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Dealing With Complications In Supply Lines For The Distribution Of Jet Fuel Among Department Of The Navy Assets In The South China Sea

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Abstract

As the U.S. moves out of an error focused on counter-terror operations and into an era defined by great powers, the U.S. Armed Forces are coming under scrutiny. U.S. leadership needs to know whether or not the U.S. Navy and U.S. Marine Corps can adequately respond to threats to human rights, U.S. allies, and U.S. citizens around the globe. This examines whether current U.S. Naval Aviation forces have adequate logistics supply lines to sustain forward-deployed operations in a war with China. The focus is on the inadequacy of current infrastructure, what improvements could be made to it, and to the decision-making processes that should go into such considerations. Building off other research in the area, this thesis determines areas of weakness in the supply chain of jet fuel (JP-5), namely infrastructure and cybersecurity, and the threats to such weaknesses based on Chinese military strategy. Ultimately it concludes that there needs to be an investment in more supply ships to support U.S. operations, what specific vessels should be invested in. and the decision-making process of why they should be adopted and how to deal with casualties to them during a conflict. U.S. supply lines are the greatest weakness when it comes to a prolonged, forward-deployed conflict and this thesis offers some of the many recommendations on ways to improve it with a thorough dive into how they should be improved through simple supply chain business practices.

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Acknowledgments

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Introduction

The issue this paper seeks to address is: **what should the infrastructure and process by which the U.S. Navy (USN) and U.S. Marine Corps (USMC) command structure determine the distribution of jet fuel to assets before and during a conflict, look like?** The U.S. military is currently, and has been, transitioning from an era focused on combatting terrorism into an era focused on Great Power Competition (GPC). The MITRE Corporation, a not-for-profit focused on problems of public interest, defines the GPC as "an ongoing push-pull among the United States, China, and Russia for global strength and influence" (MITRE, 2020), which sets GPC up as offspring, or not-so-distant relative, of the Cold War era. Russia still retains its status as a peer competitor, continuing to build up a capable military and displaying an increasing willingness to meddle in the affairs of other countries. The U.S. need only look as far as the annexation of the Crimean Peninsula or the continued involvement of Russian forces in Syria as evidence of this. China, a smaller player in the Cold War, now plays the global stage as a major player with a state government bankrolling the endeavors of its corporate and military machines to assert regional dominance in East/South East Asia. This ambition is most apparent in its illegitimate claims to sovereign waters of other nations in the South China Sea, construction of island military bases, and harassment of other nations' maritime activities by China's naval and fishing fleets.

The Department of Defense (DoD), in their *2018 National Defense Strategy,* summarizes their most prominent obstacle:

> The central challenge to U.S. prosperity and security is the reemergence of long-term, strategic competition by what the National Security Strategy classifies as revisionist powers. It is increasingly clear that China and Russia want to shape a world consistent

> with their authoritarian model—gaining veto authority over other nations' economic, diplomatic, and security decisions. (Mattis, 2018)

The goal of the U.S. is to maintain a favorable balance of powers to prevent these authoritarian takeovers and promote the security of U.S. citizenry and national interests. The DoD wants their strategic goals transparent to competitors and allies but their methods and tactics unpredictable to maintain an advantage. GPC requires a long-term strategic view for achieving a favorable balance of powers, and the DoD wants its long-term goals clear to allow for diplomacy to work and common ground to be found with allies and competitors. If diplomacy cannot prevent a conflict, then the Secretary of Defense, Jim Mattis, stated that all preparations following this new national strategy should be acted out to the backdrop of preparedness for conflict. If the U.S. wants to keep a balance of powers, it must be in a position to defend its aims in war. Even in peacetime, the capacity of the U.S. must be to win a war or otherwise actions abroad only constitute a bluff that would have severe consequences if questioned.

With a foundation to their claims, the DoD can then focus on their unpredictability of response in-theater to the actions of competitors. Forward deployment of forces, such as Navy Carrier Strike Groups (CSGs) or Marine Corps Amphibious Ready Groups (ARGs) allows the U.S. to make clear its strategic goals of maintaining maritime freedoms to promote the flow of commerce and a prospering homeland. These forces also give the DoD an edge in their unpredictability as their forces are already forward stationed where the action will occur, removing the enemy's ability to predict actions based on equipment and troop movements as they deploy towards the theater of engagement. For this paper, the regional focus of the material will be in the South China Sea, under the strategic control of the U.S. Indo-Pacific Command (USINDOPACOM), due to the high interaction between U.S. and Chinese forces and the

probability of the region being the center for a conflict between the U.S. and China, should a conflict arise. The geography of the region lends to a predominantly naval focus for combat, the role which is filled by the USN and USMC. Whereas a conflict with Russia would likely occur in Eastern Europe and, due to the geographical nature, rely less heavily on the actions of the USN and USMC and more so on the U.S. Army and U.S Air Force who occupy bases in the region.

The capability of the USN and USMC, collectively known under the umbrella of the Department of the Navy (DoN), to respond to events in the South China Sea depends on their technical capability as well as their maneuverability. The DoN maintains one of the most technically capable forces in the world with much of that ability attributed to the aircraft carriers and amphibious assault ships which act as ocean airports for the highly efficient and lethal aircraft the DoN possesses. These aircraft have advanced stealth, electronic attack, and kinetic attack means to get near an enemy and disable them before they can even see the platforms that the aircraft launched from. Whether it be at sea or alongside an amphibious action, aircraft would play a primary role in the conflict. To do their job effectively, they need a steady supply line of ammunition and fuel, the more important being fuel for as stated by Alfred Thayer Mahan, "without ammunition, a ship may run away, hoping to fight another day but without fuel, she can neither run, nor reach her station, nor remain on it, if remote, nor fight" (Wildenberg, 1996). The supply chain of jet fuel must have the capacity to meet wartime demand, flexibility to respond to changing positions of forces, and security to make sure the resource gets where it is needed. But what happens when one of these aspects is strained or fails, who gets to decide where to prioritize distribution, who to cut off, and who to fulfill when there is not enough. To answer that question this paper will look at the capabilities of the DoD logistics force, the chain of command, how allocation decisions are made, and prepare that process for conflict, offering insight into

likely complications, recommendations for changes with actionable steps, and a general framework and understanding for which future research into this question can be based on. Starting with an overview of the U.S. naval force's supply chain, this paper will then follow up with an analysis of the threats that the supply chain faces, then it will deal with the potential ways the command structure could respond to these threats and the technologies and immediate actions that could be taken in preparation for the aforementioned threats coming to reality.

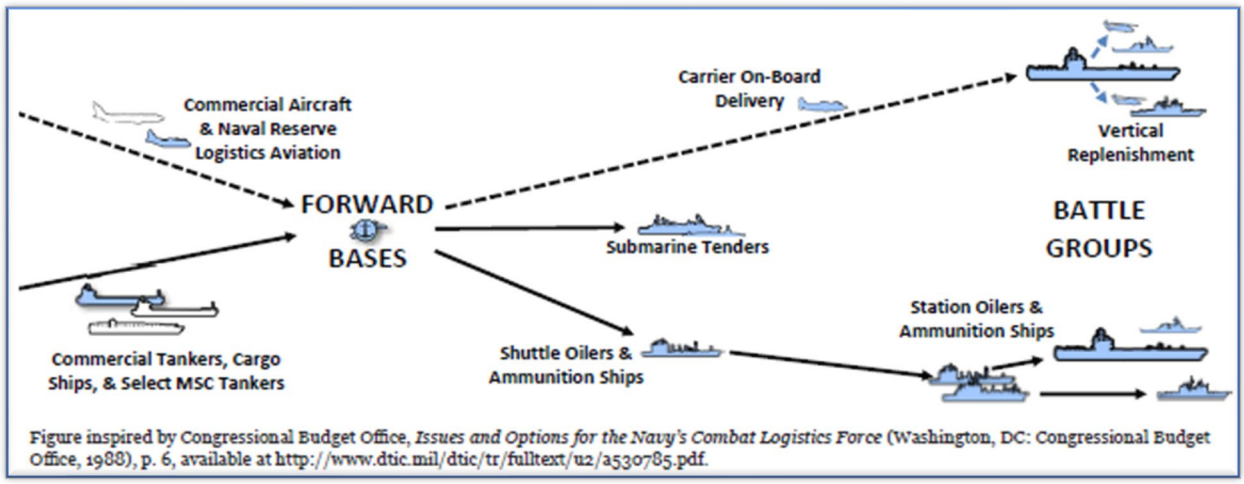
U.S. Navy's Fuel Supply Chain

The primary fuel used by the U.S. Naval aircraft is jet propellant-5, commonly referred to as JP-5. This fuel has been specifically designed for shipboard use, with a higher flashpoint to decreases the likelihood of causing a ship fire (Stone, 2020). Aircraft being resupplied in the air would be receiving JP-8, the primary fuel used for air/ground-based refueling, USN ships exclusively store JP-5. This leaves them safe to focus solely on the distribution of JP-5 for the U.S.'s naval aviation forces. There have been efforts in the past to further unify U.S. Naval fuels into a single type. These efforts have not succeeded due to the higher cost and scarcity of JP-5 compared to the Diesel Fuel Marine (DFM) that USN ships currently use. While JP-5 could substitute DFM on ships (Tosh et al, 1992), that would be only in emergency scenarios; thus this report is again cleared to focus solely on the distribution for the demands of the aviation community aboard USN ships. This report will not focus on the acquisitional aspects of JP-5 but purely on the distribution of said fuel once acquired.

The DoN does not initially own the JP-5 upon acquisition nor control its movement. After the joint field command registers a need, the Defense Logistics Agency (DLA), under the command and authority of the Secretary of Defense, works through the appropriate steps and purchases the fuel needed on the commercial market. A commercial tanker then brings the fuel out to a Defense Fuel Support Point (DFSP), large fuel depots, assigned to the region the USN fleet is in. Upon reaching the DFSPs the fuel is received and the ownership shifts from the DLA to the Military Sealift Command (MSC). The MSC falls under the command of Navy Fleet Forces Command for Navy-unique matters (Military Sealift Command, 2021), such as refueling. The specific combatant commander, for a geographical area, has authority over these resources. This authority is passed on to specific fleet commanders to serve the needs of their ships and

onboard aviation components. For each numbered fleet, there is a specific task force that deals with the operational logistics for the fleet. Specifically, this report will be looking at Task Force 73 of 7th Fleet serving under U.S. Pacific Fleet Command (PACFLT), a subordinate component command of U.S. Indo-Pacific Command (USINDOPACOM). While there is always the possibility of different fleets being called over to assist in a conflict with China, it is easiest to look at how a specific fleet should respond and then apply that to a larger scale. Figure 1 shows the general hub and spoke concept utilized by the Navy for the distribution of fuel to fleets.

Figure 1: Modern U.S. Maritime Logistics Network, From Shore to Ship (Walton et. al, 2019)



Once the fuel is in control of the MSC, it is loaded aboard Fleet Replenishment Oilers (T-AOs), major components of the Combat Logistics Force (CLF), that transit out to stationed fleets and either relieve or replenish (Walton et. Al, 2019) stationed CLF oilers that are attached to a battle group. The ships report up to their group commanders their needs and schedule underway replenishments (UNREPs) of their fuel. UNREPs involve two ships steaming side by side, separated at a distance of only 100-200 feet, as cables are sent across to transfer fuel lines and dry cargo. These last for prolonged amounts of time, severely restricting maneuverability. To cut down on the length of time spent replenishing, whole CSGs form up to have this action

completed in one span of time for all ships. The oiler is then freed to return for resupply or to move to alternative ships if it still has fuel onboard and there was a planned/urgent need.

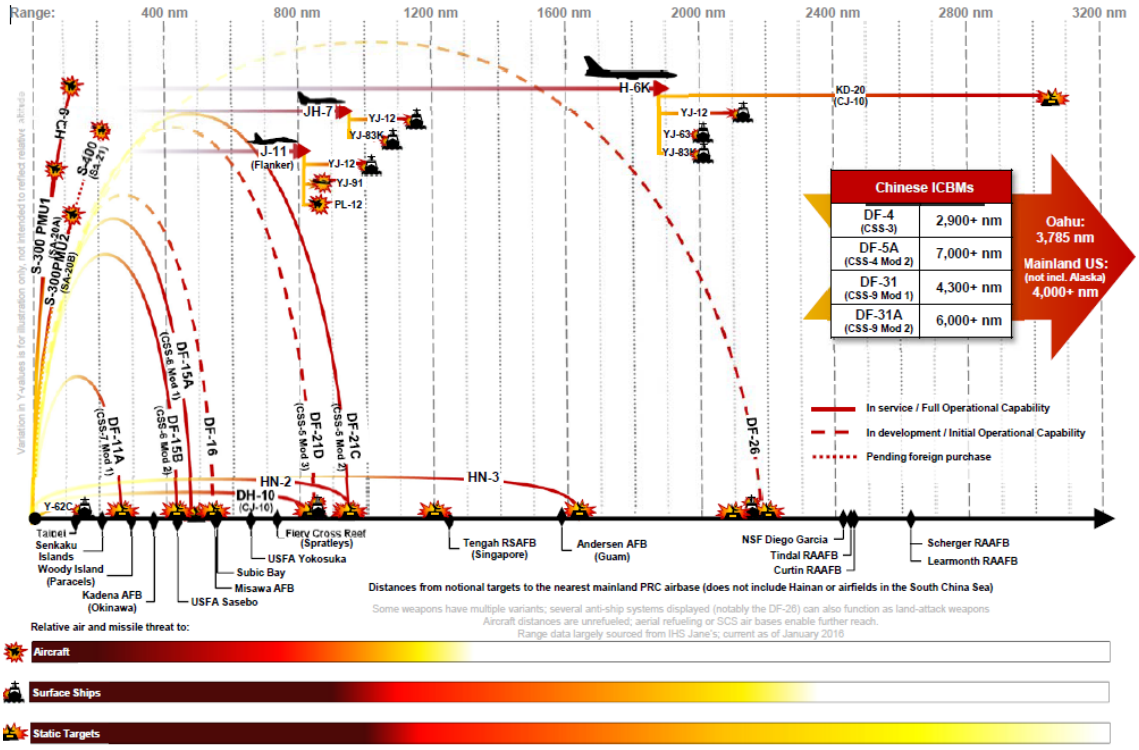
China's Strategic Plan and U.S. Weaknesses

If the U.S were to go to war with China, the engagement between the powers would take place in and around Chinese territorial waters. Whatever the cause of the conflict, it would not likely lead to immediate attacks on the continental U.S., nor maritime conflict near U.S shores, except for potential submarine warfare. China is pursuing a strategy of expanding its regional control and sphere of influence, from strong control of territorial waters to far-reaching, weaker power projection into the Indian Ocean with small military bases being established as part of its Belt and Road Initiative. To strengthen their hand, the Chinese need to force the U.S.'s influence out. This strategy, often referred to as counter-intervention, focuses on developing "the ability to hold U.S. and allied ships, planes, and bases at risk and thereby deter foreign interference" (Erickson, 2014) and directly leads to close encounters between the U.S. and China as the U.S. works to maintain their influence in the region and promote freedom of navigation in the world's busiest shipping lanes.

One of the primary tools that China uses to further this strategy of counter-intervention is that of anti-access/area denial, referred to as A2/AD. A2/AD focuses on a range of methods to keep any enemy from getting into a geographical area. CSGs operate by a similar concept with concentric rings building outward from the carrier. Each ring is dedicated to a specific platform of defense, with the furthest out being aircraft, moving into cruiser and destroyer escorts, and ending with the carrier's close-in-weapons-systems (CIWS) as the last line of defense. The goal of each ring is to prevent a target from reaching the subsequent inner ring, with the innermost ring being an area of high value. For China, this innermost ring represents the Chinese mainland and the outer rings of the Chinese plan are their different types of armaments. The Center for Strategic and Budgetary Assessments (CSBA) has developed a comprehensive diagram in their

report, *Sustaining The Fight: Resilient Maritime Logistics For A New Era,* illustrating the physical distances of the rings generated by China's armaments and aircraft, as seen in Figure 2 below.

Figure 2: Chinese Anti-Access/Area-Denial Complex (Walton et. al, 2019)



Data to build this graphic was derived from IHS Jane's (2019); National Air and Space Intelligence Center (NASIC), Ballistic and Cruise Missile Threat (2017); and CSIS Missile Threat (2019).

The bulk of this defensive effort is supported by Chinese missiles and fighter jets. China has boasted about the development of its new anti-ship ballistic missile, often referred to as carrier killers. The threat of a long-reaching, fast-moving weapon capable of nuclear payloads is part of China's continued effort to try and push back U.S. forces from the South China Sea, stating that the testing and development are "China's response to the potential risks brought by the increasingly frequent incoming U.S. warplanes and military vessels in the South China Sea" (Suciu, 2020). But as the bars at the bottom of Figure 2 show, the majority threat is towards static targets, such as U.S. and allied bases, and surface ships. There is a significantly decreased

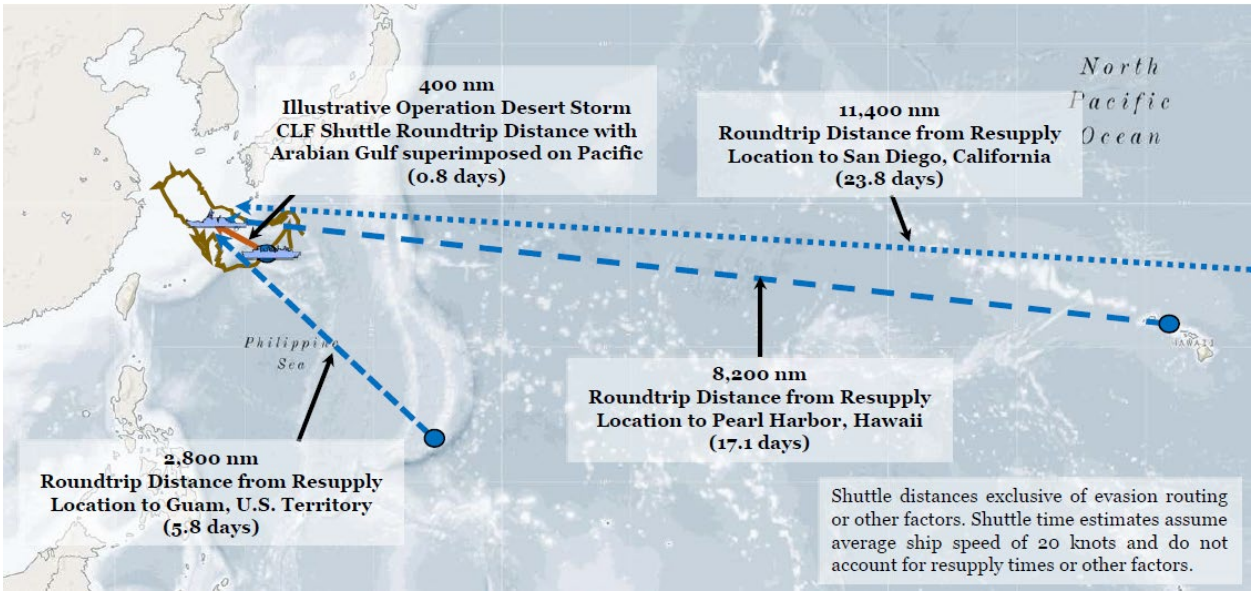
threat to U.S. aircraft operating from these carriers and U.S. bases. The majority of their armaments are developed specifically as surface-to-surface or air-to-surface weapons, meaning aircraft are not the primary target. Due to this relatively lower threat and the capabilities of U.S. aircraft, there will be a heavy reliance on U.S. Naval and Marine Crops pilots to operate as the far-reaching arm of the U.S. Naval effort in penetrating China's A2/AD boundaries.

Major Wagemenn, in his paper on China's use of A2/AD, describes China's aims as "acting on a situation as early as possible—and as far away from the ultimate objective as possible" (Wagemenn, 2014) which is in agreement with the CSBA's report that indicates Chinese strategy "emphasizes the targeting of information and logistics" (Walton et. al, 2019). Logistics and information are the backbone of any military, specifically one operating at the distances and with the technological level that the U.S. Navy is. Without these being properly defended, a military can be hamstrung by an opponent who is aware of those weaknesses. This is just what China intends to do, wait for weaknesses to present themselves and act on them decisively. For the U.S., the logistics networks present one of its weakest links.

The U.S.'s maritime logistics force has not been comprehensively updated since the 1980s. The ships making up the force have served long past their expected lifetimes and without proper fiscal attention from the DoD. Their numbers have declined to a point where they would not be able to meet the demands of U.S. Naval forces were they to enter into a war with China. The need for a strong maritime logistic force in a conflict with China would be significant due to the geographical areas of influence currently held by China and the need to be able to meet their forces in any of those regions. This requires a significant amount of fuel and supplies to reach and stay on-station once having arrived. What U.S. logistics forces did well in their most recent conflict between nations, the Gulf War, they would have to perform on a scale many magnitudes

larger due to the vast distances between regional allies, bases, contested islands, and locations of interest in the West Pacific. Figure 3, provided from the CSBA's report, illustrates the comparative distances the USN is operating over in the West Pacific relative to that of the Middle East.

Figure 3: Comparison of Distances in Arabian Gulf and Pacific (Weston et. al, 2019)



CSBA estimates a forward operating fleet would consume more than 150,000 barrels of naval and aviation fuel per day, resulting in 4.5 million barrels over a month which is the equivalent of fourteen tanker loads (Walton et. al, 2019). Acquiring this amount of fuel is more prominent of an issue today than during previous conflicts. Oil is seen today as much more of a limited resource and the DoD/DoN budgets are more scrupulous.

Additionally, getting this fuel to the fleets would pose a larger hurdle during a war with China than during the Gulf War not only due to the greater operating distances but also due to China's developed maritime fighting force, specifically their submarines. MSC assets are generally lightly armed if armed at all to defend themselves. This leaves them as prime targets of opportunity to Chinese military forces. Following their mentality of attacking at a distance for

the greatest effect, China could use their fleet of sixty submarines (Nuclear Threat Initiative, 2021) to track down and neutralize tankers or oilers, cutting off fuel lines to the USN ships the Chinese are actively in conflict within their waters. This vulnerability is exacerbated by the number of agents that possess the fuel before it reaches USN ships. The U.S. has no reason to believe that the Chinese will distinguish between attacking an oiler on route to a stationed fleet and a civilian-owned tanker moving fuel under contract with the DLA. It then becomes increasingly important that all information regarding who is supplying fuel to the DoD and where it is coming from and where it is headed is safeguarded, whether that information is on DoD or private company servers. With any sophisticated shipping company, they are likely to have an asset management system or automatic identification system following their vessels in transit. Unless this system is guarded against cyber-attacks, for which the Chinese have become expertly proficient, it could easily be used as a method to identify ships carrying fuel to DFSPs and neutralize them before they can deliver.

A war with China will lead to a large demand among USN forces aviation forces for fuel as they will be one of the primary tools used by the U.S. The uptick in aircraft sorties, the long distances to travel, and the proximate danger to allied ports and bases that could be used to refuel by Chinese missiles put a great strain on the U.S.'s fuel supply chain. This chain suffers from vulnerabilities, both kinetic and cyber, that, if exploited, could drastically affect USN's ability to respond to Chinese threats in-theater. And it is clear that the Chinese strategy would intend to seek out and exploit such vulnerabilities.

Preparatory Actions

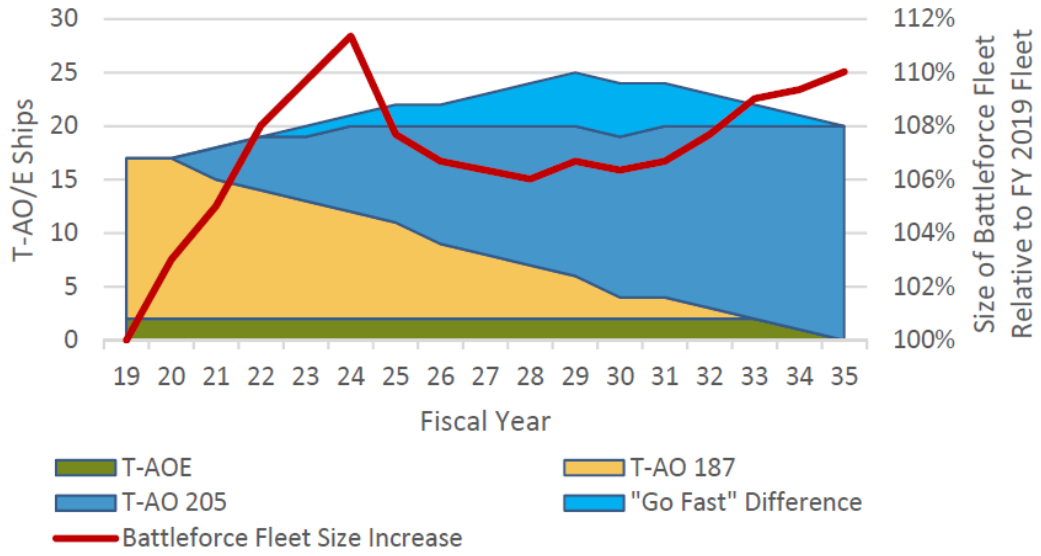
The most obvious problem facing the USN from a supply chain standpoint is a capacity issue. The CSBA analyzes in great detail the current state of the USN and its logistics forces. This thesis will take the findings from CSBA as the most authoritative, non-confidential material on the state of the U.S.'s fleet. In their report, the CSBA found that the MSC does not have nearly enough oilers to meet wartime demand for fuel, especially taking into consideration that some of these oilers will likely be lost or damaged in combat. These oilers are the backbone of the supply chain as they are the key delivery mechanism in getting fuel to a ship. No JP-5 will get into an aircraft's engine without having first been in the holds of an oiler. Very clearly being the bottleneck of this whole process, CSBA first addressed this problem with their recommendation to "Go Big…Go Fast" (Weston et. al, 2019). The idea is as the MSC looks to acquire new vessels as follows: Big Tankers (T-AOTs) and fast acquisition of new oilers (T-AOs) among other recommendations.

Before taking action on these recommendations, the Navy needs to plan how they would utilize these new assets and additionally how to respond if they are lost in combat. If they can be integrated into the fleet and would result in increased efficiency, while not leaving a fatal opening if destroyed, then they might make a worthwhile purchase. Regarding the purchase of T-AOTs, the Navy would be able to capitalize on the hub and spoke method already used. These T-AOTs could essentially replace DFSPs as the new hubs or at the least work as forward operating DFSPs. A tanker is inherently more maneuverable than an island, giving it two key advantages; defensibility and flexibility. As seen in Figure 1, China has been developing armaments capable of reaching most fixed installations used by the U.S. in the West Pacific. They can target key logistics installations in Japan used for 7th Fleet logistics support such as Okinawa, Sasebo,

Yokosuka, and as far east as Guam and as far south as Singapore, where MSC's Far East headquarters is located. This leaves Pearl Harbor, Hawaii as the only major refueling point out of range at +3000nm away. Major static installations where MSC ships might normally refuel from are no longer a safe option. Thus, the importance of maneuverable hubs arises. The added benefit of these T-AOTs would be that they cut out an extra touchpoint in the chain by potentially acquiring fuel directly from contracted suppliers working with the DLA. Working with suppliers in the region, T-AOTs would have much greater flexibility and delivery times of fuel, being able to move along with Fleet forces.

While there, T-AOTs could be retrofitted to fulfill the role of T-AOs (Weston et. al, 2019) by taking on the needed equipment to transfer fuel directly to the USN ships of their respective task forces, that job is best fit to remain with the T-AOs. T-AOs are better suited for the replenishing role for fleets, as they are significantly more maneuverable and capable of greater speeds as opposed to T-AOTs which would be larger, easier targets for Chinese forces. This is why the CSBA recommends increasing the acquisition rate for the new T-AO 205 model as shown in Figure 4 below. A T-AO is cheaper, faster, and carrying less fuel, if they are lost, there is not as significant a blow to the supply chain as compared to a T-AOT. The additional benefit from retaining the T-AOs role would be the familiarity of it. The Navy has been refueling off that specific type of vessel for years now and would not need to invest in additional training or worry about mishaps arising from unfamiliarity with a new system. With T-AOs serving as the primary last-mile delivery method, the T-AOTs can be kept at a safer distance, decreasing their likelihood of being attacked.

Figure 4: "Go Fast" Oiler Procurement Strategy (Weston et. al, 2019)



The primary questions then become how to determine where to position these hubs, what ratio of fuel to stock them with, and who is to manage them and make these decisions.

Command:

To determine where to preposition T-AOTs in support of 7th Fleet operations, the T-AOTs must be designated certain ships as the spokes to its hub. Delineating which ships the T-AOT will support would reduce management complications by simplifying the number of variables. The two main focuses for these hubs should be CSG 5 and Amphibious Squadron (PHIBRON) 11 as these are the two primary vessels conducting flight operations. A T-AOT should be assigned to each of the Task Forces that these groups are a part of Task Force 70 and Task Force 76 respectively. Each numbered fleet has a task force specifically in charge of logistical needs, for 7th Fleet, this is Task Force 73. TF 73 is commanded by a Rear Admiral who is also in command of Logistics Group Western Pacific. This commander takes control of MSC ships during wartime. Being a part of 7th Fleet, they will be in direct communication with the commanders of the CSGs and PHIBRON, and attentive and proximate to the needs of the fleet.

Intimate knowledge of the way these commanders operate makes TF 73 the best choice for directing the locations of the T-AOTs in response to developing and planned operations.

Stocking:

The best way for the DLA to determine what amounts of JP-5 to place aboard these T-AOTs relative to DFM is to develop rough estimates of the usages of fuel aboard carriers and amphibious assault craft. The USN needs to develop better feedback loops recording fuel usage by aircraft. Using electronic sensors to sound the tanks and having these sensors upload the data to a record system as simple as excel would let the Navy get a picture of their consumption of JP-5 over a period of time. This, when paired with the specific times and dates of flight operations and major exercises could offer major insight into when fuel is used and how much through simple data analytics. Using this information, the Navy could forecast approximately how much fuel a CSG or PHIBRON will use in flight operations for certain types of exercises. Coordinating the plans of attack and specific flight operations between the task forces, TF 73 could easily requisition the DLA weeks ahead of time with an estimated amount of fuel. Erring on the side of ample safety stock, TF 73 could increase efficiency in purchasing as well as logistical transportation. Safety stock would be determined using the standard deviation of lead times (this would be collected over time by the MSC), the average demand (determined through analysis of fuel consumption), and the highest reasonable service level considering the stock out cost is extremely high. The appropriate service level would be calculated based on carrying costs and the stock-out costs, the latter being a difficult number to quantitatively estimate. Allocating specific amounts to T-AOs with the appropriate lead times, based on data patterns, will allow the T-AOs to arrive just as more fuel is needed. The likelihood of stocking out of fuel is significantly decreased by the proximity of these T-AOT hubs. Everything from the handoff of fuel from the

DLA to the MSC must be under the control of TF 73 for 7th Fleet. This will greatly reduce any potential bullwhip effect while increasing operational flexibility as 7th Fleet has ultimate control over the resources it needs.

Positioning:

It is not feasible under the Navy's current force structure to have an escort for every supply ship, so strategic positioning becomes a key question. Utilizing the hub and spoke method, the T-AOTs can be placed further back from conflict and out of range of Chinese missile capabilities. There will likely be no major threat from Chinese surface or aviation forces as these units will be operating predominantly in an A2/AD role, combatting USN surface and aviation forces working to target Chinese bases on the mainland. The predominant threat to the T-AOTs will be Chinese submarines. These would be the Chinese's best options for stealthily passing by U.S. and allied forces to attack supply lines. Reminiscent of Admiral Dönitz's 'wolf-packs' in WWII, supply ships would face the possibility of being pursued by Chinese submarines should the Chinese get their hands on data pertaining to the locations of these hub ships via satellites or trailing T-AOs returning to the T-AOTs. Consequently, there must be a significant screen provided by USN ships in conflict with Chinese forces, using destroyers, aircraft, and U.S. submarines to make sure no Chinese submarines can slip through. Either that or an allocation of U.S. submarines or destroyers to patrol the water. Assuming that adequate protection could be afforded, the placement of the T-AOTs would best be calculated based on the traveling speed of the T-AOs, the number of available T-AOs, and the fuel consumption of the specific groups being refueled. Speeds and numbers of the T-AOs would be used to calculate the lead times it would take to get from the T-AOT to the designated ships being refueled, with consumption patterns determining how often a refueling is needed. Based on this simple

arithmetic, the distances that T-AOTs should be placed would be simple. Then using the planned movements of the CSGs and other ship movements (T-AOTs are fueling both aircraft and all USN ships so both must be considered) as well as geographical hazards, a location could easily be determined. There would need to be a greater weight in the calculation associated with the DFM needs of the fleet as that will be a significantly larger demand as well as the more important between that and JP-5. This weight could be applied through a mix of ratios of demand for each type of fuel as well as an appropriate understanding that a fleet is hampered if it cannot use its aircraft, but useless if it cannot move.

Responsive Actions

Helmuth von Moltke the Elder, a field marshal of the Prussian army is attributed the phrase “no plan of operations survives the first collision with the enemy main body” (Davis, 2005), a common idiom still used often today in the U.S. Armed Forces to say that no matter what preparation and planning happens, war is unpredictable and to win, one must be able to adapt to those uncertainties. How does the current USN supply chain for JP-5 respond and how would one with the proposed preparatory actions respond to losses within the network upon contact with the enemy?

Current System:

Under the current system, T-AOs are likely to perform most of their refueling from Guam or a naval base in Japan. These facilities are set up with the necessary equipment to fully stock a T-AO and send it back out to the fleet, and they have significant practice doing so. The proximity of these bases as well as their familiarity with operations leads to high cycle rates, having ships refueled and sent out to stationed USN forces quickly and efficiently. Should they survive an opening strike with China, avoiding missile strikes, then they will continue to be the primary and preferred refueling points. Positioned where they currently are, and with such a high reliance from the USN, they are likely to be primary targets under Chinese strategy. Anti-missile defenses can be set up certainly, but with the numbers that the Chinese have it is foolish to believe these installations will go unscathed. If only damaged, then their capacity drops, and operations must be shifted. Other regional refueling points, such as Singapore, face a similar dilemma or missile strike or supply ships traveling through contested waters and cannot likely be counted on to supplement Guam or Japan. This leaves Pearl Harbor as the next safest major U.S. refueling point. The number of T-AOs needed would jump significantly (and calculably, with

known demand and ship speeds) to have ships constantly on station to meet demand with the significant increase in distance to travel. This would require a greater investment on the part of the U.S. to make sure that these T-AOs are available, otherwise, aircraft will be without fuel and unable to perform strike operations putting the U.S. in a defensive position instead of offensive, prolonging the conflict and increasing the likelihood of ship attrition. The expanded routes that T-AOs must travel not only decreases their total defensibility but also increases the cost of their loss. Over shorter distances, ships can be rerouted, but longer distances will result in unavoidable stockout with a large lead time before the next available replenishment.

A stockout of JP-5 on a carrier turns one of the premier strike capabilities of the USN into a floating revenue sink, providing little combat value. Aircraft play a significant role in over-the-horizon targeting for surface ship strike capabilities, and the absence of reconnaissance aircraft decreases the effective range of surface ships, requiring them to move closer to their targets, increasing their likelihood of being fired upon, decreasing their time to react to incoming mainland missiles from China, and therefore increasing the likelihood they will be damaged. Aircraft serve not only a reconnaissance role but also a defensive role for the battle group. They can intercept incoming missiles, aircraft, or surface ships before they become a threat to USN ships. Stockouts thus decrease the defensibility of battle groups along with the time to react to threats. While USN surface forces have significant combat capabilities, the lack of aircraft would dull the edge of the USN sword. Aircraft by their nature are much smaller, more difficult to hit targets that can carry enough firepower to disable a ship or installation. They are also the best force to defeat enemy aircraft. While they can be operated without, the potency of a U.S. strike is severely diluted by their absence.

A stockout of JP-5 is a very expensive proposition not only for the USN but also for the USMC. The aircraft contingent aboard amphibious ships of PHIBRON 11 is specifically tailored to the insertion and support of USMC forces on land. Their role includes troop transport, vehicle/artillery transport, and close-in air support. While air superiority can never win a war, as noted through the U.S.'s experience in Vietnam, it is integral for protecting and clearing paths for U.S. soldiers and marines on the ground, as seen through its effective use in the Gulf War. A stockout for USMC aviation would have a similarly detrimental effect on the effectiveness of USMC ground forces. Aircraft would not be available to protect infantry from the incoming enemy vehicle and personnel fire nor would it be able to quickly remove injured marines from combat zones to get them the needed medical attention to save their lives. A USMC with no air support is a significantly dulled spear.

Proposed System:

This system is based on the recommendations from the CSBA report *Resilient Maritime Logistics* that were included in the early section corresponding to preparatory action, specifically the adoption of T-AOTs as forward-operating afloat fuel hubs and a quickened acquisition of new and improved T-AOs to complement them. Following the same considerations, that major bases in Japan and the base in Guam are rendered unusable or at the least damaged and reduced in capability, the proposed system adds an additional fallback layer. As noted in the previous chapter, T-AOTs are maneuverable and equipped with the currently available packages, can transfer fuel in heavier sea states in a manner mimicking the T-AOs. Whereas island bases are currently inside China's A2/AD rings, T-AOTs can be positioned outside at a safer distance. Prepositioned well, these vessels can avoid initial salvos and adjust positions relative to the perceived threat from Chinese forces to 7th Fleet. If the U.S.'s strikes take out numerous missile

sites, decreasing the A2/AD ring, T-AOTs can be moved in even closer than current bases, such as Guam. If there is a change in threat level, they can be tactically withdrawn to a safer distance. This increased survivability greatly decreases the stockout risk for crucial flight operations.

As mentioned earlier, it is the T-AOs that will be truly going into threat areas to refuel USN vessels. A quicker acquisition of new T-AOs increases the capacity of this crucial step of the chain with a vessel more advanced than what is currently in use. More capabilities and greater speed decreases lead times and even under high demand will enable T-AOTs to operate at a maximized safe distance. This acquisition would also be of a lesser magnitude than the one that is currently needed to boost combat logistics forces up to the level they need to be under the current system. This is because, with forward-deployed T-AOTs, the T-AOs do not need to transit the extended distance back to Pearl Harbor to refuel. Smaller distance means a smaller number of ships needed to meet fleet demands. While it is still an increase from the current force structure, an increase is needed no matter what and the implementation of T-AOTs will decrease the number of T-AOs to meet capacity requirements. Similarly, this decreases the likelihood of stockout from the loss of T-AOs in combat. The T-AOTs can adjust their position needed to meet demand, and work with other T-AOTs and commercial tankers to adjust their own refueling speeds and locations. The risk to air operations due to stockout is significantly decreased with the added benefit of increased efficiency under ideal circumstances due to the T-AOTs being able to maneuver where needed, including closer to the fleet than some Navy installations. This benefit especially comes into play as operations turn from a sea to a land battle.

While it is unlikely, it is necessary to consider what happens when T-AOTs are lost to combat. This risk, if positioning and USN submarine operations are done right, should be low

frequency, but it should also be low impact. CSBA notes that these T-AOTs could be purpose-built systems, but they could also be modified from current tankers on the market today. This gives the U.S. an easy way to buffer the stock of this vessel. Retrofitting a current tanker is much quicker than building a new one keel up, giving the USN flexibility in responding to demand for the T-AOTs. The CSBA also points out that in contingency "access to commercial U.S.-flag tankers can also be secured via an expanded MARAD Maritime Security Program" (Weston et. al, 2019) noting that under wartime flag carriers can be used by the U.S. government should necessity require it. We saw examples of this during the Gulf War as the U.S. took temporary control of U.S.-flag passenger aircraft to ferry troops across the Atlantic to quickly position them for combat. Utilizing this program decreases the budgetary expense of the government and increases the flexibility of response.

Decision-Making Process:

In a perfect scenario, the U.S. can meet the demand of its aircraft operations at all steps in the supply chain. Considering the advances of the Chinese military, it is not likely that the U.S. will come out of the war unscathed. Even if there are ships in reserve to replace supply ships lost, in that in-between time, decisions will have to be made to meet demand. Often these decisions will come with a trade-off: what are the trade-offs that need to be considered when supply is not guaranteed and who makes the decisions moving forward?

The first consideration that should be made is whether or not the fleet will be able to move where it needs to. As mentioned before, a Navy with no propulsion is useless, thus the demands of the ships most likely need to always be prioritized. To determine this, the equation for determining stockout costs of each type of fuel could be used, but in general, it will likely fall to the question of what is needed to meet ship demand followed by what is left over for aviation.

Whether there are exigent circumstances requiring aircraft to be prioritized should be primary among considerations. An example of this might be that when looking at a PHIBRON, stationed off the coast of China, supporting ground warfare, it may be beneficial to prioritize fuel for aviation elements in support of key operations on the ground. The question of who makes this decision jumps up beyond TF 73 if competition for resources arises between the CSG and the PHIBRON for JP-5. If the decision could be agreed upon between the commanders of U.S. Marine Forces Pacific and U.S. Pacific Fleet, or those they delegate to work out this agreement, then the issue could stop there. If not, it would likely need to be passed up to USINDOPACOM as the residing ultimate authority to make the decision. Having the more overarching view they would be in a better position to determine where sacrifices needed to be made and where they absolutely could not be made. This determination by USINDOPACOM would revolve around the state of the war and the nature of the problem.

If the problem is simply who gets the JP-5 their decision would look at the current operations underway and in planning. USN and USMC aviation generally fill two different roles: USN aircraft are predominantly focused on strike capabilities. If the operations are primarily at sea, against surface ships and aircraft, the USN will likely gain favorable status. This could be extended into mainland strike operations as USN aircraft are made for electronic warfare and kinetic warfare missions to disable enemy installations even far inland. While a major portion of the USMC aircraft is rotary, the very capable F-35 Joint Strike Fighter could fulfill similar roles that the Navy F-18s are playing. The preeminence, however, would not sift until the U.S. began to focus on amphibious assault and ground warfare. This is what the USMC is designed for and where their aviation forces will be key. Transportation and close air support will become the major focus as opposed to carrier-led operations. Aerial strikes and combat could be carried out

by the F-35 and it would be better to do so as it is easier and more effective to coordinate everything under a singular command structure. The Navy certainly will not be sitting idly by, but the focus will likely shift to Marine-led operations.

Having decided who needs the fuel, the allocation of such should be handed back down to TF 73. There are of course complexities that arise if say 5th Fleet were to transfer over. Whose supply lines would they use, their own, established 7th Fleet ones, new ones; what ships would be allocated to which T-AO/Ts; etc. But under the focus of a singular numbered fleet, management should be left to TF 73 acting on the operational demands of the other Task Forces. T-AOs should be assigned to specific operating groups, whatever that scale may look like, with T-AOTs assigned to an even split of forces with a focus on operating regions. Following the views of Moltke, great freedom of action should be afforded to subordinate commanders (Davis, 2005). There must be joint operations and a unified view of the intent of flag officers in a campaign, but the operational, task force, ship, and airwing commanders will generally know the best way to reach the intended goal. They are the ones carrying out the mission, they know their forces, so why unnecessarily restrict them.

Conclusion and Next Steps

The U.S. logistics force is unprepared to meet the demand of a distant war with China. It is constrained by specifically the number of vessels available to distribute fuel. Unfortunately, the USN faces an uphill battle of convincing Congress that a war with China, even though it is a low-frequency risk, is one of such magnitude that preparations need to be invested in. Not only that but specifically that the portions of the U.S. military that need investments are not the glamorous aircraft and weaponry, but the supply chain infrastructure that delivers the fuel, the very lifeblood which allows these more glamorous aircraft and armaments to be properly used.

The MSC is lacking in ships to meet the demands of the USN. While this demand may not be accurately quantified, the capacity issues are apparent and thoroughly documented by the CSBA in their report (Weston et. al, 2019). Following some of the recommendations presented will reduce the cost associated with building up the MSC to meet demand as well as innovate the way the USN and USMC run their supply lines. The purchase of a new class of vessel, T-AOTs, and use as a forward-positioned fuel hub afloat will decrease the number of T-AOs needed to refuel the fleet as well as decrease lead times, increase the defensibility of fuel storage, increase the flexibility of operations, and add new methods to refuel. The DLA should look at fuel sources in the West Pacific that could be contracted for fuel and the MSC should look at acquiring and fitting T-AOTs with abilities to quickly refuel from contracted civilian tankers at sea. This would mean T-AOTs need not return to Pearl Harbor but could meet civilian tankers somewhere in between to refuel, again decreasing lead times and increasing flexibility.

To adequately forecast the JP-5 needs of the USN and USMC, implementation of feedback systems on JP-5 fuel tanks aboard USN ships should begin immediately. Numerous electronic technologies are available to accurately determine the fuel levels and transmit that

information to an onboard database. This data should then be paired with information regarding the flight operations that took place, at a bare minimum the number of sorties, but ideally with what specific types of missions were flown as well. This information, compiled together, could easily be fed into data analytic software to find trends and approximate the fuel needs of specific operations, giving the USN some sort of forecast to predict how much fuel they will need and when they will need it. This decrease in uncertainty will allow the fleet logistics task force commander to better plan the movement of supply ships, the load they should carry, and have those demands met as operations are planned, being able to push fuel down the supply line instead of purely using pull methods.

To increase efficiency in the decision-making process, a clear hierarchy needs to be established on who has the authority to make what decisions, ultimately with the logistics task force controlling the movement of ships with superiors making decisions on who gets preeminence on fuel demand, jumping up to the level of seniority needed to encompass command over the parties involved. The structures are already in place, there is simply a need to affirm what it is. The process for consideration of what to move and where would be best to have a quantitative number to justify decisions. With data for forecasted demand, the MSC could use the information on ships' speeds, geographical positions, incoming weather, force availability to make decisions needed concerning lead time and ship positioning to maximize flexibility and minimize the risk of stockout.

Cyberwarfare is an ever-increasing threat as more and more objects in life become connected to the internet of things. The DLA needs to make sure that it is protected from electronic attacks so that the companies it sources fuel from are not discovered by the enemy, and those companies need to have higher enough security to fight potential attacks aimed at

discovering where fuel is being shipped. The enemy must be denied targets of opportunity so crucial to the success of U.S. operations.

Externally, it would be prudent to start identifying ships that are U.S. Flag Carriers and would meet the specifications to fill the role as a T-AOTs as alternatives to purchasing new vessels outright to supplement wartime numbers. Additionally, if the T-AOT is adopted it is important to begin getting these sea transfer systems retrofitted and tested out. Familiarity with the system during peacetime will significantly increase wartime efficiency. The U.S. naval forces are some of the most advanced fighting forces in the world, operating at extreme distances with incredible proficiency. But as Lt. Gen E. T. Cook, USMC stated so succinctly, “Clearly, logistics is the hard part of fighting a war.” All advancements in technology, tactics, and weaponry are bunk if the U.S. cannot get fuel where it needs to be when it is needed, in a consistent, predictable timeframe.

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EDUCATION

The Pennsylvania State University State College, PA
Smeal College of Business, College of Liberal Arts May 2021
Schreyer Honors College Dean's List 7/7 semesters
Supply Chain & Information Systems B.S.; French and Francophone Studies B.S.

EDUCATIONAL EXPERIENCE

Study Abroad in Montpellier Montpellier, France
University of Montpellier January 2020 – March 2020

- Built relationships across cultural and language barriers.
- Achieved academic goals while instructed fully in secondary language.
- Adapted and learned to thrive in new environments with new stressors.

Boeing Case Competition Fall 2019
2nd Place

- Developed 5-year plan for Boeing to scale back production of V-22s while remaining profitable with changes in contracts for aircraft.
- Provided method for reallocation of workforce to similar projects to allow decrease in production but maintain threshold for meeting flux in demand.
- Analyzed product supply chains to find components to insource, increasing production flexibility and remove bottlenecks on that component due to delayed deliveries.

Armada Corporate Project Fall 2019
Team Leader

- Organized and led communications between students, faculty and VP of Supply Chain Engineering.
- Mined data for trends in stockout reasons within DC to find key issues and develop ideas for minimizing those stockout reasons and their costs.

LEADERSHIP

Naval Reserve Officer Training Program State College, PA
Midshipman August 2017 – Present

- Instruct and mentor 50+ students in my company, preparing them for the rigors of active duty service focusing on academic, physical and character development.
- Attained knowledge of regulations and Navy programs to be able to provide all necessary documentation and resources for myself, peers or midshipman under my supervision in advancing their education and knowledge.
- Spend up to a month each summer learning leadership and technical skills during active duty training, which takes me across the country and into different professional areas of the Navy.

Navigators State College, PA
Leadership Team Member August 2018 – Present

- Formed 5-year vision for organization, with regional/campus directors and student leaders, to meet the spiritual and practical needs of Penn State students through community, service and worship.
- Volunteered renovating homes and providing meals for local communities through The Philadelphia Project, and built homes for those experiencing homelessness through Habitat for Humanity.