



NAVAL
POSTGRADUATE
SCHOOL

COMPAC J4 and OPNAV N4
Logistics System for
Distributed Maritime Operations

TEAM TIGER

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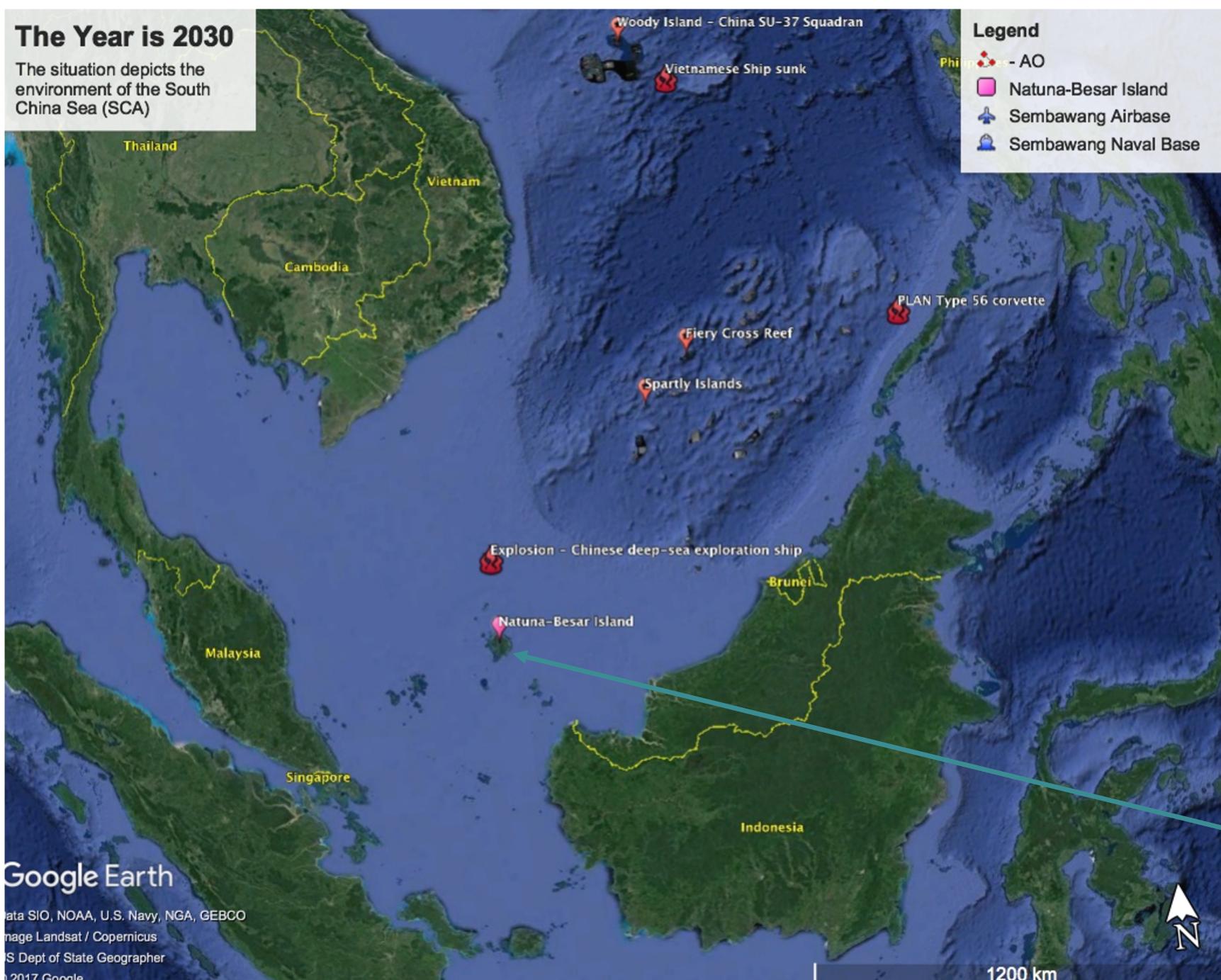


- Overview
 - Situation
 - Tasking
- Bottom Line Up Front
- Development of Models
 - Assumptions
 - Concept of Logistical Support
 - Analytical Tools and Measures of Effectiveness
 - Results
- Technical Injects
- Future Work

Situation

The Year is 2030

The situation depicts the environment of the South China Sea (SCA)

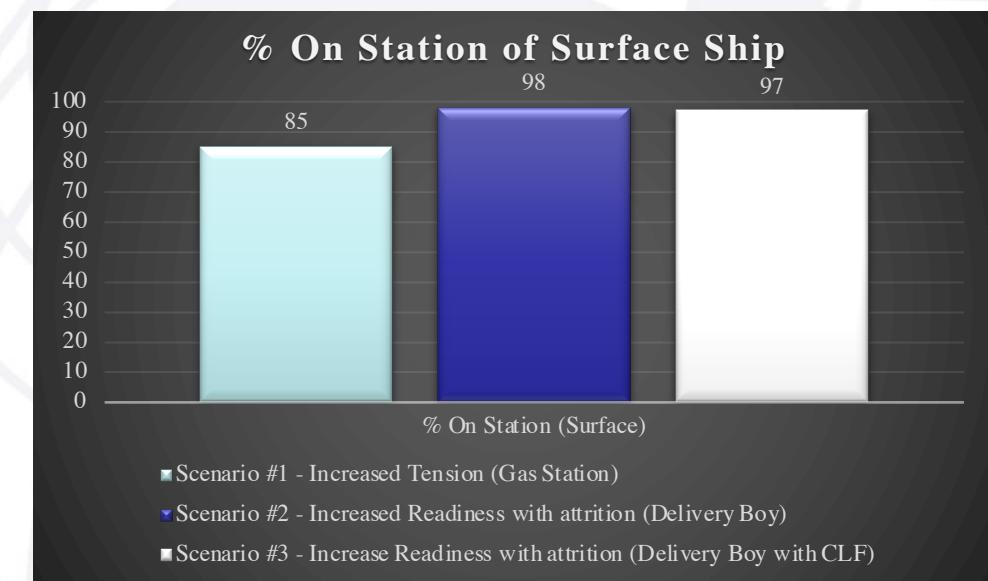
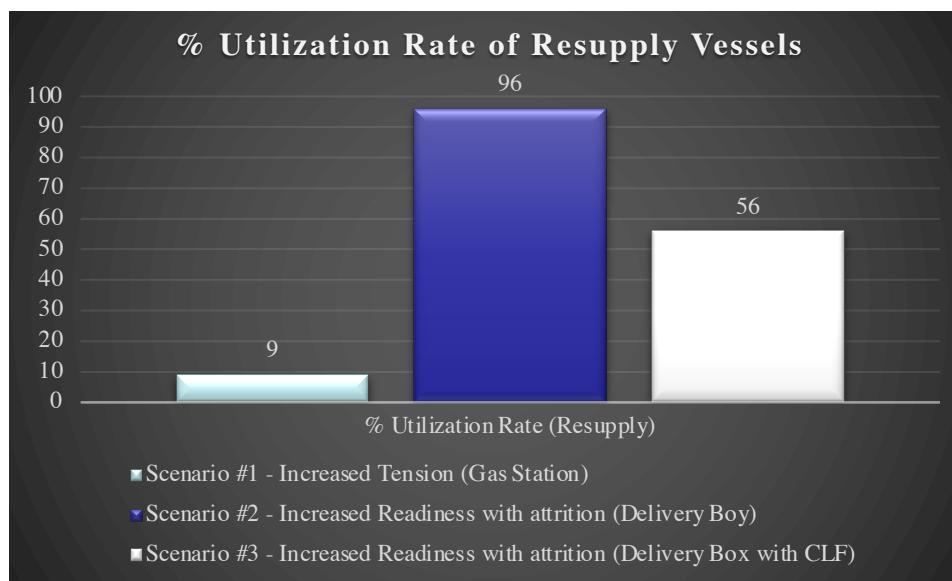


- The Chinese have threatened to assume governorship of the island of Natuna Besar to control the southern approaches to the South China Sea
- US and coalition forces have decided to intervene and deter attacks against Natuna Besar
- The mission of U.S. forces is to deter attacks against Natuna Besar and Palawan before landings can occur, by holding PLAN ships at risk



- Given a distributed maritime operations concept where contributions to sea control are made by joint, combined, and coalition partners – Fleet Tactical Grid
- COMPAC J4 and OPNAV N4
 - Design an expeditionary and distributed logistics system to support the distributed operations at sea
 - Maximize fuel and ammunition available
 - Minimize risk to logistics forces
 - Assess unconventional ideas such as the civilian afloat fuel commodities market

- One T-AOE and one T-AKE can support a Carrier Strike Group and two Surface Action Groups through the **gas station refueling method** during **operations with increased tensions** in the South China Sea.
- Two T-AOEs and two T-AKEs can support these same forces with **delivery boy refueling** during an **increased operational tempo**, but will be at a **94%** utilization rate, **unsustainable** for continuous operations.
- By adding two CLF-5000s to the logistics fleet, utilization of resupply ships drops to **56%**.





Assumptions

Geographic/Location Assumptions:

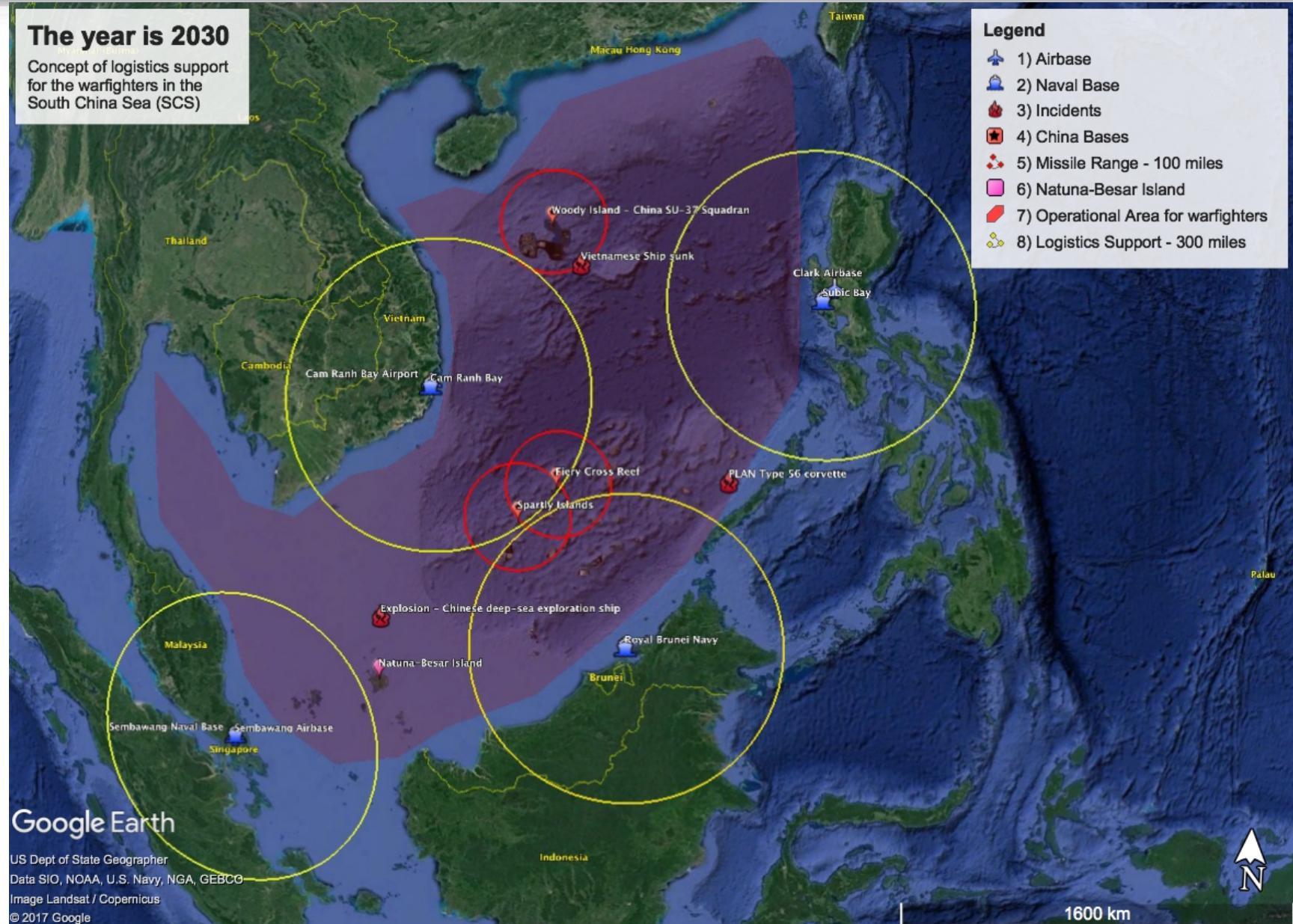
- US and coalition forces are defending and deterring attacks at Natuna Besar
- US Allies in region
 - Singapore
 - Sembawang Naval Base
 - Philippines
 - Subic Bay
 - Vietnam
 - Cam Rahn Bay
 - Brunei
 - Royal Naval Base

Logistics Assumptions:

- 7th Fleet as the baseline for demand
 - 1 x Carrier Strike Group (CSG): 1 x CVN, 3 x DDG, 1 x CG
 - 1 x Surface Action Group (SAG): 3 x DDG
 - 1 x Surface Action Group (SAG) : 1 x DDG, 2 x CG
- Re-supply of fuel and ammunition only
- Fuel consumption rate and ammo consumption rate remain constant in each scenario
- Time to resupply will be based on distance and amount of fuel/ammo needed
 - Surface ships signal for resupply at 75% fuel or ammo availability



Concept of Logistics Support





Analytical Tools and MOEs

- **Model Development:**

- Logistics Network
 - Incorporate Circulation Model
 - Built in *SimpleKit* using *Python* and analyzed data with *Excel* and *Python*

- **Simulation Parameters:**

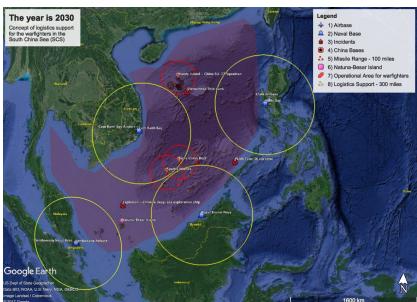
- Simulation was based on **60 days of continuous** operations with steady-state reached at **14 days**
 - Ships will be distributed randomly in the respective 'bounding box'

- **Measures of Effectiveness:**

- Consumption of surface ships
 - Fuel provided (barrels)
 - Ammunition provided (tons)
 - Utilization of Surface Ships
 - % of time on/off station
 - Utilization of Supply Ships
 - % of time ship is conducting resupply

Scenario

- Demand of logistic support
- Type of support (Gas Station vs. Delivery Boy)



Operational environment

- Increased tensions short of war
- Increased readiness operations

Means

- Type of resupply ships
 - T-AOE
 - T-AKE
 - CLF



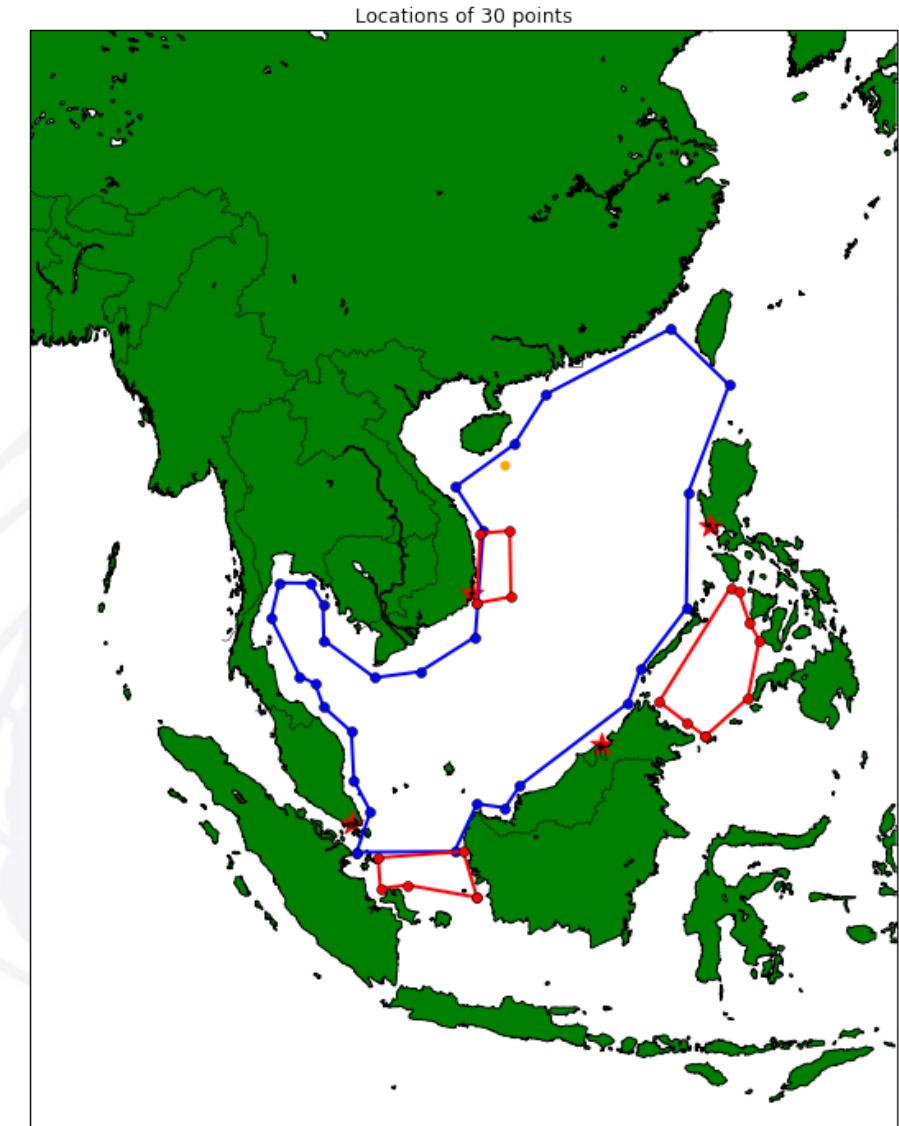
Simulation Scenario #1: Gas Station Refueling

Concept of Support - Gas Station Refueling:

- Increased tensions short of war
- Surface ships travel to secure resupply locations for refueling and rearming
- Variation of quantity of supply ships
 - Fast Support Combat Ship (T-AOE)
 - Lewis and Clark (T-AKE)

Assumptions:

- Surface ships are scheduled for resupply every 96 to 144 hours
- Once a resupply is scheduled, the surface ship is guaranteed to be resupplied
- Refueling locations are secure from enemy attack
- Resupply ships will resupply at the logistic base closest to the resupply area



Simulation Scenario #1: Gas Station Refueling

Logistics Demand

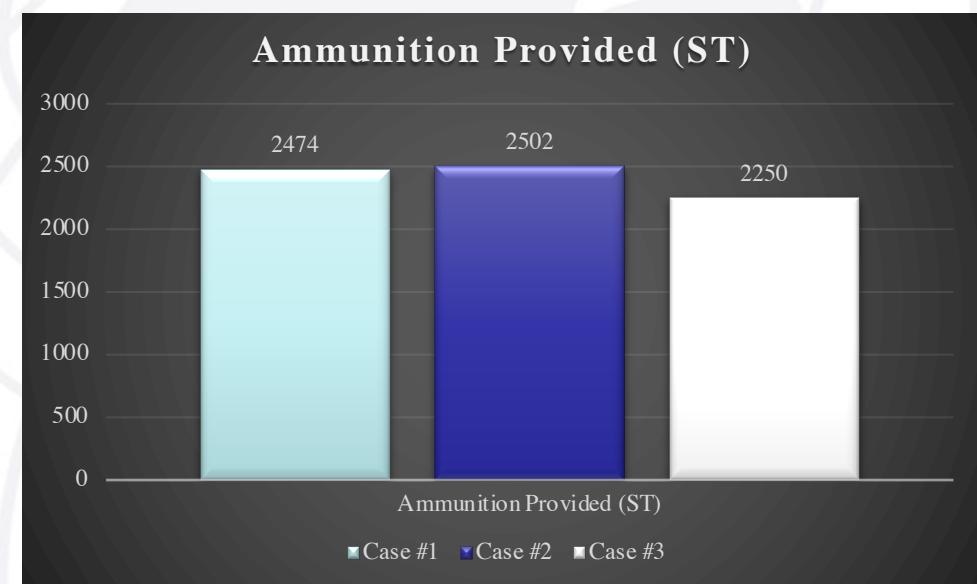
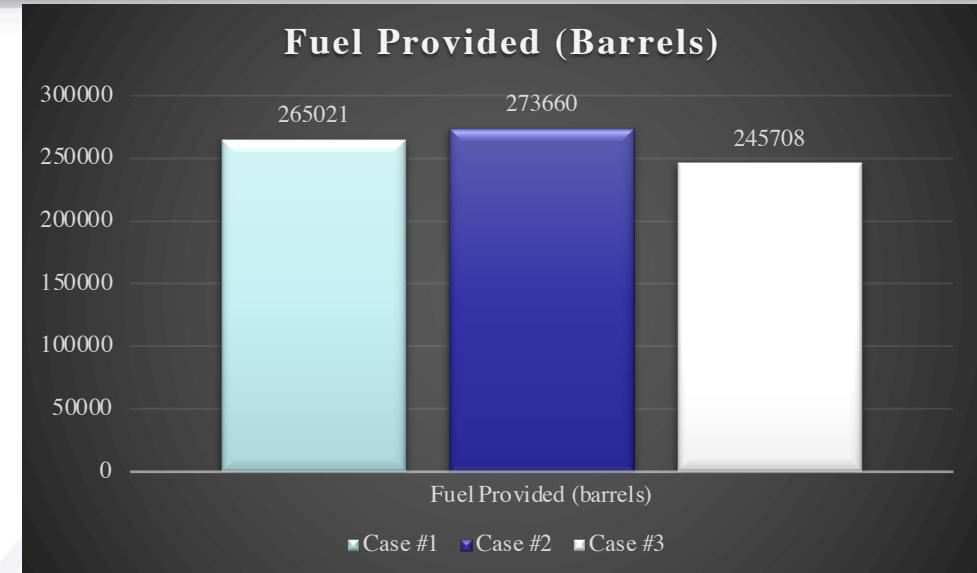
	Case # 1	Case # 2	Case # 3
Carrier Strike Group (CSG)	1	1	1
Destroyer (DDG)	4	4	4
Cruiser (CG)	2	2	2

Variation of Supply Ships

	Case # 1	Case # 2	Case # 3
Fast Support Combat Ship (T-AOE)	2	2	1
Lewis and Clark (T-AKE)	2	1	1

Results:

- 50% drop in the quantity of resupply ships does not equate to a sizable decrease to the amount of fuel and ammo provided to the surface ships





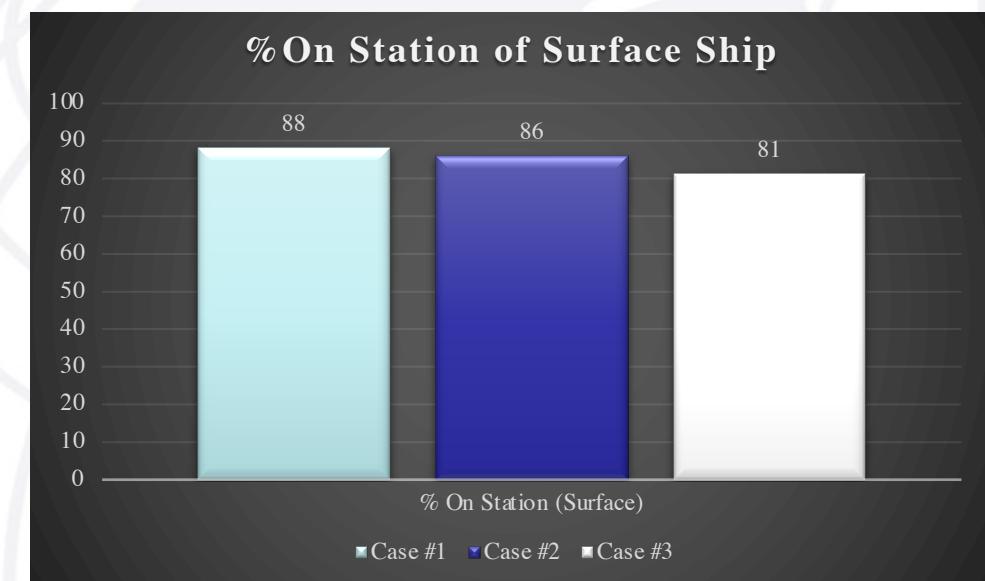
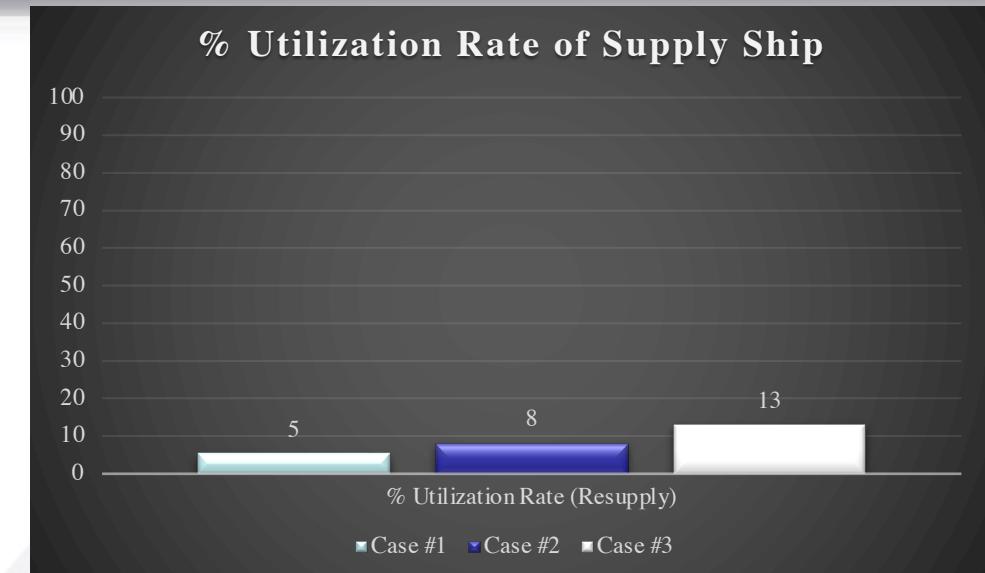
Simulation Scenario #1: Gas Station Refueling

Variation of Supply Ships

	Case # 1	Case # 2	Case # 3
Fast Support Combat Ship (T-AOE)	2	2	1
Lewis and Clark (T-AKE)	2	1	1

Results:

- Utilization rate of the resupply ships triples with a 50% reduction in the quantity of resupply ships available.
- As the number of resupply ships decreases, the utilization rate of the surface ships decreases because they must wait for a resupply ship to become available.





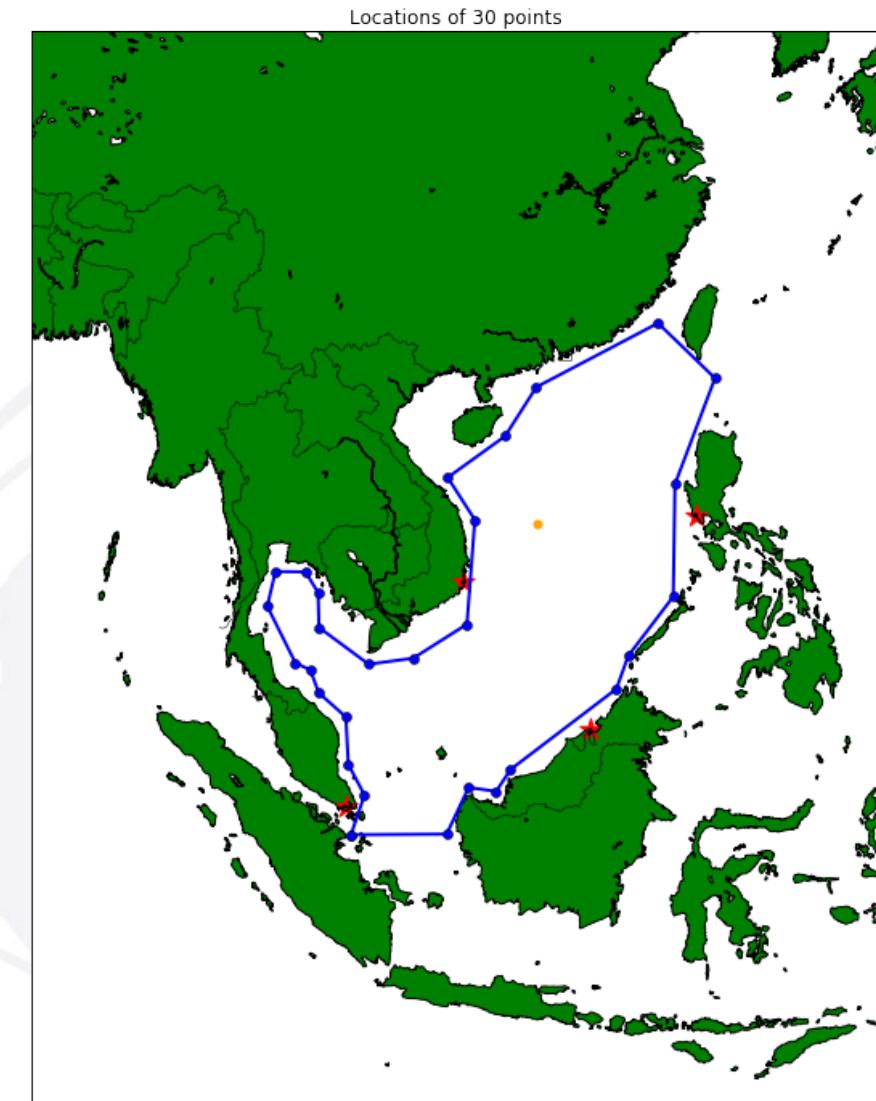
Simulation Scenario #2: Delivery Boy Refueling

Concept of Support - Delivery Boy Refueling :

- Option to increase combatant on station time to increase readiness
- Resupply ships travel to surface ship locations inside the AOR for refueling and rearming
- Variation of quantity of platforms
 - Fast Support Combat Ship (T-AOE)
 - Lewis and Clark (T-AKE)

Assumptions:

- Surface ships are scheduled for resupply every 48 to 72 hours (increase operational tempo)
- Resupply ships are placed in a circulation model with a half leg survivability of 0.98
- Resupply ships are escorted by LCS's





Simulation Scenario #2: Delivery Boy Refueling

Logistics Demand

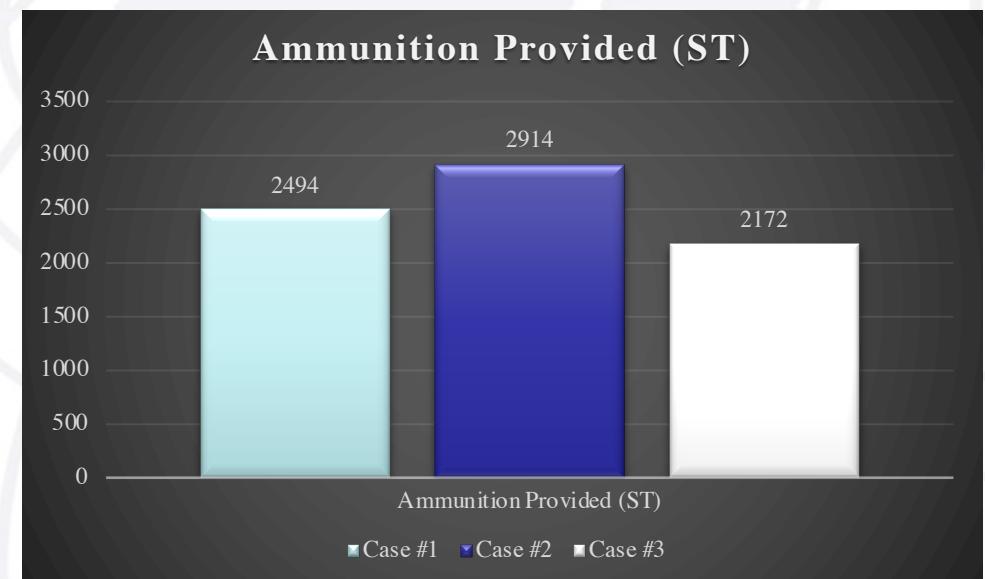
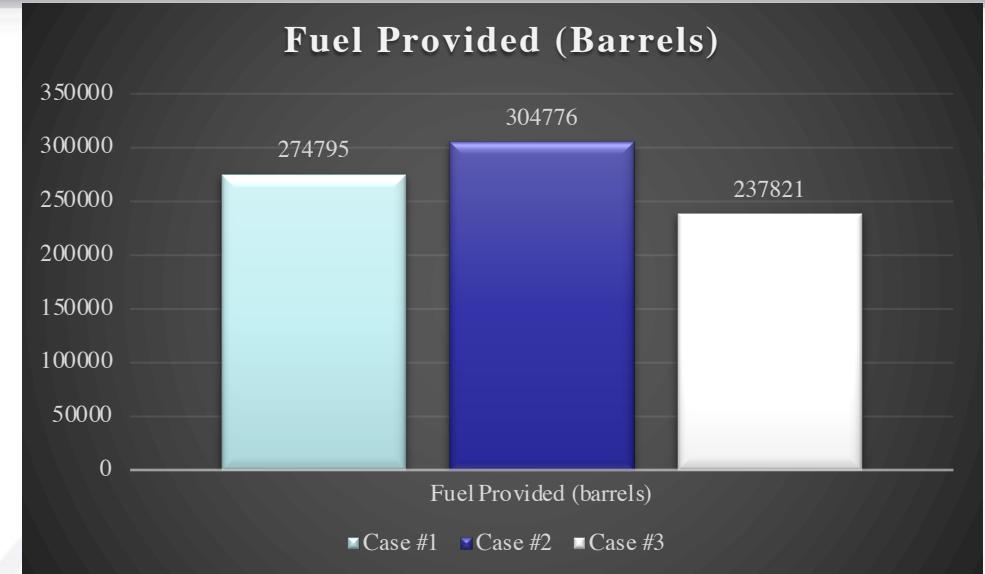
	Case # 1	Case # 2	Case # 3
Carrier Strike Group (CSG)	1	1	1
Destroyer (DDG)	4	4	4
Cruiser (CG)	2	2	2

Variation of Supply Ships

	Case # 1	Case # 2	Case # 3
Fast Support Combat Ship (T-AOE)	2	2	1
Lewis and Clark (T-AKE)	2	1	1

Results:

- 50% drop in the quantity of resupply ships reduces the amount of fuel and ammo provided by 13%.



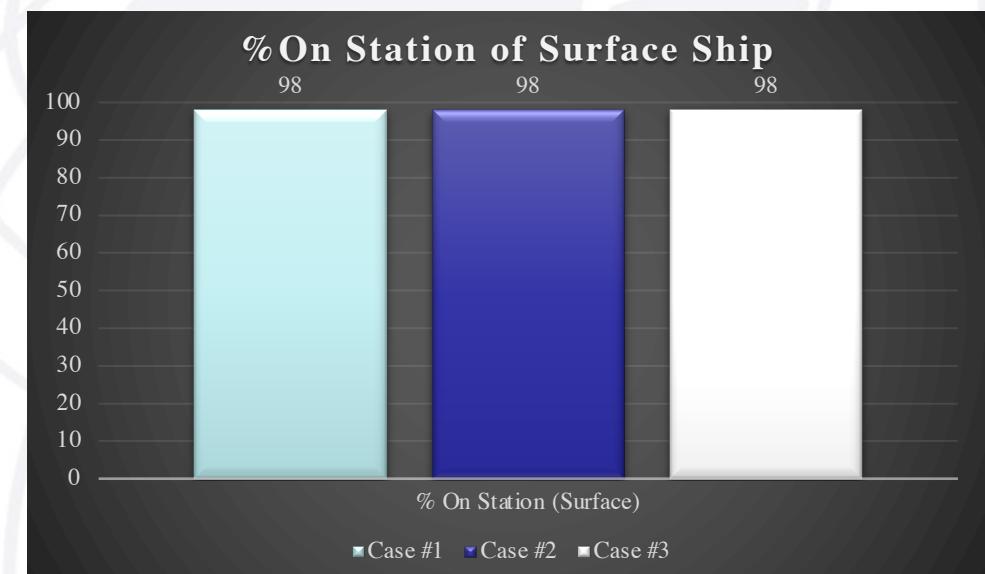
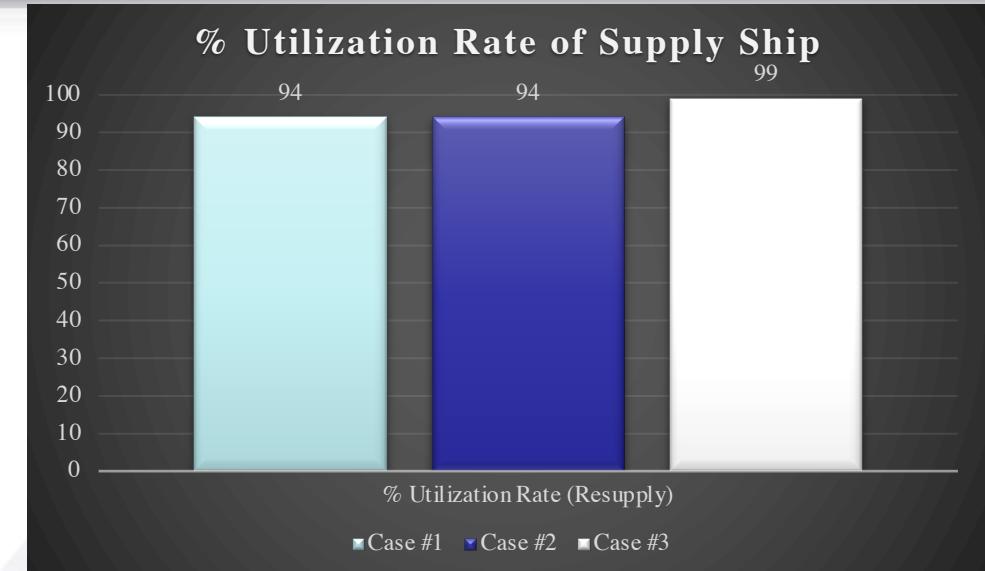
Simulation Scenario #2: Delivery Boy Refueling

Variation of Supply Ships

	Case # 1	Case # 2	Case # 3
Fast Support Combat Ship (T-AOE)	2	2	1
Lewis and Clark (T-AKE)	2	1	1

Results:

- Utilization rate of the resupply ships is maxed with a 50% reduction in the quantity of resupply ships available.
- On station time of the surface ships remain constant with Delivery Boy Refueling, giving 10% to 15% improvement over Gas Station Refueling.
- Increased risk:
 - 1 x T-AKE and 1 x T-AOE lost in Case 1
 - 1 x T-AKE lost in Case 2
- Average wait time for resupply:
 - Case 1: 125.3 hrs (5.22 days)
 - Case 2: 27.3 hrs (1.14 days)
 - Case 3: 22.5 hrs (0.94 days)





Simulation Scenario #3: Delivery Boy Refueling with CLF-5000

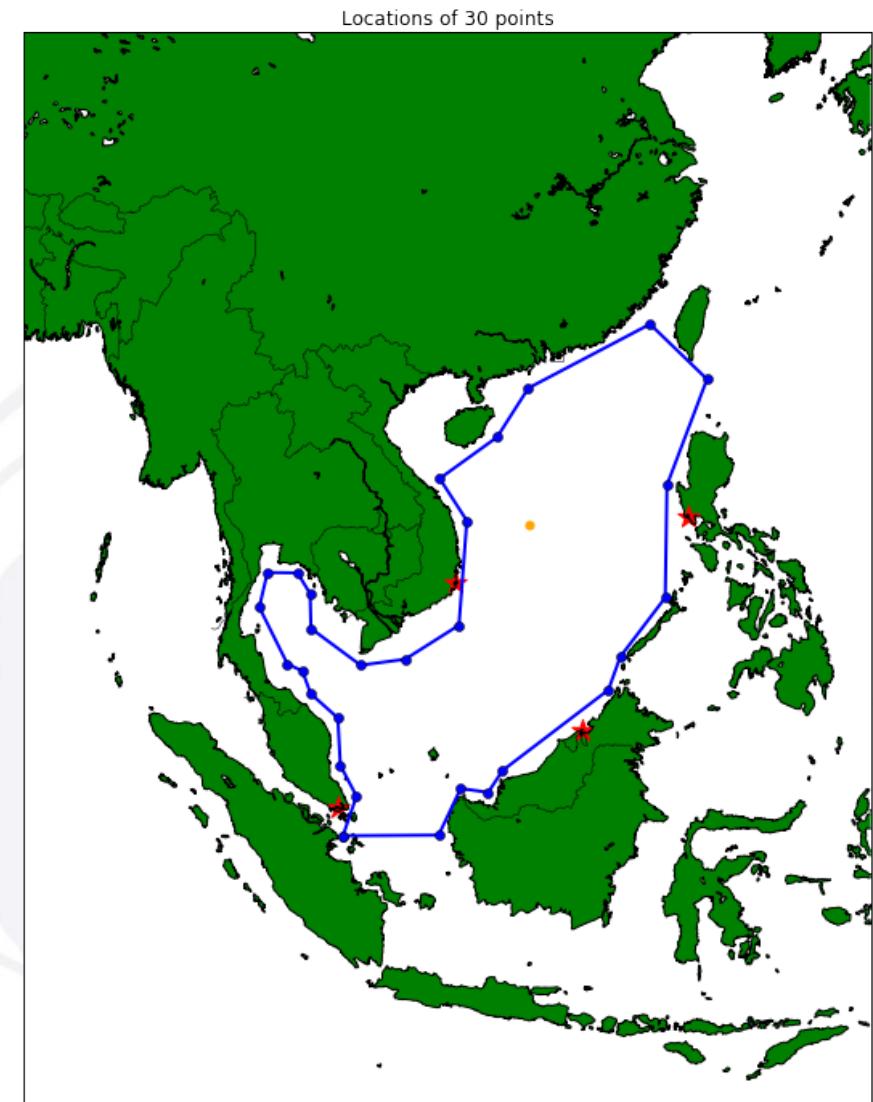
Concept of Support - Delivery Boy Refueling :

- Resupply ships travel to surface ship locations inside the AOR for refueling and rearming
 - Wartime operations
- Variation of platforms
 - Fast Support Combat Ship (T-AOE) &
 - Lewis and Clark (T-AKE)
 - Combat Logistics Ship(CLS-5000)

Assumptions:

- Surface ships are scheduled for resupply every 48 to 72 hours (increased operational tempo)
- Resupply ships are placed in a circulation model with a half leg survivability dependent on distance to surface ship (table below)
- Refueling ships are escorted by LCS's

Distance (nm)	Half Leg Survivability
distance<500	0.98
500<=distance<1000	0.96
1000<=distance<1500	0.94
1500<=distance	0.92





Simulation Scenario #3: Delivery Boy Refueling with CLF-5000

Technical Inject #1: Combat Logistics Ship(CLF-5000)

- Fuel Storage Capacity: 2900 barrels
- Ammo Storage Capacity: 500 ST
- Capable of high speed resupply (max of 35 knots)



Technical Inject #2: Medium Displacement Unmanned Surface Vessel (MDUSV)

- Self-deployed surface unmanned system capable of on station times of 60-90 days with ranges of 900 to 10,000 nm
- Speed (3-24 knots)
- Supplement for DDG or CG





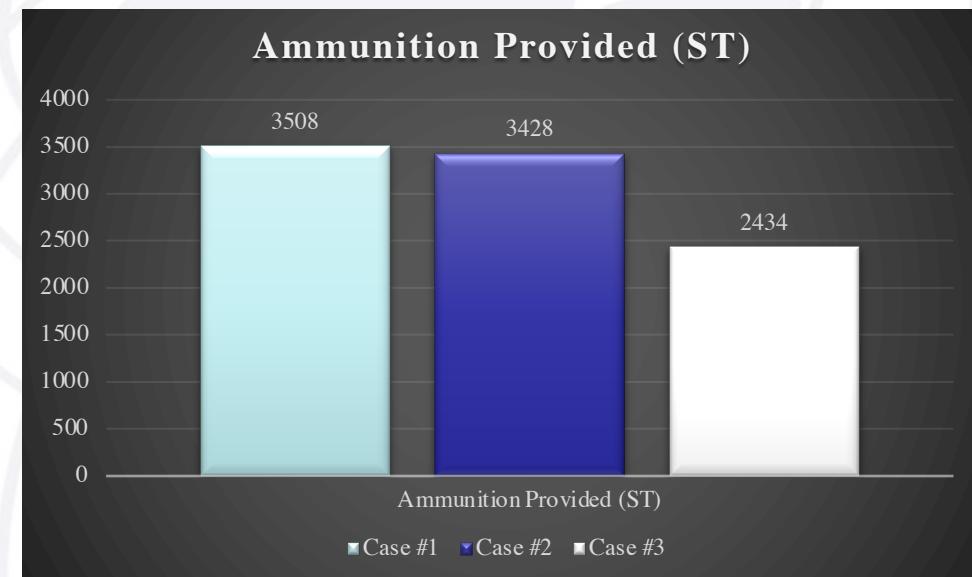
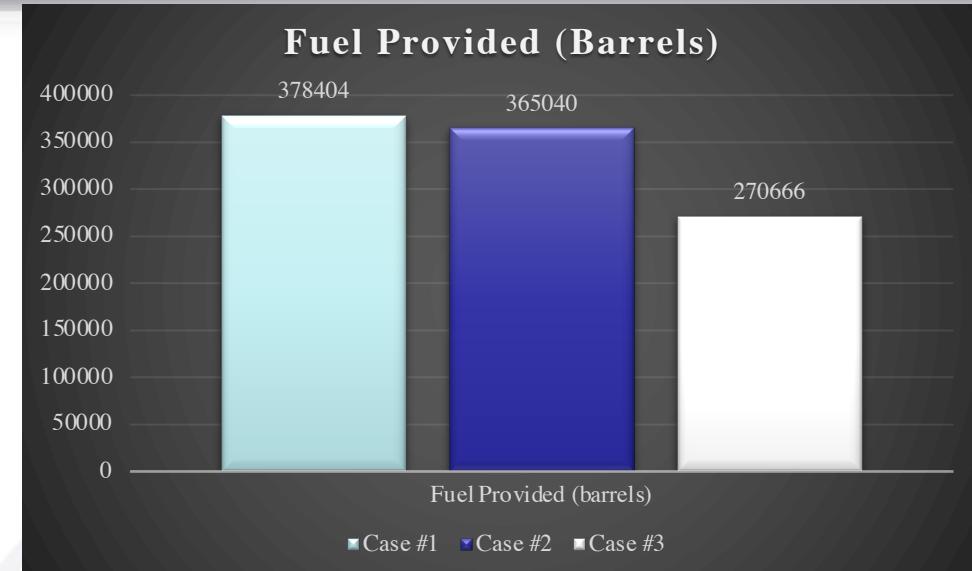
Simulation Scenario #3: Delivery Boy Refueling with CLF-5000

Variation of logistics demand

	Case # 1	Case # 2	Case # 3
Carrier Strike Group (CSG)	1	1	1
Destroyer (DDG)	4	3	2
Cruiser (CG)	2	2	2
MDUSV	0	1	2

Results:

- Addition of the MDUSV decreased the overall fuel and ammo provided by 29% and 22% respectively.





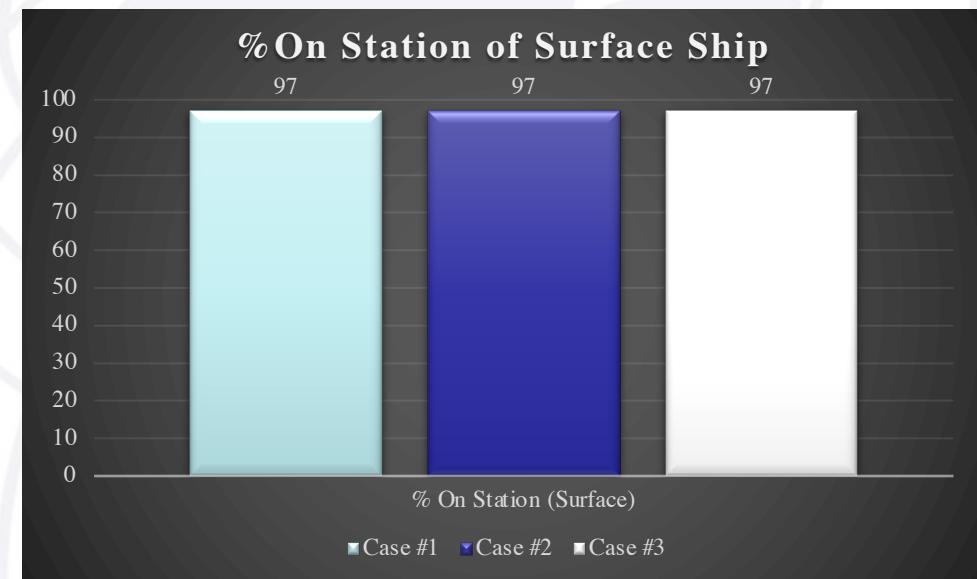
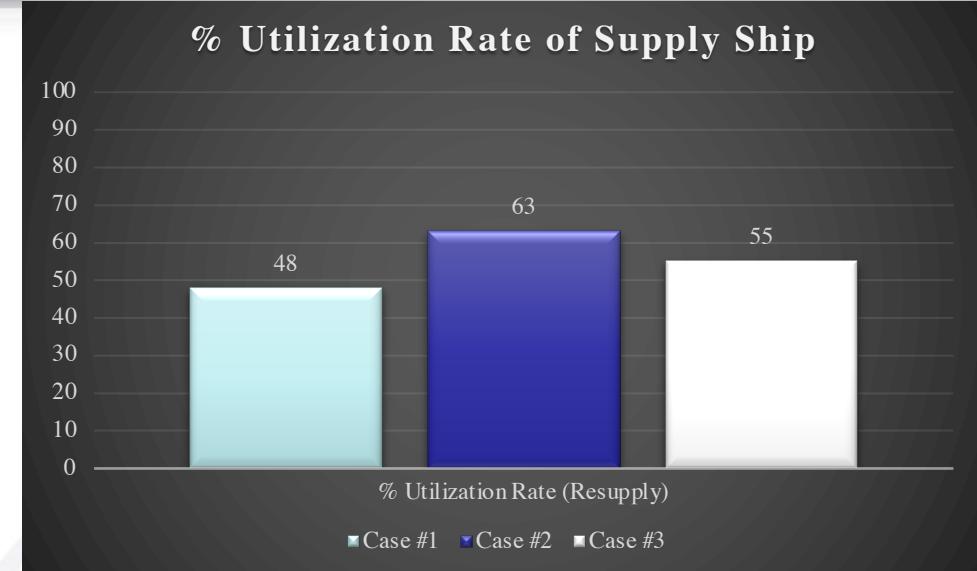
Simulation Scenario #3: Delivery Boy Refueling with CLF-5000

Variation of Supply

	Case # 1	Case # 2	Case # 3
Fast Support Combat Ship (T-AOE)	2	2	1
Lewis and Clark (T-AKE)	2	1	1
Combat Logistic Ship (CLF-5000)	4	3	2

Results:

- Utilization rates of surface ships remained consistent for all cases.
- The introduction of the CLF substantially reduces the average utilization rates of the resupply ships (decrease of approximately 50% from Scenario 2).
- Increased risk:
 - 1 x T-AOE and 1 x CLF lost in Case 1
 - 1 x T-AOE and 1 x CLF lost in Case 2
 - 1x CLF lost in Case 3
- Average wait time for resupply:
 - Case 1: 21.31 hrs (0.88 days)*
 - Case 2: 25.6 hrs (1.06 days)*
 - Case 3: 23.5 hrs (0.98 days)*





- Conduct analysis to determine true survivability of resupply ships in a wartime environment
- Implement logistics concept of support within a campaign model simulation
- Include uncertainty (i.e. weather and sea state effects on logistic supportability)
- Conduct analysis of concept of support in other geographical regions



QUESTIONS