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As discussed in the future operating environment by the Places Without Bases concept, the United States must convert to a faster lift capability that can deliver Marines over thousands of miles in hours instead of days. The troops coming ashore must be capable of doing so farther from the shore in high-speed amphibious vehicles, and logistical support for these Marines must be delivered to the shore with less risk to personnel or equipment. Therefore, US Armed Forces cannot continue to operate as they did in World War II and must leverage greater speed and maneuverability to its advantage.

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MASTER OF MILITARY STUDIES

Expeditionary Operations without a Forward Base:
Using Wing-In-Ground Craft with Other High Speed Connectors

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

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Executive Summary

Title: Expeditionary Operations without a Forward Base: Using Wing-In-Ground Craft with Other High Speed Connectors

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Thesis: To overcome the obstacles determined proposed in the future operating environment by the *Places Without Bases* concept, the United States must convert to a faster lift capability that can deliver Marines over thousands of miles in hours instead of days. Additionally, the troops coming ashore must be capable of doing so farther from the shore in high-speed amphibious vehicles, and logistical support for these Marines must be delivered to the shore with less risk to personnel or equipment.

Discussion: Based upon the successes during World War II, the United States has continued to emphasize the same expeditionary tactics for future conflicts. The expeditionary capability and forward basing of United States forces underpin the nation's ability to maintain this forward defense, but those capabilities may not always be available. The forward operating environment discussed in the *Places Without Bases* concept describes a situation where the United States may not have a forward operating base and must conduct operations from launching points as far away as the mainland. The adversary will also enjoy technologies that deny the United States access close to its shores. Fast-moving, long range lift capabilities will be needed to deliver troops and supplies into the area rapidly. A large-scale wing-in-ground craft concept could provide the lift from thousands of miles away in a matter of hours, limiting the time available for the enemy to prepare for an amphibious landing and minimizing the risks normally associated with slow-moving amphibious ships. Once the troops reach the point of debarkation, high-speed, lightly-armored personnel transports move the armed troops to shore while unmanned shipping containers deliver the needed supplies.

Conclusion: The bottom line is that the likely future environments associated with *Places Without Bases* requires a different approach to expeditionary warfare. US Armed Forces cannot continue to operate as they did in World War II and, at a minimum, must leverage greater speed and maneuverability to its advantage. Therefore, the Department of Defense should consider available technologies and concepts to modify its approach to expeditionary operations instead of continuing to purchase only upgraded ideas to current assets.

DISCLAIMER

Table of Contents

List of Figures

Introduction

Current expeditionary assets and planned future upgrades to platforms do not overcome the deficiencies US forces will face against future enemies in a denied environment. In a worst-case scenario, the United States will no longer enjoy the benefits of at least one forward-deployed base in the area of hostilities. In a more likely scenario, the United States will retain at least one base of forward-deployed forces; however, the enemy will limit access of reinforcements and supplies into and out of this base. Based on these assumptions, US forces will be required to deploy from much farther away from the target. The beginning of this long-range fight highlights the weakness of the United States' expeditionary plan.

The expeditionary plan starts with the relationship between the US Navy (USN) and the US Marine Corps (USMC). The USN uses its amphibious fleet to protect and transport USMC forces to their planned point of debarkation. Once the Marines leave the ships, they embark on a slow journey in armored vehicles to the shore – most likely under hostile fire from the enemy. From the moment the fully-loaded ships leave the harbor until the Marines establish a defended foothold on the foreign shore, both USN and USMC forces are vulnerable to catastrophic loss with minimal opportunity to counter the adversary. This form of expeditionary warfare may have worked in World War II, but it is an outdated concept that needs to be replaced in future conflicts.

No longer can the United States depend on the slow moving amphibious shipping that carries Marines and supplies to shores great distances from the home bases on the mainland. The development of anti-ship cruise missiles pushed the defensible range of hostile territories farther out to sea, and prohibit the close-in delivery of slow moving vehicles from the ship to the shore. Instead, the United States must convert to a faster lift capability that can deliver Marines over thousands of miles in hours instead of days. Additionally, the troops coming ashore must be capable of doing so farther from the shore in high-speed amphibious vehicles that sacrifice some armor for maneuverability. Finally, logistical support for these Marines must be delivered to the shore as well, with less risk to personnel or equipment.

Most importantly, due to the nature of the conflict, these expeditionary operations will take place without a forward operating base. At some point in the conflict, US forces will be forced from territories held and traditionally relied upon for staging forward-deployed forces. The United States will then have to conduct operations from thousands of miles away from the objective, taking days or even weeks using amphibious ships currently in use or in the planning process, just to reach the objective.

Future Operating Environment

Conflict in the future looks much different than it did in the past. Proliferation of advanced weapons technology will bring once third-world countries to a near-peer status with the United States. These near-peer competitors will include all of the aspects of warfare that were once dominated by the world super powers. The advancement of these countries' hostile intentions toward the U.S. or its allies will result in limited access by US armed forces into the enemy territory and serious opposition to any attempt to land on its well-protected shores.

The first obstacle encountered by any expeditionary operation of the future is entry within striking distance of the enemy's air and surface defenses. Advanced radars, signals intelligence, and other forms of information gathering not yet conceived further extend the defensive range well beyond those of today. Fixed defenses may be removed as a viable threat by using long-range land attack missiles, but moveable defenses may require aircraft entry into the effective range of these weapons in order to neutralize the threat. It is highly likely that aircraft carrier based aircraft will be equipped with the latest technologies to minimize their vulnerability to these defenses.

Once forces gain access close enough to shore to conduct an amphibious landing, the enemy defenses that survive the long-range bombardment will eliminate forces gathering for assault quickly. High profile amphibious ships that must move close to shore to deliver forces will be the most vulnerable. Coastal defense missiles will easily determine a target, launch quickly, and travel at supersonic speeds toward the target. Even if ships are equipped with the latest missile defense systems, countries who have had a significant amount of time to prepare against expeditionary operations will fire missile salvos large enough to overwhelm even the best ship defenses. For the landing vehicles that make it through the initial onslaught, shore gunfire defenses will have progressed to the point where slow-moving vehicles approaching the beach will have little chance of success.

The future operating environment is filled with uncertainty; we cannot predict any single event, but we must try to anticipate a range of possible alternative futures.[1] In those futures anticipated by the ASP "Places Without Bases" team, it appears likely that future hotspots will be in both Africa and Southeast Asia.[2] In Africa, China's influence is expanding rapidly, and we may well see in the future some formal technological transfer of Anti-Access/Area Denial capabilities to African countries where China's resource and infrastructure investments constitute a deep sunk cost, with limited access in the meantime for "engagement" by US and allied forces due to Chinese economic and diplomatic influence.[3] In Southeast Asia, we may likely find that we are indeed pushed out of long-held territories within the threat range of China's own current and future A2/AD systems. A very real need for "Plan B" is to be able to operate to operate from long range to liberate such territories.[4] Such a Plan would not be popular to implement, but demonstrating the ability to do so and prevail should go far toward ensuring that we never need to implement it in the first place. Thus, developing a robust capability for operating from beyond the range of the enemy's missile systems and delivering "amphibious" forces rapidly to the territory in dispute is crucial to both deterrence and, in the event of war, victory.

Short Explanation of WIG

To accomplish this change to the future operating environment, the United States could adopt and refine previously existing concepts and commercial off the shelf (COTS) technology. Long-range personnel and cargo delivery can be accomplished by the Wing-In-Ground (WIG) effect craft concept developed by the Soviet Union in the 1960s. The solution to rapid personnel delivery to the shore can be found in the one of two types of high-speed amphibious craft produced by Gibbs Amphibians. Lastly, unmanned cargo containers could be delivered to shore or placed in various predetermined locations using the Sea Truck concepts developed by AEPLOG, Incorporated. Combining the capabilities listed allows for a rapid response to rising hostilities in remote and denied areas of the world with reduced risk of destruction to equipment and without the need to establish a forward sea base.

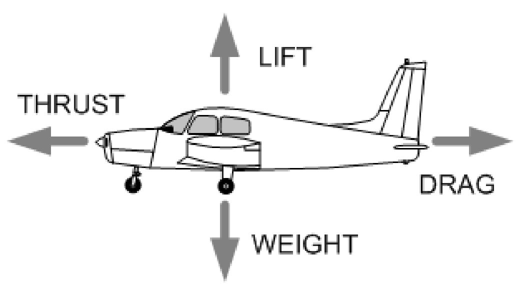

Figure 1: Basic forces acting on an aircraft.

First, this paper discusses the long-range capability of WIG to provide rapid movement of personnel and supplies to a denied environment. For the purposes of describing the basic operation of aircraft, four general terms will be used in describing forces that allow any craft to achieve flight – thrust, lift, drag, and weight and are shown in figure 1. Thrust and drag oppose each other in the horizontal direction, and lift and drag are opposing forces in the vertical direction. For example, when an aircraft remains stationary, thrust equals drag and lift equals weight. For an aircraft to move forward the force of thrust must overcome drag; and for it to move upward, lift must exceed weight.[5]

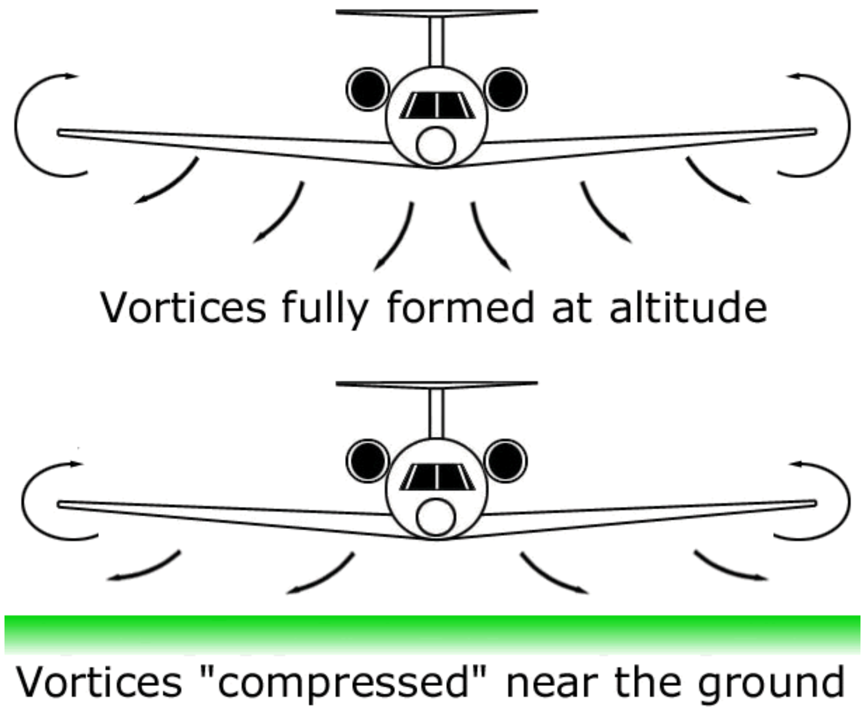

Figure 2: The change in air flow due to a terrestrial barrier.

A WIG craft is a type of aircraft the uses the effect of compressing the air between its wings and a terrestrial barrier, either land or water, due to the forward motion of the craft. The compression of air produces a pressure on the underside of the aircraft wing. This pressure is in addition to the upward force created by the shape of the wing itself, and the composition of both forces increases the upward force on the wing to create an enhanced lifting force on the wing, and the aircraft as a whole. As an added benefit, the barrier that compresses the air flowing underneath the wing also disrupts the vortices of air normally created at the tips of the wing due to the convergence of high pressure and low pressure air flow (Figure 2). These vortices create additional drag which requires additional thrust and thus, reduce fuel efficiency. Because the barrier disrupts the lateral airflow, this altered airflow results in vortex reduction and reduced drag on the craft. These factors increasing lift and reducing drag demonstrate greater fuel efficiency for a given weight of a craft flying using the ground effect versus normal aircraft flight at higher altitudes, referred to as free flight.

A WIG flying using the ground effect model does present some drawbacks. First, a craft flying low to the ground results in a greater drag force when compared to high altitude free flight based on air density closer to the ground. Because of this, cargo craft of sufficient size to move large payloads must utilize a large wing span to increase lift and reduce drag. Additionally, environmental factors such as weather, wildlife, and physical obstructions add hazards to flight that diminish as altitude increases.

Conceptual specifications of a large cargo WIG

Based on the WIG concept, a large cargo aircraft could be used to replace amphibious ships in delivering Marines to a denied environment for expeditionary operations. In the early 2000s, Boeing developed a proposal to the for an ultra large transport aircraft (ULTRA) capable of delivering a payload of up to 1,400 tons a distance of 10,000 nautical miles over water.[6] The Pelican concept as it was named is a WIG effect aircraft with a 500-foot wing span that was large enough to transport up to 17 M-1 battle tanks or 190 standard 20-foot containers at one time. The wings are designed to fold when landing on an airstrip and still achieved the desired lift necessary for controllable flight. With an airspeed of over 200 knots, this WIG would deliver its cargo over ten times faster than normal maritime shipping. Comparing early WIG prototypes, the Soviet KM, or “Caspian Sea Monster”, had a wingspan of just over 123 feet and the Hughes H-4 Hercules, or “Spruce Goose”, had a wingspan of 321 feet.[7]

Figure 3: The Pelican unloading cargo on an airstrip.

The design of the Pelican achieves cargo loading and unloading through both a hinged nose and an aft loading ramp. The cargo compartment reaches approximately 20 feet in height and the double-decked fuselage compartment holds 100 such containers on the lower deck with 50 on the upper deck. The wing sections can hold up to 40 containers.

Using a WIG for expeditionary operations

In order to perform expeditionary operations, Marines must be delivered from a base, either forward-deployed or the United States. After the initial advance upon the objective, the Marines require necessary supplies to maintain the newly-established foot hold in enemy territory. Unfortunately, US Navy ships provide the only current method to accomplish an operation of this character. The ships travel at speeds of around 20 knots and usually begin from thousands of miles from the objective.

The current concept of deploying Marines requires the slow-moving ships to move close-in to shore to deliver these troops by way of landing craft and amphibious assault vehicles.

Depending on the craft being launched, the ships ship-to-shore connectors required the amphibious ships to move in to within a few nautical miles from shore. Although this distance minimizes the time that the connectors are vulnerable while transiting to shore, the vulnerability of the large amphibious transport ships increases.

In a denied environment, amphibious ships may not proceed within sight of shore. The proliferation of anti-ship cruise missiles around the globe severely limits how close the ships may be able to proceed to shore. Even with the self defense systems installed on these ships, an overwhelming salvo of missiles from shore could easily put an end to the expeditionary operation before it even commences. Additionally, if the adversary employs a submarine threat, the ships may not even make it into the area of operation.

If the war plan exercises the option of attaching surface warships or a carrier strike group to the amphibious ships, the threat may be reduced. Surface warships provide an added defense to the expeditionary operation both in cruise missile defense and ant-submarine warfare (ASW) if needed. Aegis guided-missile destroyers and cruisers bring the ability to provide area defense of all surface units against cruise missiles for a period of time, again depending on the missile salvo size. They are also equipped with the latest in sonar and undersea weapons systems to be used if needed. The more useful option to defend the amphibious operation would most likely be the long-range assets provided by the aircraft carrier. Strike missions assigned to aircraft could demonstrate effectiveness against the located ground targets like missile launchers on shore. Both of these options require expensive ships to enter dangerous areas with what could be a lowering possibility of survival as the ships move closer to the opposed shore. For this reason, the warships may need to remain at maximum range while conducting long-range land strikes using aircraft and conducting ASW. Tomahawk land attack missiles (TLAM) effectiveness against enemy targets can be reduced by mobile launchers, and thus will remove one of the most effective strike methods the U.S. has used in recent history.

Due to the recent and future dangers presented by a near-peer adversary in the future operating environment, an ULTRA WIG provides a sensible alternative to the current concept of operations. An aircraft with large cargo capacity that flies a sea-skimming profile at high speed reduces the major vulnerabilities currently present in an expeditionary operation. The unique capabilities of lift provided by a WIG craft present several advantages over conventional lift.

First, the significantly higher transit speed reduces the overall time required to commence the operation and limits the adversary response time. Troops can be loaded into the WIG with necessary support equipment for the mission at hand at predetermined bases. Moving the WIG to the associated base would take a matter of hours instead of days to begin the loading process. Loading the necessary equipment will be accomplished relatively quickly from an airfield instead of the time-consuming transfer from shore to the transport ship. Additionally, the speed coupled with the sea-skimming flight profile raises the difficulty for search radars to acquire and track the WIG, even one of the sized of the Pelican. Although enemy target acquisition against the US armed forces today most likely look for high-altitude, high-speed aircraft or slow-speed surface ship traffic, they will adapt procedures to look for the WIG craft; however, land strikes and enemy radar capabilities may make detection of an incoming WIG difficult.

Another advantage of the Pelican comes from its operating environment. Since a WIG is normally an aircraft that flies close to the water, it is not susceptible to the threat provided by a submarine for the majority of the transit. The WIG would only be vulnerable to a subsurface threat when landing, moving into position, unloading and reloading as required, and taking off to return to base. Based on the speed and maneuverability of the WIG, a credible subsurface threat requires assets to be in close proximity to the WIG landing zone ahead of the craft actually arriving on station.

Since the Pelican is designed to be a land-based craft, loading and unloading of troops and supplies can occur from a base far inland, and this could allow for more options in cargo to better suit the desired mission of the Marine Corps. Although the range becomes significantly reduced when transiting over land, a 40 percent reduction leaves a range of over 6,000 nautical miles when cruising at 20,000 feet. This particular WIG demonstrates versatility by not only accomplishing the expeditionary mission normally reserved for the US Navy and Marine Corps partnership activities, but it can be utilized as a cargo lift between friendly airstrips similar to the relationship normally seen with the US Army and Air Force. As a result, this could become a partnership between the US Air Force and the US Marine Corps by combining the normal strategic lift function of the Air Force with the expeditionary nature of Marine Corps operations.

The Pelican concept comes with the added benefit of initially replacing Maritime Prepositioning Force ships. Cargo loaded onto the Pelican can be configured for delivery to the shore by way of amphibious barges or containers. In the event of a contested environment preventing the acquisition of a port controlled by the adversary, the cargo capability provided by the Pelican can deliver additional combat power and logistical support to the shore without the need of a port. Further, the supplies can be loaded onto the Pelican in good working order and delivered to the operating environment before the equipment store on prepositioned ships can even make it to the area of operations with the added security of not having to deal with surface and subsurface threats that are sure to be encountered by the slower moving surface ships.

In order to accomplish the expeditionary operations proposed, the Pelican concept requires some modifications. In contrast to early WIG craft tested by the Soviet Union, the

Pelican proposal operates only from airstrips. Operating from land reduces the structural reinforcements required to the fuselage as the stresses due to take-off and landing are absorbed by the landing gear. To make a Pelican a feasible amphibious craft, the structure would have to be reinforced as necessary to withstand the forces applied by the water by the acceleration or deceleration of the WIG during take-off and landing. As a result, cargo capacity could be greatly reduced; however, a reduction in payload capacity by 50 percent would still dwarf that of current and planned amphibious ships of the US Navy. Additionally, the rear loading ramp would require modification to support offload at sea. In this concept, amphibious vehicles and containers require the ability to drive off the ramp and into the ocean in rapid fashion in order to minimize the vulnerability window for the WIG.

Although cost estimates of the Pelican have not been made available, this analysis uses an estimate based on a comparison to the US Air Force B-2 Spirit bomber. Due to the size and complexity of the aircraft, the unit cost a B-2 reached $1.16 billion in 1998 dollars[8]. Therefore, a reasonable figure of $2 billion will be estimated for the Pelican concept. As proposed, the Pelican will replace two *San Antonio*-class amphibious transport dock ships at a cost of $2 billion each, and with capability to be used in place of two maritime prepositioning ships, at $500 million each, due to its rapid cargo delivery.[9] This results in an estimated savings to the US Navy of around $3 billion.

A new amphibious vehicle

The US Marine Corps has used the current Landing Vehicle, Tracked, Model 7 (LVTP7), or more commonly used Amphibious Assault Vehicle (AAV) Model 7 with various capability upgrades since 1972. This tracked vehicle drives out the aft end of ships and carries up to of 25 personnel to shore with an advertised maximum speed of around 8 knots. Due to its tracked propulsion, the AAV can also overcome obstacles up to 36 inches in height.[10]

The drawbacks of this AAV become clear when demonstrating an amphibious landing. First, the AAV must approach the shore from a short distance when compared to other frequently used landing craft. This elevates the danger of the transport ship delivering the AAV to the point of debarkation as well as the AAV itself. Further, the armored vehicle is slow and possesses limited maneuverability in the water. The 8-knot approach speed requires a calm sea state to limit resistance to propulsion. Any significant sea state not only reduces the speed of advance to shore, but could prohibit the usage of the AAV altogether and force troops movement to shore by way of other means. Finally, the fighting effectiveness of the Marines inside the AAV could become reduced the longer they remain inside the AAV while advancing toward shore. Although World War II Marines endured many hours in amphibious connectors to get to shore and were effective once there, the fact that the United States still employs a WWII tactic to take a beach is means to look for an alternative method. To quote Lieutenant General Robert Walsh, commanding general of the Marine Corps Combat Development Command, “My father was in World War II. He went ashore in an AmTrac going four to six knots… Marines today are going to shore in [assault amphibious vehicles] at about the same speed. Let’s look at the technology out there and find different ways to do this.”[11]

A new approach to deliver Marines to the objective provides a solution to this problem by using a current commercial design with modifications. When approaching the problem, speed and maneuverability took top priority. The other criteria maintained the coherence of a typical Marine Corps infantry squad. Consisting of 12 squad members with a squad leader and assistant squad leader, the solution required a capacity of 14 personnel. Figure 4 shows two variations of the Phibian amphibious craft produced by Gibbs Amphibians in the United Kingdom that meets these criteria.

Figure 4: Unenclosed and enclosed versions of the Gibbs Phibian.

At roughly the same size, 30 ft long by 8 ft wide by 12 feet high, as the standard Model 7 AAV, the Phibian craft weighs in just over 13,000 pounds gross weight compared to the standard 42,000 of an AAV. Understanding that the AAV brandishes armor plating and weaponry with an enclosed troop compartment while the Phibian does not as it is designed for recreational and civil use, the Phibian design can be modified to some extent to suit military needs.

As stated earlier, the Phibian meets the speed and maneuverability requirements. Design specifications of the Phibian list a greater than 30 mph speed on the water accompanied by a 70-mph land speed. The passenger capacity of 15 actually fits the concept of delivering a fighting force to shore using more craft that take advantage of higher speeds and more maneuverability, thus distributing the Marines and limiting the number of troop losses that occur when one transport vehicle is taken out of service and the probability of more squads making it to shore is increased.

As with the Pelican, design changes will be required to make this platform a feasible option of troop delivery. The addition of armor to the Phibian is needed to increase survivability of the craft and passengers. It is understood that the added armor will come with a decrease in craft speed; however, careful consideration must be made as to how much speed and maneuverability should be sacrificed. Also, adding weight will affect the ground clearance and land maneuverability unless the suspension is upgraded to accommodate the addition. To match the AAV currently in service, the Phibian must retain at least 12 inches of ground clearance[12] to retain maneuverability in rugged terrain. Finally, mounted weaponry and communication gear must be added to make the Phibian functional in the expeditionary environment.

Survivable cargo delivery

Increasing the ease of delivery and survivability of cargo required to support the Marines in theater is a must. Ideally, the cargo should be delivered using industry standard containers and minimize the risk to personnel involved while in a hostile environment. As stated earlier, the Pelican has the capacity to deliver up to 190 standard 20-foot containers. If there were a reasonable way to deliver numerous containers to shore without the need for a port, the WIG concept would demonstrate even greater functionality in an expeditionary environment. The Sea Truck design by AEPLOG, Incorporated for unmanned cargo delivery[13] could be the ship-to-shore connector method of delivery from the proposed WIG craft.

Figure 5: Various versions of Sea Trucks.

Also, other groups of Sea Trucks bring even more unmanned options to cargo delivery. One category of Sea Truck can function as a liquid or petroleum deliver platform from sea to the shore. Another variation can be assembled at sea to form floating platforms for various vehicles, depending on sea state. Together, these Sea Trucks could form an at-sea refueling landing platform, or "lily pad", to increase the overall effectiveness of vertical take-off and landing aircraft. Figure 5 illustrates several configurations of the Sea Truck.

The modular design of the Sea Truck matches an expandable bow module with an aft propulsion module to the ends of a standardized cargo container creating an unmanned surface craft capable of travelling 300 miles and achieving speeds of 40 knots.[14] An operator controls the entire delivery system by way of a portable remote control unit that fits into a hand-carried case. The system is designed for complete retrograde recovery of the propulsion and bow modules for reuse.

With this technology, logistic personnel on shore could drive several modules to shore at once after the containers are assembled and offloaded from the Pelican. Multiple containers can travel to shore with increased survivability probability, enhancing the effectiveness of the

Marines already ashore and minimizing the possibility of loss of personnel during the transport process.

Case Study: The Falkland Islands Conflict[15]

Since the end of World War II with the advent of air warfare and the end of broadside battles of the dominant battleships of the day, the navies of the world had not witnessed the employment of existential threats to their warships, the challenges of fighting in a conflict thousands of miles away from the nearest point of logistic reinforcement, nor the results of attempting to perform these maneuvers in an expeditionary manner. That all changed when Argentina invaded the Falkland Islands (known to the Argentinians as the Malvinas) in April, 1982. After the United Kingdom's Prime Minister Margaret Thatcher, deeply entrenched in a political battle in which she and her party were losing at home, deployed the task force to counter this invasion. She and the rest of the United Kingdom learned that threats to the mission included more than opposing the invading force. They dealt with conducting expeditionary operations without prior planning or surface fleet support, protecting the task force in the environments of air warfare and anti-ship missiles, and performing it with an over-extended logistic chain.

On a relatively small cluster of islands in the South Atlantic Ocean, about 400 miles from Argentina and 8000 miles from London, an ongoing territorial dispute culminated in an invasion over 200 years in the making. In 1767, the British Marines established a presence on the Falkland Islands, and with the exception of a five-year period from 1826 to 1831, had maintained a near continuous presence there until the conflict in April 1982. Throughout the years of British settlement on the islands, the Argentines maintained a claim of that territory as well as the island of South Georgia 800 miles further east, also permanently inhabited by British.[16]

Upon the coming into power of the military junta in December 1981, led by General Leopoldo Galtieri, the Argentinians sought to reclaim the Malvinas. On 5 January1982, the Junta decided to "reactivate to the fullest extent all negotiations for the sovereignty of the Malvinas, South Georgia and South Sandwich Islands."[17] Coinciding with the declaration to open negotiations, the Junta began preparations for a military option to reclaim the islands if necessary. Derived from Argentine National Security Directive 1/82, the Junta began secret planning of military operations for a bloodless occupation of the disputed islands in hopes that there would be minimal reaction by the British, and enhance the Junta position for later negotiations.[18]

The short conflict started when Argentine Marines landed on the islands on 2 April 1982, and ended with the conclusion of active hostilities on 12 July 1982, although the full exclusion zone was not lifted until 22 July 1982. Events within this timeframe range from the requisitioning of merchant ships and the dispatch of British Forces to the disputed islands, stopping at Ascension Island halfway through the journey, the planning and conducting of the amphibious assault, to the surrender of Argentine forces.[19]

On 2 April 1982, the first elements of the British Task Force (CTF 317), commanded by Admiral Fieldhouse who remained in the United Kingdom, sailed south for the Falkland Islands and Operation CORPORATE had begun. Over subsequent days, the remainder of the Amphibious Task Group set sail as well. The Landing Force travelling in various warships, Royal Fleet Auxiliary (RFA) ships, and Ships Taken Up From Trade (STUFT), essentially merchant ships requisitioned by Queen Elizabeth II for use in the conflict, departed the United Kingdom and regrouped mid-journey at British base on Ascension Island. In order to convey the proper political signal to the public, the RFA and STUFT hastily set sail from the British Isles and required a reorganization of their combat loads to effectively conduct the planned expeditionary operation.[20]

To begin, the Royal Navy did not properly support the force with the necessary ships or aviation assets. At the start of the CORPORATE, the fleet did not possess an adequate number or type of ship required to conduct an operation so far from home. In order to assemble the assets required, Queen Elizabeth II signed an Order-In-Council that authorized the Department of Trade to requisition any British-flagged ship and its contents for the conflict.[21] In all, the government procured 59 STUFT for use in CORPORATE to include roll-on roll-off (RORO) ships, trawlers, cruise liners, freighters and tankers. During the short duration of the conflict, only one of the STUFT sank from an Argentine attack, the *Atlantic Conveyor*.[22] Although these ships could be used for supply and reinforcement of troops conducting landings and movement once a beachhead was established, the larger ships ferried jets and helicopters to the battlefield.

Additionally, Naval Gun Fire Support (NGFS) was hindered by the small number of ships guns at the landing site. With the fleet's attention focused on fighting threats from the Soviet Union during the Cold War, the Royal Navy developed and used more Anti-Submarine Warfare (ASW) ships that restricted its ability to provide shore support to the Royal Marines.[23] Specifically, the Type 22 Frigates were armed with only one 4.5-inch gun[24] and the Type 21 Frigates had one 4-inch gun.[25] The reduced number of guns per ship required more ships on station for NGFS which was a significant degradation from the supporting ships of World War II. To further reduce the capability of these ships, the minimal number of Anti-Air Warfare (AAW) weapons meant the majority of these ships had to withdraw from NGFS missions during the daylight hours to prepare for incoming air threats and the need to maneuver as needed.

The United Kingdom displayed the reduced survivability of a fleet designed for a Cold War enemy and assembled in such a rapid manner with supplemental merchant ships during Operation CORPORATE. First, the Royal Navy modified the STUFT in a minimal manner. The conversion only added equipment required to transport and operate the assigned cargo. For most of the 59 merchant ships, the shipyards modified them by adding helicopter pads and modifying holds to be used as ammunition lockers.[26] The Royal Navy did not add significant weapons systems to these ships, and, thus, ship's self-defense was not a concern. For the warships sent to the Falkland Islands War, the organic missile defense systems did not provide a tremendous amount of protection for the warship and even less for any other ships in the area. The older Type 21 *Amazon*-class frigates operated with one SeaCat quadruple-tube launched Surface-to-Air Missles (SAM),[27] and the Type 22 *Broadsword*-class frigates employed two sextuple-tube launched SAM.[28] Both classes of warships used a version of the SeaCat fire control radar for their SAMs, and this system led to the air defense vulnerability of these ships. Essentially, the inability the radar tracking system to detect and engage a salvo of more than two missiles proved to be a combat weakness of the warships.

Additionally, the missile systems designed to combat Soviet threats proved weak against missile threats of the western world. The weapons systems designed and used by the Royal Navy demonstrated effectiveness against large air-to-surface missiles that approached from high altitudes. The weapon system designs did not take into account for a western designed missile. The French *Exocet* missile approaches with a sea-skimming profile even when launched from an air platform.[29] The glaring design omission of the protective systems stems from the failure to think that powerful western countries would battle third-world nations that purchased and employed western missiles. As a result, three British ships - *HMS Sheffield, HMS Glamorgan* and the *Atlantic Conveyor* - sustained damage from *Exocet* missiles, and only the *Glamorgan* did not sink.[30]

The logistic problems faced by the United Kingdom combined the previously mentioned lack of ships along with moving these assets the incredible distance from the British Isles to the Falkland Islands. In order to provide a politically sensitive response to its sovereign territory, the United Kingdom had to move forces the 8000 miles in an expeditious manner. With no available airfields in South America, the majority of pre-war staging took place at Ascension Island. At 3800 miles from the Falkland Islands, Ascension Island played the role of forward staging base for logistics and air attacks against Argentine forces.[31] Even at this reduced distance, aircraft still required air-refueling in significant numbers to achieve operational capability when the Falkland Islands were reached. Also, the response took over one month from the initial departure of British forces on 5 April until the establishment of a beachhead on 21 May.[32] This elapsed time was mainly because of the required transit time of shipping. Since no significant force remained in the general area of the Falkland Islands, critical time elapsed that could have resulted in a buildup of Argentine forces on the islands if there was some expectation of full retaliation by the British.

Despite its advancements in the post-World War II era, the United Kingdom fought a conflict in which it was ill-equipped when it comes to the Falkland Islands War. The fact that it had to conduct an expeditionary operation to defend sovereign British territory without having a significant force near the area nor the shipping necessary to conduct a long-range expeditionary landing proved to be a daunting task. To further complicate things, the British had been planning and designing systems to combat the Soviet Union and not a third-world country equipped with weapons purchased from Western powers; however, the excellent planning and the superb training of the forces involved allowed the British to overcome these challenges and come out victorious. In the end, the Falkland Island War was a much-needed victory for a country that was struggling at home to deal with Cold War issues and a trial of ideas and equipment designed to fight a completely different enemy.

Conclusion

Based upon the forecasted future operating environment and the difficulties encountered during the Falkland Islands conflict, the United States requires development of assets and tactics designed to counter a more capable adversary. The WIG concept provides an entirely new means of personnel and cargo transport for expeditionary operations that fits this need. A versatile asset capable of transport of personnel, fighting vehicles, and cargo into the area of operations makes sense to meet this objective. Also, fast-moving personnel transport connectors and unmanned cargo delivery methods will reduce the casualties received and increase the survivability of units able to conduct the expeditionary operation. Additionally, the personnel transport and unmanned delivery methods exist and can be readily incorporated into current tactics for future development and use.

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[1] Christopher Wagner, "Considering the Future: Removing Blind Spots in Forecasting" (master's thesis, Marine Corps University, 2017).
[2] Adam Stenberg, "The Past as Prologue, the Future in Forecasting: Preparing the US Military for Conflict in 2030" (master's thesis, Marine Corps University, 2017).
[3] Jane Oren, "The African Future Environment: Facing Chinese Influence Across the Elements of National Power" (master's thesis, Marine Corps University, 2017).
[4] David Meadows, "Defeating Comparable Competitors While Hiding in Plain Sight: An Alternate Plan for an Alternate Future" (master's thesis, Marine Corps University, 2017).
[5] Brian Dunbar, "The Four Forces of Flight," *NASA Education*, last updated April 10, 2009, https://www.nasa.gov/audience/foreducators/k-4/features/F_Four_Forces_of_Flight.html
[6] William Cole, "The Pelican: A big bird for the long haul," *Boeing Frontiers* 1, no. 5 (September 2002), http://www.boeing.com/news/frontiers/archive/2002/september/i_pw.html
[7] Leo Byun, Kiley Donohue, Michael Mayo, Julian McCafferty, Ruth Miller, *Ground Effect Vehicle Transoceanic Civil and Cargo Transport Network*, (NASA Aeronautics Academy, August 21, 2014), presentation, https://nari.arc.nasa.gov/sites/default/files/attachments/IFAR_AeroAcademy_2014.pdf
[8] Air Force Global Strike Command Public Affairs Office, "B-2 Spirit," last modified December 2015, http://www.af.mil/About-Us/Fact-Sheets/Display/Article/104482/b-2-spirit/

[9] Congressional Budget Office, 114th Cong., 2015, *An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan*, 21-23, https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/50926-shipbuilding-2.pdf
[10] *Jane's Land Warfare Platforms: Armoured Fighting Vehicles*, "BAE Systems AAV7A1 (LVTP7A1) Amphibious Assault Vehicle," October 19, 2016, http://janes.ihs.com.lomc.idm.oclc.org/Janes/DisplayFile/JAA_0251
[11] Hope Hodge Seck, "Marines on the Hunt for a Ship-to-Shore Game-Changer," *DoD Buzz Online Defense and Acquisition Journal*, (September 28, 2016) https://www.dodbuzz.com/2016/09/28/marines-hunt-ship-shore-game-changer
[12] John Pike, "LVTP7 Landing Vehicle, Tracked AAVP7A1 Assault Amphibian Vehicle Personnel," Global Security.org, last modified November 01, 2016, http://www.globalsecurity.org/military/systems/ground/aavp7a1.htm
[13] "Versatile Unmanned Sea Trucks (and Sea-Truck-Based Platforms) for Autonomous Maritime Logistics," AEPLOG, Inc. Unmanned Logistics, http://www.aeplog.com/aeplog/index.html
[14] Ibid
[15] Johnny Lykins, "Operation CORPORATE: Significant Problems That Did Not Cost the United Kingdom the War" (unpublished manuscript, March 6, 2017), Microsoft Word file.
[16] Julian Thompson, No Picnic: 3 Commando Brigade in the South Atlantic 1982, (New York: Hippocrene Books, Inc, 1985), 2.
[17] Lawrence Freedman, The Official History of the Falklands Campaign: Volume I: The Origins of the Falklands War, (New York: Taylor & Francis, Inck, 2005), 154.
[18] Ibid
[19] Peter Hore, "The 'Logistics Miracle' of Ascension Island." In The Falklands Conflict Twenty Years On: Lessons for the Future (New York: Frank Cass, 2005), 4-6.
[20] Julian Thompson, "Chapter XXXIV Falkland Islands (Op CORPORATE, May-June 1982)." In Amphibious Assault: Manoeuvre from the Sea – Amphibious Operations from the Last Century, edited by Tristan T. A. Lovering,(London: Crown, 2005), 435.
[21] A. D. Baker III, "Sealift, British Style." Proceedings (June1983), 111.
[22] Ibid
[23] Norman Friedman, "Surface Combatant Lessons." In Military Lessons of the Falkland Islands War: Views from the United States, (Boulder: Westview Press, 1984), 22.
[24] Sandy McClearn, Type 22 Multi-purpose Frigate, Haze Gray & Underway, March 15, 2017, http://www.hazegray.org/navhist/rn/frigates/t22/
[25] Sandy McClearn, AMAZON Class (Type 21), Frigate, Haze Gray & Underway, March 15, 2017, http://www.hazegray.org/navhist/rn/frigates/amazon/
[26] A. D. Baker III, "Sealift, British Style." Proceedings (June1983), 112-113.
[27] Sandy McClearn, AMAZON Class (Type 21), Frigate, Haze Gray & Underway, March 15, 2017, http://www.hazegray.org/navhist/rn/frigates/amazon/
[28] Sandy McClearn, Type 22 Multi-purpose Frigate, Haze Gray & Underway, March 15, 2017, http://www.hazegray.org/navhist/rn/frigates/t22/
[29] Norman Friedman, "Surface Combatant Lessons." In Military Lessons of the Falkland Islands War: Views from the United States, (Boulder: Westview Press, 1984), 25.
[30] Gordon Smith, Part 52: British Ships Lost & Damaged, BATTLE ATLAS of the FALKLANDS WAR 1982 by Land, Sea and Air, last modified May 31, 2013, http://www.naval-history.net/F62-Falklands-British_ships_lost.htm
[31] Rodney A Burden, Michael I Draper, Douglas A Rough, Colin R Smith, and David L Wilton, Falklands: The Air War(Poole: Arms and Armour Press, 1986), 185.
[32] Michael Clapp and Ewen Southby-Tailyour, Amphibious Assault Falklands, (Annapolis: Naval Institute Press, 1996), ix-x.

Bibliography

Baker III, A. D. 1983. "Sealift, British Style." *Proceedings*, June: 111-118.
Burden, Rodney A, Michael I Draper, Douglas A Rough, Colin R Smith, and David L Wilton. 1986. *Falklands: The Air War*. Poole: Arms and Armour Press.
Byun, Leo, Kiley Donohue, Michael Mayo, Julian McCafferty, and Ruth Miller. *Ground Effect Vehicle Transoceanic Civil and Cargo Transport Network*. Presentation. NASA Aeronautics Academy, August 21, 2014. https://nari.arc.nasa.gov/sites/default/files/attachments/IFAR_AeroAcademy_2014.pdf
Clapp, Michael, and Ewen Southby-Tailyour. 1996. *Amphibious Assault Falklands.* Annapolis: Naval Institute Press.
Cole, William. "The Pelican: A big bird for the long haul." *Boeing Frontiers* 1, no. 5 (September 2002): http://www.boeing.com/news/frontiers/archive/2002/september/i_pw.html.
Freedman, Lawrence. 2005. *The Official History of the Falklands Campaign: Volume I: The Origins of the Falklands War.* New York: Taylor & Francis, Inc.
Friedman, Norman. 1984. "Surface Combatant Lessons." In *Military Lessons of the Falkland Islands War: Views from the United States*, 21-36. Boulder: Westview Press.
Hore, Peter. 2005. "The 'Logistics Miracle' of Ascension Island." In *The Falklands Conflict Twenty Years On: Lessons for the Future*, by Stephen Badsey, Rob Havers and Mark Grove, 213-225. New York: Frank Cass.
Jane's Land Warfare Platforms: Armoured Fighting Vehicles. "BAE Systems AAV7A1 (LVTP7A1) Amphibious Assault Vehicle," October 19, 2016. http://janes.ihs.com.lomc.idm.oclc.org/Janes/DisplayFile/JAA_0251.
Lykins, Johnny. "Operation CORPORATE: Significant Problems That Did Not Cost the United Kingdom the War." Unpublished manuscript, last modified March 6, 2017. Microsoft Word file.
Meadows, David. "Defeating Comparable Competitors While Hiding in Plain Sight: An Alternate Plan for an Alternate Future" Master's thesis, Marine Corps University, 2017.
Oren, Jane. "The African Future Environment: Facing Chinese Influence Across the Elements of National Power" Master's thesis, Marine Corps University, 2017.
Seck, Hope Hodge. "Marines on the Hunt for a Ship-to-Shore Game-Changer." *DoD Buzz Online Defense and Acquisition Journal*, (September 28, 2016): https://www.dodbuzz.com/2016/09/28/marines-hunt-ship-shore-game-changer
Stenberg, Adam. "The Past as Prologue, the Future in Forecasting: Preparing the US Military for Conflict in 2030" Master's thesis, Marine Corps University, 2017.
Thompson, Julian. 1985. *No Picnic: 3 Commando Brigade in the South Atlantic 1982.* New York: Hippocrene Books, Inc.
Thompson, Julian. 2005. "Chapter XXXIV Falkland Islands (Op CORPORATE, May-June 1982)." In *Amphibious Assault: Manoeuvre from the Sea – Amphibious Operations from the Last Century*, edited by Tristan T. A. Lovering, 435-444. London: Crown.
Tilford, Earl. 1984. "Air Power Lessons." In *Military Lessons of the Falkland Islands War: Views from the United States*, 37-50. Boulder: Westview Press.
US Congress. Congressional Budget Office. *An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan*. 114th Cong., 2015. 21-23.

Wagner, Christopher. “Considering the Future: Removing Blind Spots in Forecasting” Master’s thesis, Marine Corps University, 2017.