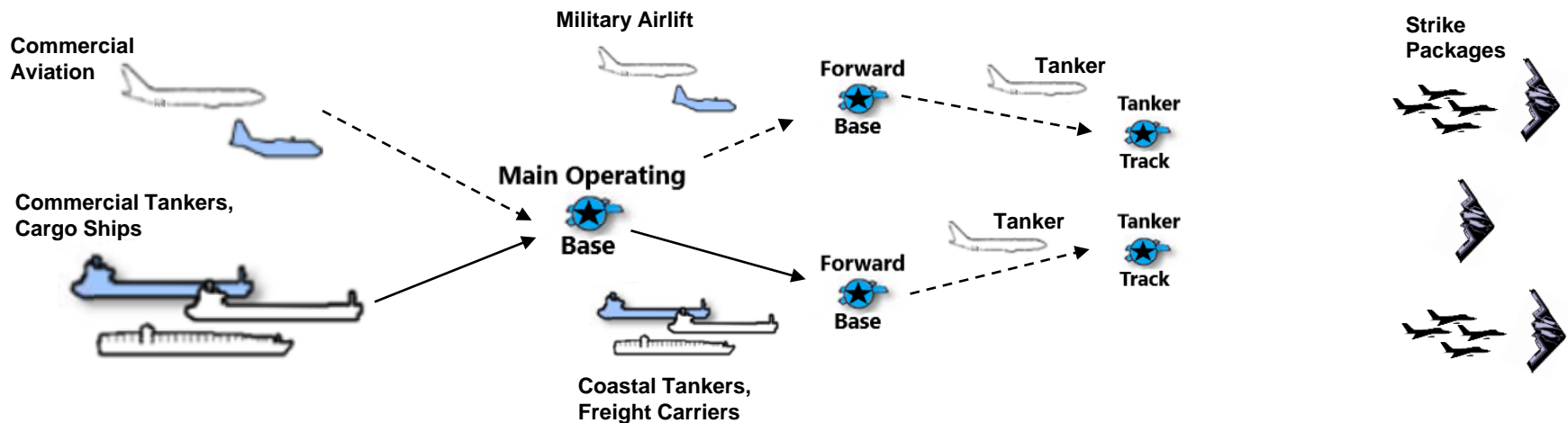
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30 October 2023

Overview of Operational Logistics



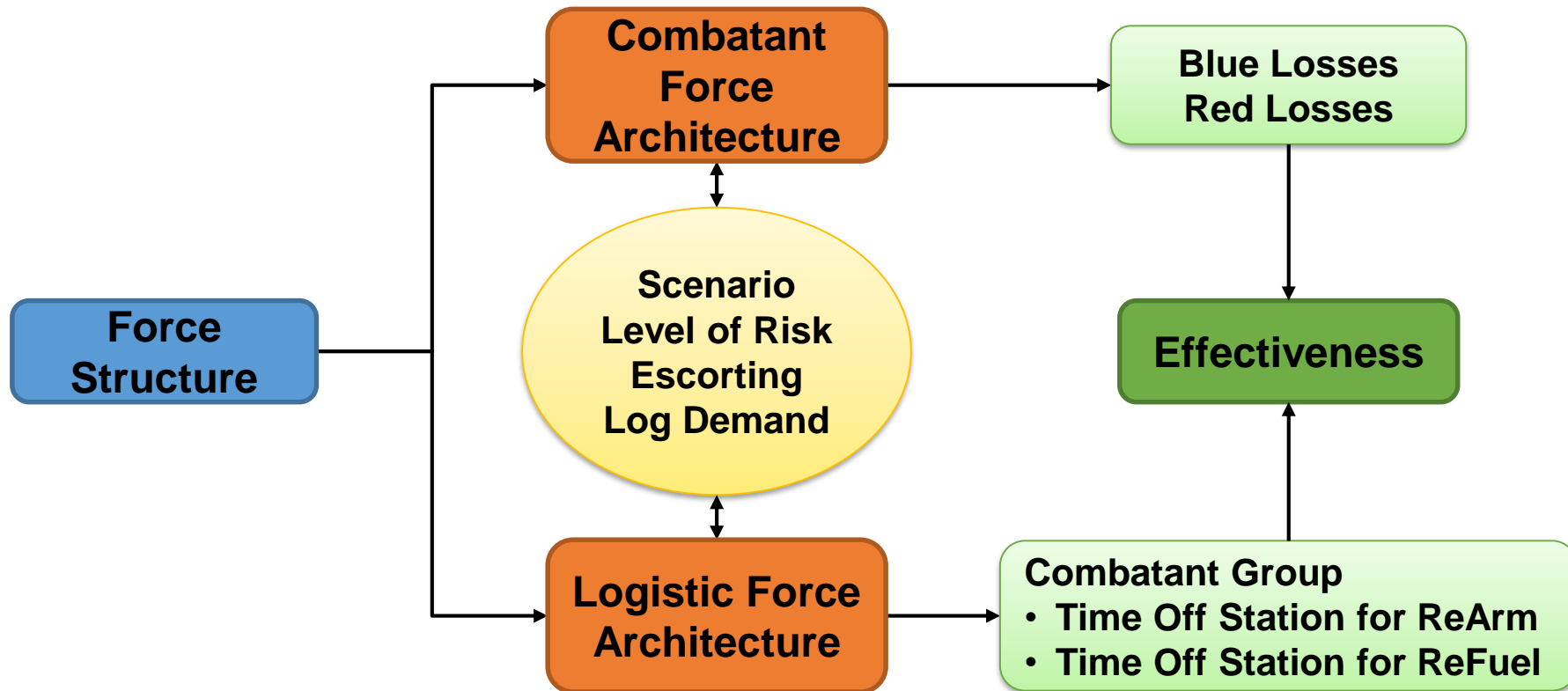
Navy's fleet logistics concepts principally revolve around supporting concentrated Carrier Strike Groups (CSGs), Amphibious Ready Groups (ARGs) and other naval forces. Also applicable to other Services.



Operational logistics is a hub and spoke based model.

Logistics in a Contested Operations

Problem: Operational logistics not being adequately modeled in campaign analysis despite being driver in combat performance.



"Logistics ... as vital to military success as daily food is to daily work."
- Capt. Alfred Thayer Mahan, Armaments and Arbitration, 1912

Agenda

- **Maturation of Logistics Analysis**
- **Logistics Demand**
- **Supplying Logistics to meet Demand**

Incorporation of Logistics in Analysis

Future Surface Combatant Force (FSCF)
Analysis of Alternative (AoA)
(2017-2019)

- Measure stress on combatant force to protect logistics force.
- Determined logistics is important to campaign analysis.

Future Surface Combatant Force (FSCF)
Logistics Excursion (2019-2020)

- Measured effectiveness by examining Red & Blue losses.
- Logistics analysis limited to fuel consumption.
- Determined all aspects of afloat logistics needed to be examined.

Future Afloat Logistics Force (FALF)
Initial Capabilities Document (ICD) (2020)

- Examined demand across all five R's (Refuel, Resupply, Rearm, Repair and Revive) of logistics.

Next Generation Logistics Ship (NGLS)
AoA (2021-2023)

- Improved afloat logistics operations to ensure support to combat force was logistically feasible.
- Assumed that ashore infrastructure was in place with adequate quantities of all commodities.

Advanced Naval Base Analysis
(2023-2024)

- Improved ashore logistics operations to examine if investments in infrastructure are adequate to support the combat force.

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- **Maturation of Logistics Analysis**
- **Logistics Demand**
 - Nodal Analysis of Logistics
 - Fuel Demand
 - Ordnance Demand
- **Supplying Logistics to meet Demand**

Nodal Analysis of Demand Across the Force

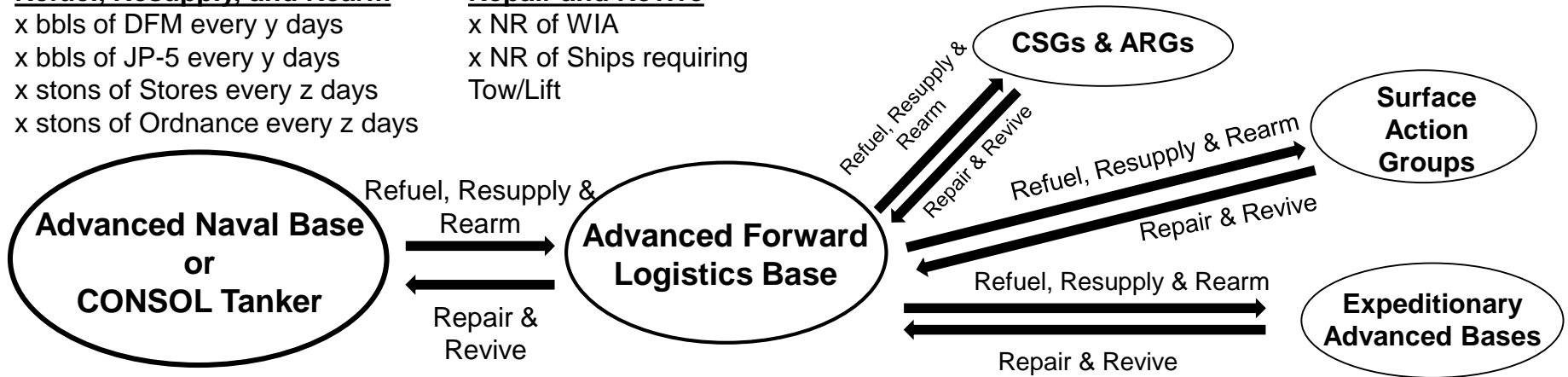
Across all 5Rs of Logistics

Refuel, Resupply, and Rearm

x bbls of DFM every y days
 x bbls of JP-5 every y days
 x stons of Stores every z days
 x stons of Ordnance every z days

Repair and Revive

x NR of WIA
 x NR of Ships requiring
 Tow/Lift



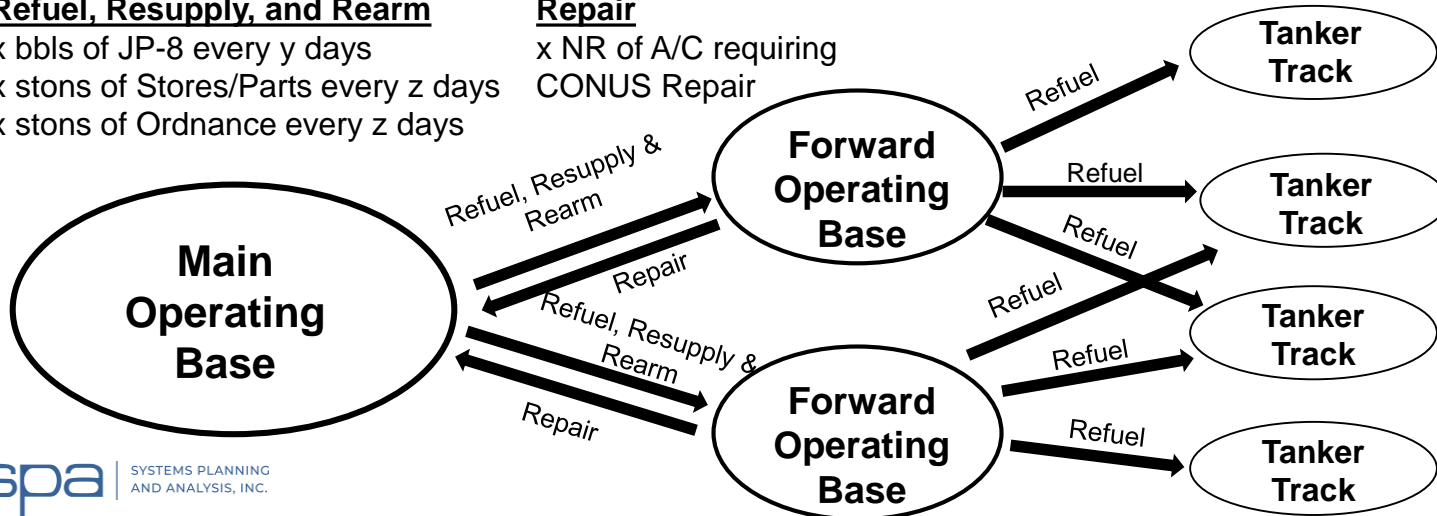
Across 4Rs of Logistics

Refuel, Resupply, and Rearm

x bbls of JP-8 every y days
 x stons of Stores/Parts every z days
 x stons of Ordnance every z days

Repair

x NR of A/C requiring
 CONUS Repair



Concurrent tanking mission support could include:

- Strike
- CAP
- Nuclear Alert
- Navy/MC tanker support

Nodal Analysis of Logistics – Supply & Demand

Modeling Demand

- Force structure. Size of force and force generation models.
- Commodities (Fuel, Food and Stores, Ordnance, Repair Parts).
- Demand over time.

Modeling Supply

- Force disposition and laydown of logistic hubs.
- Speed, capacity and commodity transfer rates of Logistics Force.
- Commodity safety level, daily usage rate, and storage capacity of each ship determine the periodicity required for logistics support.

Turn Around Time

- Speed of Logistics Force
- Distance to transfer point from resupply location
- Transfer times



Revisit Rate

- Capacity of customer
- Usage rate of customer
- Commodity Safety Level
- Capacity of Logistics Force



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Dynamic Maneuvering - Fuel

Forces have two states – Maneuver or *Stationary* (MODLOC)

Maneuver

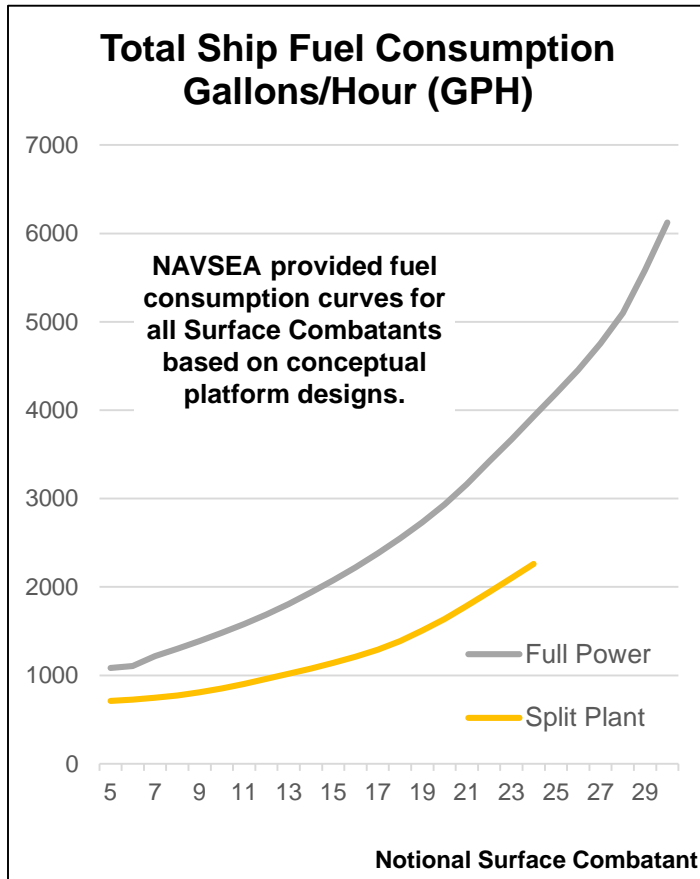
- Surface Action Groups (SAGs) and Carrier Strike Groups (CSGs) change location every couple of days at random time.
- Use dynamic maneuvering based on the composition of the group to ensure group force protection.

MODLOC

- MODLOC is the more important of the two states since the ships spend the majority of the time in this state.
- Although stationary, maneuvering is dynamic and must be as specific as possible.

Modeling Thresholds

- CSGs and SAGs return to refuel when low on aviation fuel (group) and/or Diesel Fuel Marine (DFM) (lowest single ship)



Level of fidelity important for modeling logistics – model explicitly or use planning assumptions.

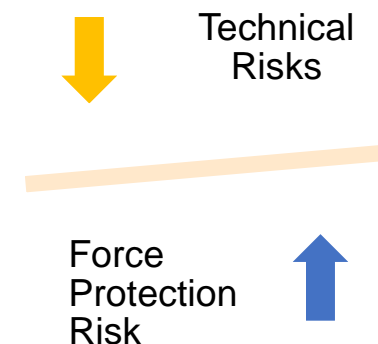
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Ordnance Modeling

- Campaign modeling ideal for modeling ordnance:
 - Varies over time because pace of conflict is not constant.
 - Varies by location due to the threat.
 - Fidelity of campaign analysis dependent on the level of detail in mission level analysis.
- Deterministic modeling of ordnance is difficult because of the variation by time and location. To resolve:
 - Requires an examination of previous campaign analysis.
 - Business rules based on the function of the combatant.
 - Complicated by platforms utilizing multiple weapon systems.
- Consumption drives off station time to reload.
 - Closer rearm location results in the less time off station but greater risk to the force.
 - Solution must balance technical risk with force protection risk.

Rearming Considerations



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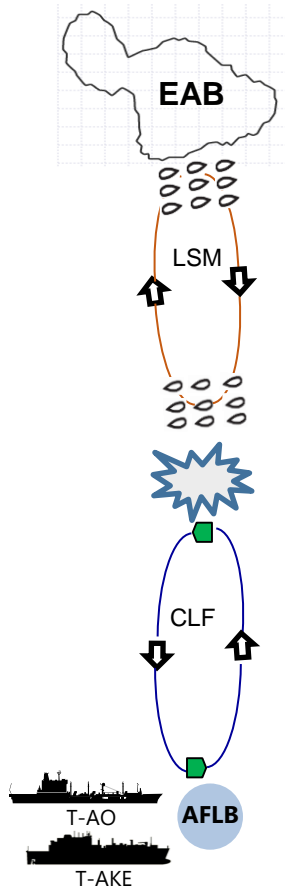
Logistics Employment (Understanding the Customer)

Ice Cream Truck COA

All LSMs meet with one shuttle Combat Logistics Force (CLF) every X days.

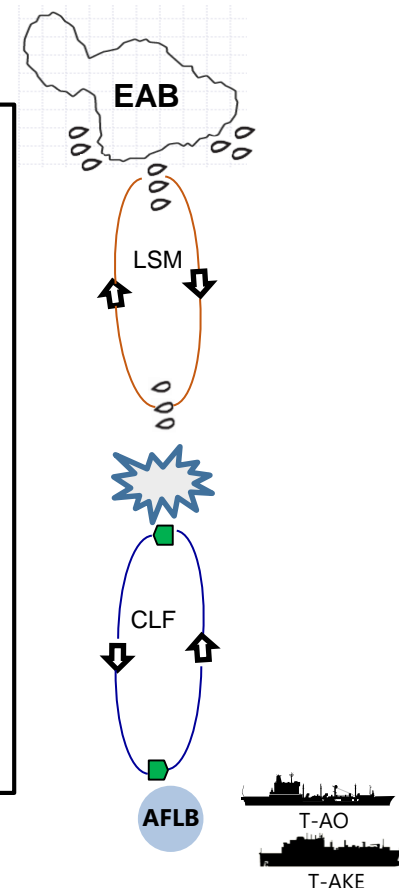
A variety of specialized LSMs COA or I'll go out for the rest of us COA

CLF service resupply LSMs with shuttle CLF. LSMs then return to EAB to service LSMs at EAB.



Issues:

- Customer demand and operations drive logistics force design.
- Location of the transaction point drives force structure – more LSM or more logistics force?
- Understanding capability important to meeting customer needs.
 - Support to shore – is there an intermediate connector?
 - Can refueling and crane operations happen concurrently?

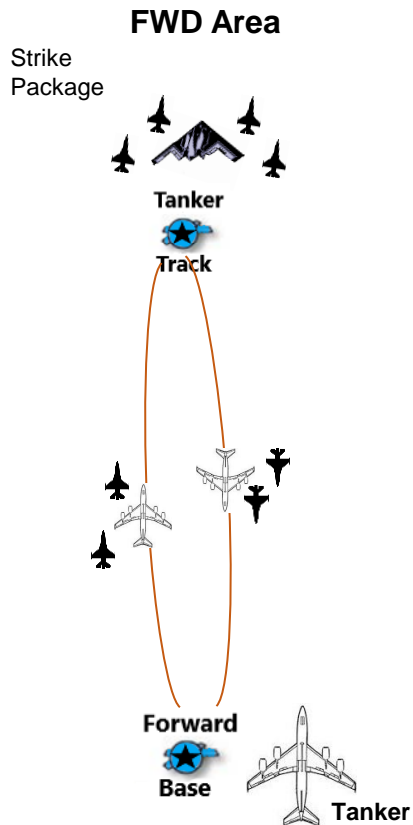


CLF (reFuel/reSupply/reArm)

Logistics Employment (Level of Risk vs Combat Effectiveness)

Home Delivery COA – Periodic Supply

Logistics force goes all the way to combat element in the forward area.

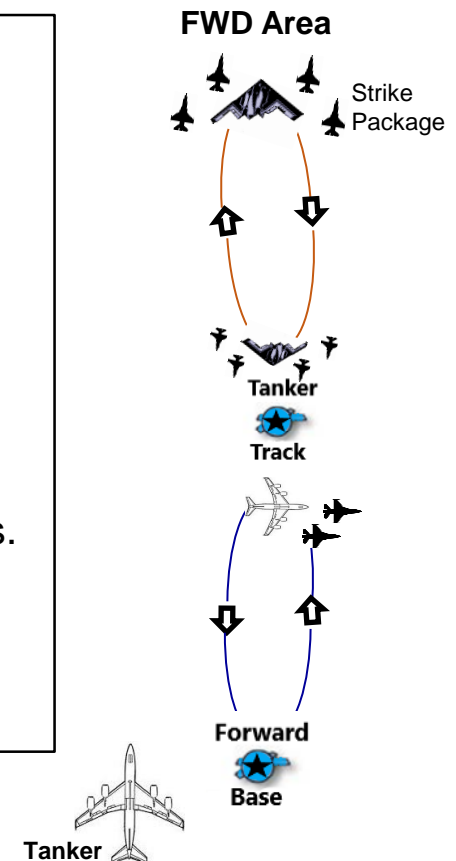


Issue:

- Measure of Performance (MoP) vs Measure of Effectiveness (MoE).
 - Location of transaction could drive combat effectiveness.
 - Time off station to refuel/resupply means less time in contested area for combatants.
- Logistics is a Zero-Sum Game, the location of transaction drives logistics force structure:
 - Extended distances result in more logistic forces.
 - Farther into contested area will result in:
 - Greater attrition to logistic forces.
 - More risk to combat force. Need adequate defensive capability to return to low risk area.

Meet Me Halfway – Episodic Supply

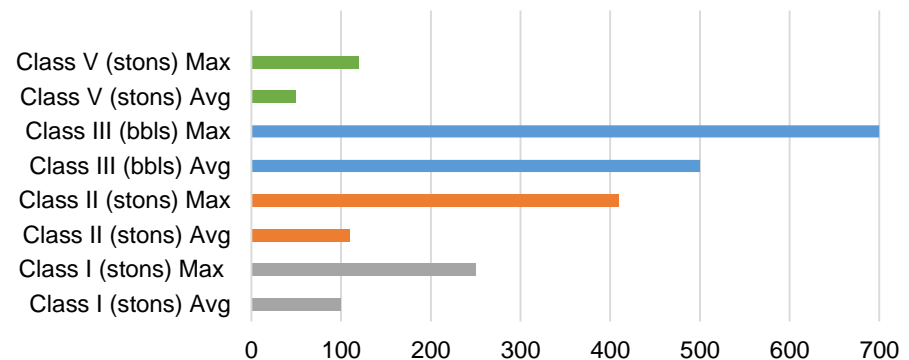
Combatant element comes off station to meet logistic force.



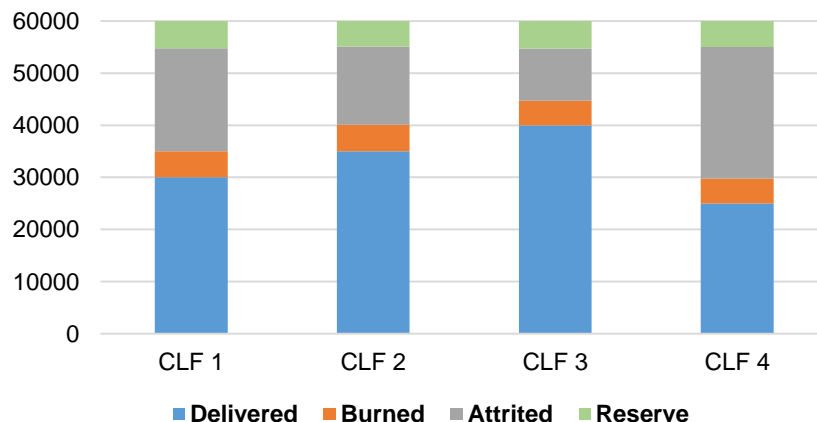
Logistics in Force Level Modeling

- Logistic feasible - logistics had to be scheduled in the model to fully support forward force over entire duration of operation.
- Different phases of operations changed the location and composition of the blue force required logistics force to be conduit for transition.

Shore Node - Daily Throughput



Afloat Logistics - Total DFM (bbls)



- Force level model allows for sustainability and fragility of logistics to be examined through a variety of CONOPS and assumptions.
- Modeling entire theatre of operations can determine the capability and capacity of the logistics infrastructure – both afloat and ashore.

"Bitter experience in war has taught the maxim that the art of war is the art of the logistically feasible." - ADM Hyman Rickover, USN

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- Maturation of Logistics Analysis
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- Supply Logistics to meet Demand
- **Lessons Learned**

Lesson Learned in Contested Logistics

Operational logistics is essential to modeling combat performance in campaign analysis since it enables the combat force.

- Adequate logistic support enables combat forces to remain on station which results in more forward presence to affect red force actions.
- Having too few logistics or not adequately protecting logistics results in combat forces having to come off station which results in fewer red force losses.
- Effectiveness of blue concept of operations against assumed red actions can be measured when campaign analysis is employed.
- Force level analysis provides the means to assess the ability of logistic nodes to sustain the force based on the required capacity and throughput capability.

"My logisticians are a humorless lot ... they know if my campaign fails, they are the first ones I will slay." – Alexander the Great



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