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The *ROYAL CANADIAN AIR FORCE JOURNAL* is an official publication of the Commander Royal Canadian Air Force (RCAF) and is published quarterly. It is a forum for discussing concepts, issues and ideas that are both crucial and central to air and space power. The *Journal* is dedicated to disseminating the ideas and opinions of not only RCAF personnel, but also those civilians who have an interest in issues of air and space power. Articles may cover the scope of air-force doctrine, training, leadership, lessons learned and air-force operations: past, present or future. Submissions on related subjects such as ethics, technology and air-force history are also invited. This journal is therefore dedicated to the expression of mature professional thought on the art and science of air warfare and is central to the intellectual health of the RCAF. It serves as a vehicle for the continuing education and professional development of all ranks and personnel in the RCAF as well as members from other environments, employees of government agencies and academia concerned with air-force affairs.

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ROYAL CANADIAN AIR FORCE JOURNAL

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EDITOR'S **MESSAGE**

This winter 2021 issue of the *Royal Canadian Air Force Journal* provides a decent assortment of articles. In this issue, you will find a historical article, an article discussing evolving and emerging technologies in relation to NORAD as well as an article regarding tactical aviation's wartime integration within the future fight.

The article by Captain Nevin McFarlane, "Evolving Threats and Emerging Technologies: Requirements for NORAD Modernization in a Multipolar Geopolitical Environment," first provides a brief history of NORAD and the evolution of ballistic missile detection. The article goes on to discuss some significant geopolitical and adversarial capability changes in terms of reach, detection and technical advancements. Traditional and emerging adversaries are now possessing and developing weapons with extremely high velocities that are difficult to detect. The article concludes with a discussion on countering these new threats and maintaining an effective defence of North America.

"The Hump from Spain to Berlin: Strategic Development of American Military Airlift, 1936–1949," by Lieutenant-Colonel James Pierotti, is a historical article describing airlift, which—at the time—was a new and unparalleled logistics component for moving troops and combat service support equipment precisely and rapidly into the theatre of operations. The background is set with an introduction to airlift's history and evolution as well as an explanation of how multifaceted airlift became in a few short years. The author then describes how years of war brought airlift to maturity and, finally, how the Hump missions developed as well as the significance of their strategic effect.

The third article, "Tactical Aviation within the Future Fight" by Major Greg Zweng, details a recent exercise located in Twentynine Palms, a United States Marine Corps (USMC) training area in the Mojave Desert. This massive USMC-conducted force-on-force exercise also included the United Kingdom's Royal Marines and attached our very own world-class 408 Tactical Helicopter Squadron (CH146 Griffon) from Edmonton, Alberta. The author writes, "mention of the CH146 integrated into the joint application of force often gets a muted response." Read this article, however, and I guarantee more than a few raised eyebrows regarding this airframe's employment; the airframe proves worthy, and the superior training and extremely high calibre of the mission specialists, aircrew, support teams and pilotage ensure a strong and steady hand in tactical aviation's coalition contribution.

In the "Points of Interest" section, "A Bird's Eye View of Logistics in Lebanon" by Major Michael Duong (a captain at the time of writing) describes his experiences in one of the Canadian international training missions established to build capacity with overseas partners; in this case, with the Lebanese Armed Forces and specifically in the area of logistics management and operations. This article is written from Duong's perspective as an RCAF officer taking part in this mission under the auspices of Operation IMPACT.

Lastly, the book *New Directions in the Study of China's Foreign Policy* by Alastair Iain Johnston and Robert S. Ross is reviewed by Captain Hani M. Mustafa. Mustafa outlines the historical, economic and strategic interests of this topic. The book is the result of work from academics in various fields, and is divided into four main components.

Enjoy the read and, as always, your thoughts are welcome.

Sic Itur Ad Astra

Major Derrek Williamson, CD, P.Log
Senior Editor

EVOLVING THREATS AND EMERGING TECHNOLOGIES:

REQUIREMENTS FOR NORAD MODERNIZATION IN A MULTIPOLAR GEOPOLITICAL ENVIRONMENT

By Captain Nevin McFarlane

The idea of the North American Aerospace[1] Defence Command (NORAD) was born in the 1950s at the outset of the Cold War. The principal threat at the time was long-range Soviet bombers, and the solution was early detection and interception. While NORAD's mission has evolved over the past 60 years, the idea of early detection remains as relevant today as it was then. The key system currently being used for NORAD early detection is the North Warning System (NWS). Since its installation in the 1980s, there has been significant proliferation of intercontinental ballistic missiles (ICBMs), with countries like China and North Korea now fielding missiles that can reach North America and will not travel over the Arctic, as was expected of Russia. Additionally, progress is being made on new technologies like hypersonic missiles, which cannot be detected by current capabilities. NORAD detection systems, as they exist today, are incapable of detecting current threats; they need to be modernized to cover all approaches to the continent and detect the next generation of missile threats. The first portion of this article will examine the history of aerospace detection in NORAD and how the mission of early detection has evolved over the years. In the second section, the changing geopolitical environment and new missile technologies will be explored. Lastly, there will be a discussion on the way ahead for NORAD's modernization so that it may remain effective in its defence of North America.

Joint cooperation between the United States (US) and Canada to defend North American airspace started after the Second World War. Into the 1950s, it became clear that long-range, manned Soviet bombers, or long-range aviation (LRA), were a key threat. They were expected to come over the North Pole to launch an attack on North America. Early detection of an attack to allow for the launch of fighter interceptors and a retaliatory bomber fleet was the strategy to defeat them.[2] In an effort to shorten response times, Canada and the US collaborated to build radar detection lines, including the Mid-Canada, Pinetree and Distant Early Warning (DEW) Lines. The DEW Line was the northernmost detection line in North America and it became functional in 1957. The details of the NORAD agreement were worked out in 1957 and it was formalized in May 1958.[3]

As the NORAD negotiations were being finalized, the Soviets launched the first man-made satellite, Sputnik, in October 1957. For many, this heralded the end of the LRA threat and the beginning of the ballistic missile threat. This was only partially true, as the LRA threat persisted alongside the new ICBM threat. Unfortunately, the recently completed DEW Line could only detect aircraft, not ballistic missiles.[4] With increased development of ICBMs throughout the 1970s, there were increasing calls for the modernization of the DEW Line. An agreement was signed between Canada and the US in 1985 that allowed for the replacement of the DEW Line. The new system, which included more recent radar technology, became known as the NWS.[5]

The Cold War finished shortly after the NWS became operational. However, the fall of the Berlin Wall did not mark the end for NORAD, as many would have expected. The Soviet LRA flights probing Arctic airspace did end, yet many of the Soviet successor states, including Russia, still had ICBMs that could threaten North America. After 9/11, NORAD took on a new role of responding to incidents within North American airspace as part of Operation NOBLE EAGLE. In 2007, Russia recommenced their polar flights as part of an increasingly assertive foreign policy and the NWS regained its importance.[6] Despite the fact that Russian LRA flights continue to probe the northern reaches of NORAD's airspace today, there are other threats developing around the world.

One of the greatest new threats to NORAD is China. Over the first two decades of the twenty-first century, the country has vastly expanded its military. Mass capital acquisitions have led to the development of new capabilities, and the entire military has gone through a reorganization that will allow it to execute complex joint operations.[7] In addition to holding the largest army in the world and having a burgeoning submarine fleet, China has "one of the most active and diverse ballistic missile development programs in the world."[8] China has deployed between 75 and 100 ICBMs, including silo-based and submarine-launched ballistic missiles. At least 125 missiles are thought to be nuclear capable and able to target North America.[9] As Chinese missile inventories continue to grow, so too will the threat to North America. Although somewhat obvious, it needs to be stated that any missile launched from China would not travel over the North Pole. This illustrates one of the key themes of this article—that placing radar systems solely in the North is no longer sufficient for the defence of North America.

Another country developing a strong missile capability is North Korea. North Korea has been running separate nuclear and missile programmes for some time with the ultimate goal of being able to field nuclear-capable ICBMs. The country conducted several nuclear tests between 2006 and 2017, with the North Korean leader declaring completion of nuclear development in 2018.[10] Missile development has also come a long way in recent years. In November 2017, the North Koreans tested a new missile, the Hwaseong-15. While it is still considered to be under development, it is assessed to have a range of 13,000 km, and it can strike anywhere in the continental US and Canada.[11] There are other capabilities being developed in North Korea, including the Pukkuksong series of missiles, which are a type of submarine-launched ballistic missile.[12] Again, it needs to be stated that, much like missiles coming from China, North Korean missiles will not travel over or be detected by the NWS.

The last country with a growing missile programme to be discussed is Iran. Iran has been working to build a nuclear bomb and field ICBMs for many years. The Joint Comprehensive Plan of Action was signed in 2015 by world powers and Iran with the intention of limiting Iranian nuclear development over the medium term. However, 2019 has seen Iran announce a partial withdrawal from the plan, as they have restarted uranium enrichment.[13] Iran also has the largest stockpile of ballistic missiles in the Middle East.[14] Currently, Iranian ballistic missiles are thought to not be able to reach much further than 2,000 km. However, given time for further development and the potential completion of nuclear research, Iranian nuclear missiles could soon reach North America.[15]

In addition to recent geopolitical changes, there have been great technical advancements in missile technology that are challenging NORAD detection capabilities. The largest is hypersonic missiles. Until recently, missiles have largely been described as supersonic, meaning they travel above the speed of sound, or Mach 1. A hypersonic missile, on the other hand, is one that travels at or above Mach 5 and can still be manoeuvred in flight.[16] These projectiles can take two main forms: hypersonic glide vehicles (HGVs) and hypersonic cruise missiles (HCMs).

An HGV is initially propelled by a rocket and then released at a predetermined altitude to glide independently at hypersonic speeds. HGVs generally take advantage of minimal friction outside the atmosphere and travel at an altitude of 40–100 km. At this height, an HGV is still capable of producing lift and maintaining its speed. While not normally powered, a small propulsion system can be included on an HGV to aid in directional control, yet this comes at the cost of added weight and greater design complexity.[17] The HCM uses a different concept, as it operates within the atmosphere and 20–30 km above the earth.[18] It requires a conventional system like a rocket to accelerate it to Mach 4 or 5 before an air-breathing engine, such as a scramjet, will take over and maintain the hypersonic speed.[19] While the technical details behind a scramjet are beyond the scope of this article, it should be noted that it will only operate when the vehicle is already travelling at supersonic speeds, hence the need for acceleration via the rocket.[20] HCMs and HGVs could be loaded with conventional explosives, nuclear warheads or nothing at all. Due to the speed of the missiles, the kinetic energy alone can be used to damage hardened or even underground facilities. This potential damage is illustrated in Figure 1.[21] The problem associated with defending against hypersonic missiles is twofold: detection and interception.

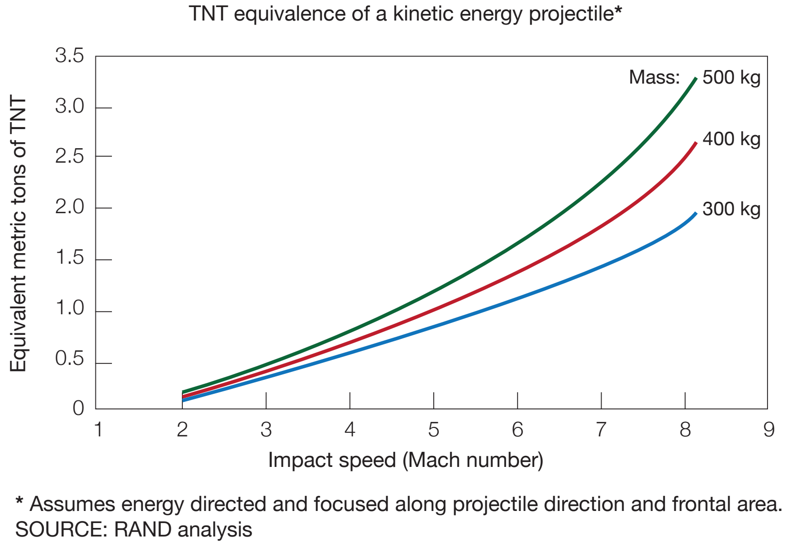


Figure 1. The destructive power of a hypersonic missile[22]

The first issue to be discussed is the detection of hypersonic missiles, as it differs significantly from detecting ballistic missiles. A ballistic missile will launch with a predetermined destination, use a rocket engine to bring it to speed, reach apogee outside the atmosphere and then use gravity to glide back to earth at incredibly high speeds.[23] Due to the high altitude that ballistic missiles reach, a ground-based radar system can detect them with some lead time. Hypersonic missiles, on the other hand, cannot be detected as early due to the lower altitude they travel at, as illustrated in Figure 2.[24] A RAND Corporation study provided a qualitative example of this concept: A ballistic missile with a 3,000 km range can typically be detected 12 minutes prior to impact by ground-based sensors. A similarly ranged hypersonic missile would only be detected 6 minutes prior to impact because of the difference in altitude.[25]

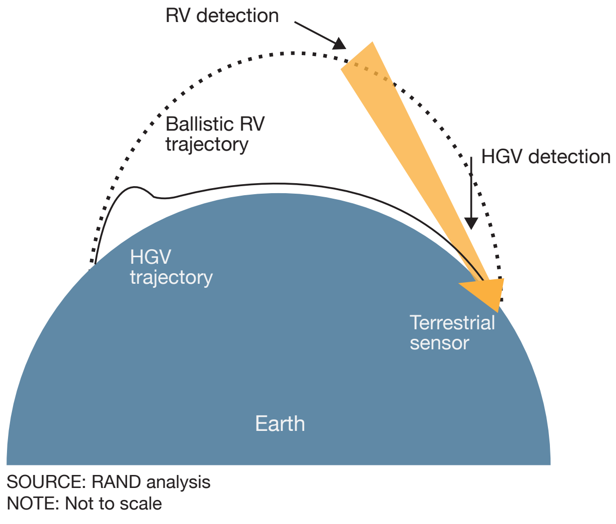
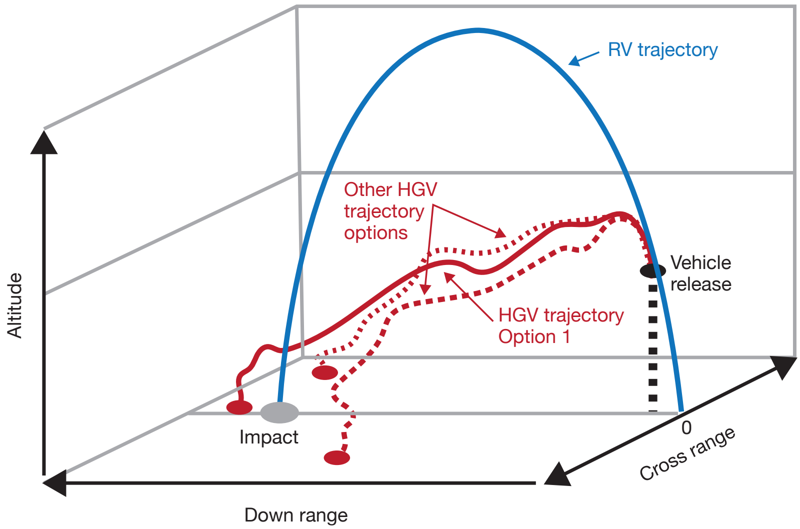


Figure 2. Ballistic vice hypersonic missile detection by ground sensors

Other issues associated with tracking hypersonic missiles include infrared tracking and predicting the intended target. The first issue here is that hypersonic missiles are difficult to track with infrared sensors. One reason is that current infrared satellites cover a wide portion of the earth and are only designed to look for missiles firing their engines. The main system used today for this purpose is the American Space-Based Infrared System (SBIRS) constellation of satellites.[26] Unfortunately, due to the size and temperature of hypersonic missiles, they are actually much dimmer than targets being tracked today. This means that systems like the SBIRS that are being used today are ineffective at tracking hypersonic targets. The second issue is accurately predicting a target. As previously mentioned, ballistic missiles take off for a predetermined target, which can be calculated based on its trajectory, and the missile is unable to change its path in flight. However, hypersonic missiles are capable of changing course mid-flight, making the prediction of a target nearly impossible, as illustrated in Figure 3.



SOURCE: RAND analysis

Figure 3. Ballistic re-entry vehicle versus HGV trajectories

As hypersonic missiles continue to be developed around the world, they will present both a challenge and a threat to NORAD as well as other countries. What does NORAD need to do to adapt to current threats? There are three key areas NORAD will need to modernize to effectively defend against current and developing threats: new intelligence, surveillance and reconnaissance (ISR) capabilities; expanded command and control (C2); and further research on hypersonic defence systems.

The first area, the improvement of ISR capabilities, is perhaps the greatest area for improvement. Even though there are many new threats to North America, the threat of Russian LRA coming over the North Pole does remain, and it needs to be addressed. The NWS is already due for replacement; there needs to be a new radar line constructed that can see across the Canadian Arctic and provide the greatest advance warning possible with today's radar technology. In *NORAD: Beyond Modernization*, Andrea Charron et al. argue that, due to the increased ranges of Russian cruise missiles, any new radar system needs to extend beyond Canadian airspace and into Russian territory, if possible, as some cruise missiles could be launched from that distance to strike North America.[27] Replacing the NWS is the first step in modernization, but it hardly stops there. As already pointed out several times, ISR needs to be expanded beyond the northern borders, and this requires something other than radar.

Space-based systems are one solution that can act as a key enabler and allow for early detection of enemy threats around the world. Any space-based system to be incorporated into the NORAD system needs to be capable of detecting the launch of missiles from any actor threatening North America through infrared and radar capabilities. It also needs to be able to track hypersonic missiles throughout their flight, a capability which is not yet realized. The *2019 Missile Defense Review* conducted by the US Department of Defense (DoD) emphasized the importance of space-based ISR: "Space-basing for sensors provides significant advantages. Such sensors take advantage of the large area viewable from space for improved tracking and potentially targeting of advanced threats, including HGVs and hypersonic cruise missiles."[28] Any future NORAD ISR system needs to incorporate space-based systems to detect and track hypersonic weapons. Depending on the capability of space-based ISR systems, or the lack thereof, it may also make sense at one point to place long-range surveillance radars on the west coast of North America or even on American Pacific islands, such as Hawaii, to be able to track airborne threats that originate from Asia.

The second area NORAD needs to focus on is the development of C2 systems to manage all of this new ISR data. New, computerized C2 systems will be necessary to connect NORAD headquarters with all of the regional commands and display the information from the new ISR capabilities discussed in the last two paragraphs. Operating from legacy or inadequate C2 systems will not allow for early detection. Today's threats are faster and more agile than ever before; this requires robust and redundant C2 systems that can allow NORAD commanders and national leadership to make timely decisions in the defence of North American aerospace.

The last area NORAD needs to concentrate on is research into the interception of hypersonic missiles. This is an evolving threat that needs to be better understood. Research shows there is a limited ability to defend against HGVs when they are in the terminal phase.[29] Instead, current research indicates that the optimal time to intercept a hypersonic missile would be in its initial boost phase, when the missile is travelling slowest. However, this requires timely detection. Other potential options for defeating hypersonic missiles include kinetic kill vehicles or even directed energy weapons (e.g., lasers), neither of which currently exists in an effective format.[30] As hypersonic missiles are an emerging threat, there is a lot of research still required to determine how to best defeat them. If deemed potentially effective, new technology, like directed energy weapons, may also need to be developed.

This article demonstrated that the threat to North America has expanded in recent years, and northern surveillance is no longer sufficient in defending North American aerospace. While Russia remains a threat, there are new actors—including China, North Korea and Iran—who are holding or developing ICBMs capable of striking North America that will not be detected by radar systems in their current positions. Additionally, the ongoing development of hypersonic missiles presents a new challenge that NORAD is currently unprepared to counter. To evolve to meet current and changing threats, NORAD will have to modernize and expand its ISR network through both ground- and space-based systems. C2 systems to manage the ISR data and present it for leadership to make timely decisions are also required. Lastly, the threat of hypersonic weapons means that there needs to be extensive research into the detection, tracking and interception of these weapons. If NORAD is able to modernize itself along these three key themes, it will be able to stay relevant in today's multipolar geopolitical climate.

Captain Nevin McFarlane, originally enrolled in the Canadian Armed Forces as a naval warfare officer, sailed with Her Majesty's Canadian Ships TORONTO and ST. JOHN'S. He was also deployed on Operation ARTEMIS. While transitioning from naval warfare officer to intelligence officer, Captain McFarlane also transitioned into a Royal Canadian Air Force uniform. He was employed at 2 Wing, Bagotville, as A25 at 2 Air Component Coordination Unit and most recently as Deputy Officer Commanding Intelligence at 2 Operations Support Squadron, and he deployed to Kuwait as part of Operation IMPACT.

ABBREVIATIONS

C2	command and control
DEW Line	Distant Early Warning Line
DoD	Department of Defense
HCM	hypersonic cruise missile
HGV	hypersonic glide vehicle
ICBM	intercontinental ballistic missile
ISR	intelligence, surveillance and reconnaissance
LRA	long-range aviation
NWS	North Warning System
OSD	Office of the Secretary of Defense
RV	re-entry vehicle

NOTES

1. NORAD was originally charged with the protection of airspace. This was changed to aerospace in 1981 to encompass threats coming through both air and space.

2. Gordon A. A. Wilson, *NORAD and the Soviet Nuclear Threat: Canada's Secret Electronic Air War* (Toronto: Dundurn Press, 2011), 106–7.

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8. US, OSD, *2019 Missile Defense Review* (Washington: DoD, 2019), 13.

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14. US, OSD, *2019 Missile Defense Review*, 11.

15. "Hwaseong-15."

16. Richard H. Speier et al., *Hypersonic Missile Nonproliferation: Hindering the Spread of a New Class of Weapons* (Santa Monica: RAND Corporation, 2017), 1–2.

17. Speier et al., *Hypersonic Missile Nonproliferation*, 8–9.

18. Speier et al., *Hypersonic Missile Nonproliferation*, 12.

19. For more information on scramjet technology, see Fredric F. Alexander and Alexander D. Baxter, "Jet Engine," Encyclopædia Britannica, September 27, 2015, https://www.britannica.com/technology/jet-engine/Ramjets-and-supersonic-combustion-ramjets#ref135193.

20. Speier et al., *Hypersonic Missile Nonproliferation*, 11–12.

21. Speier et al., *Hypersonic Missile Nonproliferation*, 13.

22. All the figures used in this article were taken from Speier et al., *Hypersonic Missile Nonproliferation*.

23. Missile Defense Advocacy Alliance, "Ballistic Missile Basics," accessed November 3, 2019, https://missiledefenseadvocacy.org/missile-threat-and-proliferation/missile-basics/ballistic-missile-basics/.

24. Speier et al., *Hypersonic Missile Nonproliferation*, 10–11.

25. Speier et al., *Hypersonic Missile Nonproliferation*, 11.

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THE HUMP FROM SPAIN TO BERLIN:

STRATEGIC DEVELOPMENT OF AMERICAN MILITARY AIRLIFT, 1936–1949

BY LIEUTENANT-COLONEL JAMES PIEROTTI, CD, MA

Author's note 1: The United States Army Air Force (USAAF) was known as the United States Army Air Corps before June 20, 1941, but "USAAF" will be used to describe this service before and during the Second World War to avoid confusion.

Author's note 2: The capitalized "Allies" is used to describe the Soviet Union, the United States, the United Kingdom and others during the Second World War. The lower case version, "allies," is used in the latter part of this article to indicate that the Soviet Union was no longer part of the group normally identified by the uppercase version of the term.

INTRODUCTION

The role of logistics in warfare has often been undervalued—even though logistics describes a nation's ability to supply, transport and maintain its military forces to achieve national objectives. A key subset of this capability is military airlift: the use of aircraft to accelerate the logistical movement of personnel and equipment for tactical or, as is the focus of this article, strategic objectives. The first successful use of airlift with obvious strategic outcomes was the Berlin Airlift of 1948. While that airlift achieved significant geopolitical effects during this critical, early event of the Cold War, it will become clear that the growth, professionalization and strategic possibilities of American airlift had already reached maturity at the end of the Second World War. How and why American airlift achieved success in Berlin and prior events remains a relevant topic today due to similar effects that the Royal Canadian Air Force may need to achieve in the future.

The USAAF conducted a massive expansion of airlift throughout the Second World War to achieve national strategic effects, and the ability to deliver people and cargo has become an important component of the United States' (US's) capacity to win wars. This transport capability, however, did not develop in isolation or without problems. The Americans were able to learn from the German air force, the Luftwaffe, by incorporating airlift lessons into American doctrine and avoiding many of the Germans' mistakes. In particular, the Americans determined that the European theatre at the height of the war was not a satisfactory location for airlift resources because the combat employment of aircraft could have disastrous consequences. Instead, starting in 1942, the USAAF sent transport aircraft into the Pacific theatre, where airlift was discovered to have strategic potential. After the strategic successes of American airlift in the Second World War, the Berlin Airlift would prove to be anticlimactic.

For the purposes of this argument, strategy will be defined by the United States Air Force's (USAF's) current definition of national strategy: "the art and science of developing and using the political, economic and psychological powers of a nation, together with its armed forces, during peace and war, to secure national objectives."[1] This definition will be applied to air power by examining the link between airlift and national objectives. When a clear political objective was presented to the military and airlift was used as the primary capability to achieve that objective, then that airlift will be identified as strategic.[2] Once this article has clearly outlined the airlift lessons that the US learned from Germany early in the war, the strategic nature of American airlift between 1942 and 1949 will be explored.

American development of airlift started when the USAAF observed German airlift during the Spanish Civil War in 1936 and realized what air transport could achieve. Development continued with transit operations of freshly built aircraft over oceans, called ferry missions, and incorporated new procedures and equipment for safe operations. The initial American use of civilian aircrew then changed into a fully military capability due to the increased enemy threat towards any flight overseas. Following the militarization of airlift, the American air transport capability became strongly associated with one man, namely General William H. Tunner; he was largely responsible for the development and success of early military airlift, as demonstrated by the Hump airlift between Burma and China. After other strategic successes in the Pacific theatre in 1945, Tunner went on to command the Berlin Airlift. In Berlin, he refined lessons from the Pacific theatre back into the European theatre, where short distances and many aircraft compounded familiar difficulties—often to such an extent that most observers incorrectly assumed the capability was new. I will argue that American airlift applied lessons learned from the Luftwaffe and became a fully developed strategic capability in 1945, long before Berlin.

THE EVOLUTION OF AIRLIFT, 1936–1942

An overdue professionalization of the USAAF transport organization was achieved in 1941– 42, which was a necessary reaction to the demonstrated use of airlift in the first years of the war. This feat was a result of internal factors as well as lessons learned from the Luftwaffe's movement of Moroccan troops to Spain between July and October 1936 in the opening phase of the Spanish Civil War.[3] The airlift relied on only 10 aircraft and their civilian crews from the German civilian airline, Lufthansa, yet "estimates gave the total number of troops flown from Morocco to Spain as 14,000, in a remarkable airlift that assisted Franco [the Nationalist leader backed by Hitler], to consolidate his position during the first two months of the civil war."[4] Hitler's motivation to assist was "a way to forge the Axis with Italy while distracting Mussolini's attention from Austria and the Balkans."[5] The airlift manoeuvre achieved early German strategic aims and served as a warning to other nations that the rapid movement of troops using aircraft was a new standard in logistics and strategy.

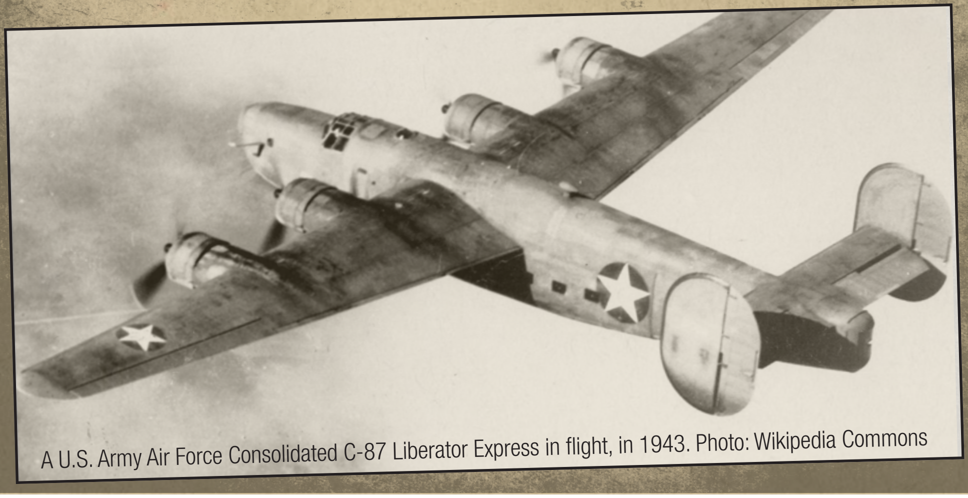
This airlift was successful partly due to the simplicity of the operation. It operated only 10 aircraft among multiple airfields, minimizing congestion and the risk of collisions. The loads that were transported did not include heavy equipment, which allowed for easy loading and offloading. It used civilian pilots because they were the most easily accessible personnel with sufficient training for the mission and there was little to no risk of enemy activity towards the aircraft. The routes were of extremely short durations and in good weather over the Mediterranean, and only one organization ran the airlift. As the world became involved in war after 1939, all of those factors that were easy in the airlift of the Spanish Civil War would become significant complications that needed to be resolved before future airlifts could achieve similar strategic effects.[6]

A key factor for the development of airlift was ensuring the availability of the right number and type of aircraft. The Germans used the Junkers Ju 52 as the main transport aircraft for both military and civilian transport roles and were able to build them rapidly. In 1939, Germany produced 1,037 transports, and the Luftwaffe had more dedicated transport aircraft than all the rest of the world's air forces put together.[7] In contrast, the American military in 1940 had only 2,800 personnel staffing and maintaining 20 transport aircraft. USAAF planned to resolve the low number of transport aircraft, partly by following the German model and contracting out much of its needs to commercial aviation using existing long-range commercial aircraft; this was conducted through secret talks in late 1940 with Pan American Airways.[8]

Understanding that contracted aircraft would still be insufficient to the demand, the Americans chose to build a military version of the well-known DC-3 Dakota, creating the C-47 aircraft, while other civilian aircraft were converted into the C-46 Commando and the C-54 Skymaster.[9] All of these aircraft allowed for quick production times because the necessary assembly lines already existed. However, commercial aircraft were found to be problematic in a military environment because they were built to carry people instead of large cargo, and it was time-consuming to load and unload the equipment.[10] The Germans solved the cargo problem by using large gliders towed behind their main transport aircraft, the Ju 52, throughout the war. In contrast, the Americans built

THE SWIFT CAPTURE OF NORWAY FULLY DEMONSTRATED HOW AIR TRANSPORT CAN SUPPORT STRATEGIC AIMS—IN THIS CASE, THE CONQUEST OF ANOTHER COUNTRY.

Junkers Ju 52, 1943-1944 Photo: Wikipedia Commons



A U.S. Army Air Force Consolidated C-87 Liberator Express in flight, in 1943. Photo: Wikipedia Commons

a transport version of the B-24 bomber aircraft in 1942, called the C-87 Liberator Express, which was capable of much higher tonnage and quicker loading times.[11] The C-87 had some problems, but the bomber conversion and the larger civilian aircraft conversions satisfied the growing American airlift requirement throughout the war.[12] Although the Americans originally followed the German example of single airframes for commercial and military missions, they learned quickly to develop larger aircraft to make loading and unloading as fast as possible.

Equally important to the aircraft available was the crewing of those aircraft. The Americans learned from Spanish Civil War airlift about the use of civilian pilots for air transport. The immediate benefit to the USAAF was that it was able to charter civilian aircrew for positions that could not yet be filled by the military training system.[13] In the first two years of the Second World War, both military and civilian crews were used to keep as many pilots flying missions as possible while the training system expanded. USAAF hired female pilots to help maintain a steady flow of aircraft movements within the continental US, thereby maximizing all available human resources.[14] However, the risk of enemy fire upon transiting aircraft increased as the German U-boat threat expanded into the Atlantic, and the USAAF decreased the use of civilians in transport missions outside of the continental US. Gradually, the use of civilian aircrew eroded, as those personnel with valuable transport experience were brought into military service and the training system caught up to demand.[15] Although civilian crews were critical to the early expansion of operational military aircrew, the militarization of airlift personnel allowed the airlift capability to function seamlessly from the domestic environment to the immediate support of troops in battle.

The military use of airlift close to the battlefield was acutely on display in early German operations. The German campaign in Norway from April to June 1940 provided an effective example for the Allies to consider how airlift could be used to support combat operations: "The first phase of operations in Norway consisted in the transport of parachute troops which were dropped at enemy airfields to eliminate resistance and take possession of them."[16] After the initial assault, the transport aircraft were used at the captured airfields in typical airlift fashion, which is the orderly flow of personnel and equipment along a route and into an airfield with limited enemy risk. For the Luftwaffe, airlift after the assault included several phases: "The first … consisted in the transport of a large force of air-landing troops. During the third phase, mixed units were flown in, made up partly of reinforcements for the fighting troops and partly of Luftwaffe personnel and equipment for a ground organization."[17] The swift capture of Norway fully demonstrated how air transport can support strategic aims—in this case, the conquest of another country.[18]

The Norway operation became a very important indicator of the necessity of air superiority, or control of the air above ongoing ground operations. The Germans captured the Norwegian airfields very quickly, so there was little enemy air response available to shoot down the transports or otherwise interfere with the operation.[19] In the subsequent German attack on the Netherlands, there was considerable threat to German aircraft because the Luftwaffe had no air superiority in that battle, and the results were far different. The Luftwaffe transport aircraft that were used on May 10, 1940, in the assault on the Netherlands suffered over 200 losses of the 450 Ju 52s utilized in an attack that, at the time, was considered a success.[20] In hindsight, this was a costly operation that suggested limits to the capabilities of transport aircraft in an area with a high concentration of enemy air defences.

The staggering loss of transport aircraft during the Netherlands operation demonstrated the huge risks to lightly armed and slow-moving transport aircraft if air superiority was not achieved first. To make matters worse, the loss of transport aircraft had a compounding effect because they were often lost with all personnel and cargo on board or wounded personnel on outgoing flights, so one lost aircraft also meant the loss of needed equipment and people to support the mission on the ground.[21] The losses in the Netherlands suggested that success on the ground could be achieved with fewer overall planned aircraft resources if threats to transport aircraft were minimized before transport operations began. This lesson was not lost on the Americans, who were initially focused on the ferrying of aircraft across oceans as safely as possible, even with little enemy presence.

The transport of aircraft to Britain had become desperately important in the early stages of the war, as the Royal Air Force urgently required additional aircraft from North America. Initially, aircraft were put on ships and had to survive the U-boat gauntlet of the North Atlantic but, by the end of 1940, the British government ordered all newly purchased aircraft to be flown to the British Isles in a type of mission called a ferry flight.[22] Eventually, these ferry flights carried mail, passengers and freight to maximize the efficiency of transiting aircraft.[23]

The Ferrying Command was the USAAF organization established to transfer new aircraft overseas after the passage of the Lend-Lease Act of March 1941.[24] The Command set up flight safety standards, flight training for night and bad-weather operations, and delivered thousands of aircraft every year of the war after the Command's creation on May 29, 1941.[25] This organization was focused on keeping the aircraft moving at all times—ensuring crews were rested and ready at the next stop—instead of employing crew-based scheduling, as was common in all other USAAF forms of air power.[26] The procedures developed by the Ferrying Command allowed for the safe and efficient transfer of aircraft overseas, and these procedures formed the basis with which air transport organizations would manage large airlifts later in the war.

The British organization that conducted the same task on the Canadian side of the border worked with the Ferrying Command to develop procedures for transatlantic operations. At the start of ferry operations, there had been no assigned altitudes and communications were poor. As aircraft took off every five minutes, often in bad weather, the result was many losses.[27] Weather was such a significant factor in the safe transport of aircraft over oceanic distances that weather forecasting was quickly expanded to provide crews with the knowledge needed for these long flights.[28] Additionally, communications towers were built to improve the command and control of flights. Lessons on both communications and weather would translate directly to specific requirements for success in the planning of later airlifts.

Safety of flight was also addressed through the development of transatlantic flight procedures, resulting in the loss of only 1.5 per cent of all transatlantic flights in an era when such bold flights were brand new.[29] The ferry experiences of both British and American organizations "laid the foundation for the system of civil aviation we now take for granted" and allowed for air operations by both organizations to be conducted in coordination.[30] The procedures and infrastructure requirements necessary in the first years of the war were important developments on the road to greatly expanding airlift operations in later years.

In summary, the German experience in the Spanish Civil War can be seen as a catalyst for the expansion of American air transport logistics in the Second World War. The relatively simple operating conditions of the airlift in Spain were replaced by around-the-clock wartime operations that required the development of equipment, regulations, procedures and training for the personnel to operate in the global transport environment. Compared to the German operation in the Netherlands, where large losses of aircraft and personnel to enemy fire were tolerated, the US built an airlift structure that focused on safety, effectiveness and cooperation with other military organizations.

THE MANY USES OF AIRLIFT IN THE SECOND WORLD WAR

Transport aircraft were important to most European operations early in the Second World War, whether they were used to transport equipment overseas, drop parachutists into combat areas or support an army in times of crisis.[31] Although the different types of transport missions offer much useful insight, two key lessons emerge: First, planning was needed to account for risk analysis and avoid unnecessary losses. Second, a highly efficient flow of aircraft in and out of a combat area was crucial to maximize the resources that were committed to the airlift. The strategic implications of these lessons from the European theatre became important to the success of airlift operations in the Pacific theatre, where the lessons were successfully applied.

To understand why differences emerged between the European and Pacific theatres, it is useful to reference the German classification of air transport activities. The Luftwaffe classified airlift missions into three distinct activities: air transport, air supply and employment in combat.[32] Air transport is described as an activity to move personnel and equipment entirely over friendly territory.[33] Air supply aimed to create an "air bridge" between the landing or operational area separated from front lines by intervening in enemy territory, which could be accomplished by landing at airfields or dropping personnel and equipment from the air.[34] Employment in combat describes the delivery of parachute-delivered troops into combat, called airborne operations, and the use of aircraft landing at nearby airfields to bring in additional combat troops.

As previously outlined, German operations in both Norway and the Netherlands were examples of the first phase of combat employment of transport aircraft in airborne operations. By 1938, Germany had developed paratroop forces that "could function as a powerful and immediately available combat force in the planning of top-level command."[35] The Americans also developed a very large airborne capability. They established the Troop Carrier Command in July 1942 as a dedicated air transport force for airborne operations and went on to participate in "major airborne assaults in North Africa, Europe, the Pacific and Burma."[36] This use of transport aircraft occurred with or without air superiority and was part of the larger campaign to advance into enemy territory. These missions demanded detailed planning to determine the loads needed at various stages of the planned assault. In addition, the impact of failed transport missions needed to be analysed for its potential effect on the larger campaign. Both planning and risk analysis would become important factors in the transition from small and localized missions to large strategic airlifts.[37]

The follow-on operations of transport aircraft's combat employment can be categorized as short-term responsive airlifts. These have been previously described as typical airlift missions once the ground forces clear an area around the airport to reduce the risk. Both airborne and short-responsive airlifts, as important as they were to support the troops in the area, do not provide examples of airlift alone achieving strategic effect and do not require amplification here.

Similar to the combat employment of transport aircraft, the second major type of transport aircraft operations, air supply, accomplished the same goal of supporting combat troops on the ground. The Germans conducted four major operations of this type, and the first large example was executed for the II Army Corps trapped at Demyansk, south of Leningrad, in the winter of 1941–42.[38] There were 100,000 troops trapped in the pocket and they "required no less than three hundred tons [of supplies] per day" in what developed into the first major airlift operation in the Second World War.[39] Due to the technical difficulties experienced by the Luftwaffe in maintaining the Ju 52 transports during harsh winter conditions, the Luftwaffe deployed almost 500 Ju 52s to the airlift to ensure 150 of them would be available each day so tonnage targets could be achieved.[40]

The Soviet ground forces were aware of the airlift; they attacked the airfields to disrupt the operation and attempted to shoot down as many transports as possible.[41] The Luftwaffe, at times refused the use of airfields due to the high risk of enemy fire, switched from landing aircraft to airdropping supplies directly to the ground troops. Airdrop in the vicinity of enemy forces was problematic due to difficulties resulting from inexact locations, poor communication, few visual cues and the dangerous requirement for multiple passes.[42] Thus, while airdrop kept the troops supplied, it also put the Ju 52s within lethal range of enemy guns for extended durations.

Fortunately for the Germans, the Soviet Air Force was not overly active in the area and the German operation achieved almost uninterrupted air operations over nine months.[43] However, due to the pressure from Soviet ground forces and bad weather, 165 Ju 52s were destroyed throughout

AIRCRAFT FLYING INTO AND OUT OF A COMBAT ENVIRONMENT REQUIRED AN ORGANIZED FLOW AND CAREFUL PRE-PLANNING TO REDUCE THE TIME SPENT IN THE RANGE OF ENEMY FIRE

Junkers Ju 52, 1943-1944. Photo: Wikipedia Commons this operation, and the training programme had been deprived of 300 aircraft for a period of nine months, leaving a training gap that "had still not been closed completely by the end of the war."[44] As a result of the airlift, "84,844 tonnes of supplies and 35,000 men were flown into the Demyansk Pocket on the Eastern Front in 33,086 flights."[45] The large effort of transport aircraft kept the fighting force intact despite the fact that the German Army overstretched its logistical supply lines, but the success came at a considerable cost to German air power. A key lesson from this airlift was that aircraft flying into and out of a combat environment required an organized flow and careful pre-planning to reduce the time spent in the range of enemy fire; applying this lesson would minimize aircraft losses and maximize resupply efforts.

Another important lesson was that the risk involved in urgent ongoing operations needed to be balanced against the requirement to keep enough airlift capability for future needs. Due to the perceived success at Demyansk, this operation was repeated in Stalingrad a year later, where the stakes were even higher. At Demyansk, 100,000 men had been trapped and the force needed 300 tonnes of airlift daily, which required 150 aircraft available to fly each day out of 500 in the area.[46] At Stalingrad, however, there were 250,000 men trapped, and 750 tonnes per day were needed. Unfortunately for the Luftwaffe crews, the pressure from Hitler himself on the airlift to succeed—along with unusually poor flying weather conditions and a very difficult military situation—"made it impossible to comply with all the necessary safety precautions."[47] The results were stark: 488 of the 600 aircraft employed were lost within two months of airlift, with hundreds of aircrew on board, and on the best day only 290 tonnes were airlifted into the pocket.[48] The airlift into Stalingrad was a complete disaster.

German airlift operations in 1942 and 1943, specifically the Stalingrad airlift, made compelling arguments for taking a different approach to the use of aircraft as a logistics bridge into an operational area dominated by heavy enemy fire. Indeed, the USAAF did not turn to a large air supply effort for the US force trapped in the Philippines in early 1942. Bataan as well as Corregidor were cut off from sea lines of supply and the besieged force was desperate for help, which came from a ragtag collection of various aircraft types meant to support the resistance as long as possible.[49] This "Bamboo Fleet" consisted of just four small aircraft, but the heroic effort of the crews kept the ground force sustained for two weeks longer than expected. The Bamboo Fleet is assessed to have kept "the resistance alive in the Philippines for a total of six months, four months longer than the Japanese had planned."[50] The interesting difference between this case and Demyansk is that, instead of augmenting the airlift, the Americans used only aircraft immediately available and retreated with limited loss of aircraft.

The key type of airlift described by Luftwaffe theory and put into operational practice was air transport. It was described as "the utilization of air transport units for the movement of personnel and materiel within areas occupied by German [or friendly] troops."[51] However, in the vast distances of the Pacific theatre compared to Europe, this definition was not applicable to the Allied operating environment against the Japanese because the Americans were able to operate through enemy territory with limited risk to aircraft. Although there were Japanese fighter patrols, they were not supported by radar or effective communications. Without enemy radar to locate aircraft at distances beyond visual range, American aircraft losses on transport routes were rare.[52] Additionally, the USAAF did not rely on air transport in the Pacific theatre until after 1942, when more lessons had been learned, so it was able to develop the capability differently. The USAAF determined that a "heightened emphasis on safety was possible, because few transport missions were so essential that they could not be delayed for a day or so until technical problems could be fixed, weather got better or the military situation along their routes improved."[53] Air transport missions, as practised by Allied forces outside of the European theatre, operated with reduced exposure to enemy forces.

The first large air transport of Allied troops was undertaken in September 1942 by General George Kenney's Fifth Air Force in support of American forces in the south-west Pacific theatre that were commanded by General Douglas MacArthur. Despite misgivings from MacArthur and his staff—and notwithstanding the fact that the Fifth Air Force had only 41 of 78 promised transport aircraft, 15 of which were used for spare parts—Kenney convinced MacArthur to use airlift to deploy the 128th Infantry Regiment to Port Moresby, New Guinea, from Australia.[54] The approximately 4,000 personnel of the 128th Infantry Regiment left three days after the 126th, which had travelled by sea, but the 128th arrived two days earlier and with no losses.[55] Subsequently, operations used returning transport aircraft for the evacuation of the wounded, and Kenney moved to acquire as many transport aircraft, military and civilian, as he possibly could to meet the growing needs both to and from operational areas.[56] This success was the first step towards a growing use of air transport in the Pacific theatre of operations, and it demonstrated that airlift could accomplish rapid logistical movement in an area where there was space to avoid enemy locations. One can reasonably conclude that the lessons of airlift, as used in Europe, convinced the USAAF to use air transport in Pacific areas primarily where there was limited threat against the aircraft.

"FLYING THE HUMP WAS CONSIDERED AS HAZARDOUS AS FLYING A COMBAT MISSION OVER GERMANY."

William H. Tunner. Photo: Wikipedia Commons

THE STRATEGIC DEVELOPMENT OF AIRLIFT

By 1942, the USAAF had solved basic problems for the use of air transport on transoceanic missions by using communications, weather stations and intelligence to avoid enemy concentrations. Furthermore, lessons were learned from the European theatre on load prioritization and the operational flow of aircraft into a theatre of operations, all of which combined to allow for effective air transport missions in the Pacific theatre, where the threat of enemy action was relatively low. All of the pieces were in place for substantial airlifts.

The need for such an airlift was presented in early 1942. On February 25, President Theodore Roosevelt announced, "it is obviously of the utmost urgency … that the pathway to China be kept open."[57] At both the political and military levels, it was considered essential that China be kept in the war as the only plausible launching point for an eventual counter-attack against Japan.[58] Road options to meet the President's intent were made impossible by Japanese victories at Rangoon in March 1942 and then at Bhamo, Myitkyina and Lashio. The only way to get supplies into China was by aircraft "from the Assam valley itself all the way to Kunming, over the mountains and jungles of northern Burma."[59] This operation was known as the Hump.

Although the Hump airlift is one of the most well-known airlift achievements of the Second World War, lesser known is the appalling accident rate that the airlift suffered once it became fully operational in December 1942. Matters were made worse when night flying was introduced to increase the flow of tonnage into China. Night flying, winds and wild weather over the Himalayan mountain ranges, combined with greater numbers of aircraft flying the same routes, resulted in 38 accidents during the month of November 1943 alone. According to Tunner, "flying the Hump was considered as hazardous as flying a combat mission over Germany."[60] Strategic effect was possible, but the loss rate needed to be reduced to avoid following Stalingrad's example.

To improve the operation, the Air Transport Command turned to the Ferrying Command, the organization that had experience with safe and effective long-distance operations. The commander, Tunner, had made the Ferrying Command into a fine example of effective operations, and he was assigned command of the Hump operation on September 4, 1944.[61] Tunner and his team immediately built new communications sites that allowed the operation to modify the routes of aircraft in flight to avoid enemy aircraft activity throughout each day.[62] Moving routes from south to north meant longer flights and more dangerous mountains but, with much less enemy aircraft to shoot down USAAF aircraft, the move proved worthwhile. Additionally, Tunner improved flight procedures for mountainous and bad-weather operations to maximize the benefit of flying with a reduced threat of enemy fighters. In less than a year, the safety rate increased eightfold and the tonnage increased from 23,000 tonnes in August 1944 to 71,042 in July 1945.[63] The success that the Hump airlift achieved came at a cost of 590 aircraft and 1,659 aircrew over three years. These losses seem incredibly high but occurred at a sustainable and ever-improving loss rate compared to airlift operations such as those in Demyansk and the Netherlands.[64]

Tunner stated that, "by means of the Hump, we enabled the Chinese armies to keep up their resistance, which in turn made it necessary for the Japanese to keep a well-trained and well-equipped force of up to two million men in China."[65] Every Japanese soldier tied down in China was one less Japanese soldier engaged with American forces in the islands of the Pacific. Applying the lessons of the Ferrying Command and real-world examples from the European theatre allowed Tunner and his India-China Division to achieve the strategic success of keeping China in the war that President Roosevelt had desired back in 1942.

By the end of the war, the American airlift organization had grown to over 300,000 personnel as well as 3,224 aircraft, and the reduction of urgent airlift requirements by mid-1945 meant a great deal of spare capacity was available to further strategic ends.[66] After the surrender of the Japanese on August 15, 1945, the Americans moved quickly to gain control of the region. The surrender meant that an occupation force needed to arrive very rapidly in Japan to establish order and control. Outside of Japan, communist forces in China were in a position to accept the surrender of Japanese forces in Shanghai and other locations in China, which threatened the ruling Nationalist party controlled by Chiang Kai-shek, a staunch and formal ally of the Americans in the war against Japan.[67]

The immediate concern of Chiang was to prevent a Chinese civil war between his Nationalist forces and the communist army, which was 1,000,000 strong and led by Mao Zedong. To accomplish this goal, he requested American assistance to transport his troops to the East to accept the surrender of the 300,000 Japanese troops in the area, and he asked that it be done before the communist army could take the surrender first. Unsurprisingly, the Americans turned to Tunner and his Hump airlift forces to move troops to the threatened East Coast locations.[68]

Despite large distances and the lack of refuelling locations, General Tunner's India-China Division moved 26,237 Chinese troops over 18 days during September 1945 to allow the Chinese

Nationalist forces to secure Shanghai.[69] Other American airlift organizations were sent to assist, and they completed the total movement of 107,114 Chinese troops over seven weeks, allowing Chinese troops to secure the East Coast.[70] *The New York Times* reported this achievement as "the greatest airborne movement of troops in Asiatic history," and the impact of strategic airlift was becoming clear to leaders and the public alike.[71] The truly impressive part of the operation was the complexity of managing large loads over huge distances with minimal locations for fuelling. However, the lack of an enemy threat made planning considerably easier and allowed the airlift to concentrate on standard altitudes, airspeeds and routes to maximize efficiency. The planning and practical application of strategic airlift operations had achieved maturity.

Concurrently, General MacArthur had requested that the Air Transport Command provide airlift for his force surrounding Japan to quickly establish a strong presence in that country following its surrender. The resulting operation was named Mission 75 and, over four weeks in August, the force transported 23,000 troops into Japan without losing a single aircraft.[72] American scholar Robert Owen succinctly summarizes this period of time: "If the Hump airlift demonstrated the ability of sustained airlift to supply a whole theatre of war, Mission 75 showed the capacity of a globally articulated airlift command to concentrate vast capabilities quickly for strategic effect."[73] Airlift was only one tool available to leaders, but it was an important one for the US's achievement of strategic ends in 1945.

THE ANTICLIMAX OF BERLIN

The American concern with the communist army in China during 1945 was an early indication that the western allies and the Soviet Union had competing interests over the ideology of governments around the world. After the Second World War, the primary focus point for these competing ideologies became Berlin, with four nations—the Soviet Union, the US, Great Britain and France—all struggling with the coordinated administration of various regions of Germany.[74] The Soviet Union deeply opposed plans of a West German nation, which the western allies had demanded after the lack of progress with the Soviets towards German unification.[75] In an effort to disrupt the West Germany plans, the Soviets blocked road and rail access through the Soviet administration zone of Germany to the western-controlled half of Berlin on April 1, 1948.[76] The inability to transport supplies using rail or road to the military garrisons within Berlin meant that the only option the allies had was to use airlift to keep the garrisons supplied until a diplomatic solution could be found.

The lack of inbound food supplies made the situation an immediate humanitarian crisis, and the British started an airlift to feed the people of the city, followed shortly by the Americans. As the airlift expanded over the summer, the Americans once again relied on the airlift expertise of Tunner, who took command of the operation on July 28, 1948. On August 13, in a day now known as Black Friday, miserable weather hampered the landing in Berlin, and aircraft made multiple approaches into the airfield to try to complete the mission. These multiple approaches caused havoc to trailing aircraft, as they were only separated by minutes each. Unfortunately, the congestion resulted in many accidents. Tunner had just taken command and had not yet made massive procedural changes to achieve maximum flow in and out of the few available airfields. Among many other changes, he limited the aircraft to only one approach; they had to fly at exact altitudes and airspeeds, and he acquired additional communications and airfields to maximize the tonnage input each day.[77]

The changes made were impressive, but they were resolving the same problems from earlier airlift efforts in a far more compressed environment. The addition of British aircraft into the mix meant harmonizing procedures, which had previously been accomplished in ferry operations over the Atlantic. The issue of weather was a familiar one. Organizing a flow of aircraft on timelines had been completed in China in 1945, although admittedly not on this scale of operation. Indeed, behind these entire airlift successes was one man: Tunner. A combination of his experiences in the Ferrying Command, the Hump and the Pacific made Tunner intimately familiar with solutions to airlift problems. Tunner's advancements in Berlin were incremental changes that took his effective operational capabilities from the Pacific theatre and compressed as well as refined the procedures to meet the realities of Europe.

As the airlift increased in scope and tonnage, the allies came to believe that airlift could be a long-term solution to the ongoing crisis with the Soviets.[78] Indeed, Tunner's transformation had resulted in daily tonnages that met the heating and food needs of Berlin's people throughout the winter, and the four nations went back to negotiations. In early 1949, it was apparent that, "from the standpoint of the Soviet interests, the blockade had become a liability, furthering developments it had been intended to prevent."[79] Combined with the American presidential election in November that confirmed American resolve in Berlin, the Soviets no longer believed the blockade was effective, and they backed down on May 12, 1949.[80] The result was a massive public success for the allies, and it had been achieved because the USAF airlifted 1,715,585 tonnes into Berlin and Britain had added another 516,014 tonnes that kept the city warm and fed.[81] There was little question that strategic ends were achieved through this airlift, but the results were predictable based on Tunner's related and highly successful experience from 1945.

The Berlin Airlift is often given as the first example of airlift as a strategic capability, a new capability that was solely responsible for success in the first serious crisis in the Cold War.[82] This view is arguably an exaggeration, as the airlifts of 1945 in the Pacific theatre have demonstrated. The importance of the Berlin Airlift to this discussion is not the unprecedented tonnage over the time frame; it is the lasting awareness of airlift that was achieved in the eyes of national leaders and the public in contrast to the fleeting recognition of airlift in 1945.

As an interesting aside, Canada did not participate in the Berlin Airlift, even though it was requested to join. The government of the day determined that Canada's interests were better served as a diplomatic presence to assist negotiations between the allies and the Soviets.[83] Airlift is important, but strategy can be achieved by non-military means.

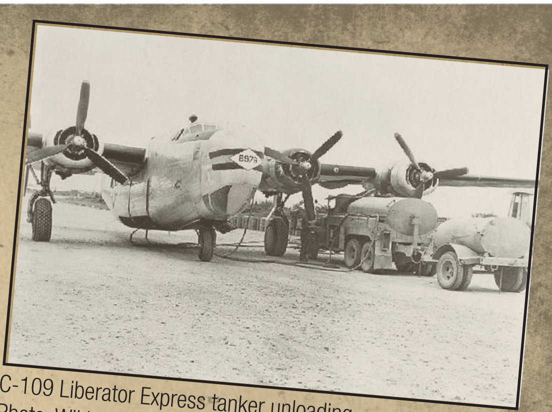
Since the Berlin Airlift, there have been other very large airlifts that helped achieve strategic aims. Operation (Op) NICKEL GRASS in 1973 was an American mission that aimed to prevent Israel from being overrun during the Yom Kippur War, and the mission "very likely saved Israel from defeat and by doing so prevented a Soviet proxy victory in the Middle East."[84] This operation did not involve the threat of enemy forces, so only the early lessons of strategic airlift (e.g., weather) applied. Op PROVIDE PROMISE was an airlift operation, this time involving Canada, in which a threat to the aircraft did exist.[85] The strategic objective of Op PROVIDE PROMISE was to save lives, and it worked because, "by the end of 1993, over 345,000 Bosnians depended on airdropped supplies for their survival."[86] In this airlift, all the lessons of the Second World War were applicable. One can conclude that airlift as a strategic capability for political objectives, as demonstrated by the USAAF in 1945, continued to be relevant to airlift operations up until 1993.

CONCLUSION

General Henry "Hap" Arnold had commanded the USAAF throughout the Second World War, and he stated, "cargo and passenger air transport, serving all arms and operating with airline precision and techniques, is an essential part of military operations."[87] From the Luftwaffe's experience fighting in Europe to the American experience over the Hump and the Pacific, this has become a widely accepted truth. However, airlift can be viewed as an aspect of air power that goes beyond military logistics into the domain of strategic impact. Political goals like keeping China in the war, preventing communist forces in China to take the Japanese surrender and start a civil war as well as getting control of Japan quickly were high-level objectives that were achieved by airlift between 1942 and 1945.

An interesting view on the process of developing strategy has recently been offered by renowned military historian Hew Strachan: "Experience, and the experience of failure, is fed back into theory in order to give it purchase on the future by its incorporation of the lessons of the past."[88] Arguably, this occurred during the Second World War through American observation of German operations in airlift. Even successful German airlift operations, such as the capture of Holland and the rescue of the force at Demyansk, demonstrated that the cost of using transport aircraft in combat operations could be very high. Stalingrad was an example of that cost turning into disaster when transport aircraft operated close to the front lines.

THE IMPORTANCE OF LOGISTICS AND THE PRECISE FLOW OF AIRCRAFT—AS KEY FACTORS IN THE SUCCESS OF THE BERLIN AIRLIFT—ARE LESSONS THAT STILL RESONATE TODAY.



C-109 Liberator Express tanker unloading
Photo: Wikipedia Commons

As a reminder, combat losses of transport aircraft affect not only the air force equipment and personnel but also the ground force organization. Losses can also impact other organizations using the same aircraft, most notably training units, so effective use of strategic airlift should aim to avoid operating in the enemy's presence whenever possible. It is understood that airborne operations are sometimes worth the cost to achieve land force goals very quickly, especially if air superiority is maintained, but the potential for aircraft losses needs to be considered in the planning stages. American use of transport aircraft in the Second World War demonstrated an understanding of these problems and was "fed back into theory" to reinforce the practice of air transport in areas of lowered enemy threat, such as the Hump. Airlifts after the Hump proved that swift airborne logistics can meet some national objectives.

The other lessons that were "fed back into theory" were communications, logistics, dealing with poor weather and the orderly flow of aircraft. The improvements made throughout the Second World War provide key areas of concern for any future airlift: most importantly, to deliver the payloads needed, the equipment and personnel that are to be moved must be meticulously planned to permit an orderly flow of aircraft. In today's world, communications and training for poor weather are already built into existing systems, but the importance of logistics and the precise flow of aircraft—as key factors in the success of the Berlin Airlift—are lessons that still resonate today.

It is not only the Americans who need to be concerned with airlift and its strategic impact. Canada needs to participate in airlifts that help the nation achieve strategic ends. Sometimes, as with Berlin, avoiding airlift and focusing on diplomatic efforts best serve Canada's interests. However, there will always be times when strategic airlift will help Canada keep a military force from failure or provide hope and food to starving people. Strategic airlift, as developed during the Second World War, can still be an incredibly strategic response to a crisis.

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ABBREVIATIONS

USAAF	United States Army Air Force
USAF	United States Air Force

NOTES

1. US, USAF, Air Force Doctrine Document 26.1, *Airlift Operations* (Montgomery, AL: Air Force Doctrine Center, November 13, 1999), 61.

2. The Canadian and American air forces both have doctrine documents that define strategic airlift as intertheatre or intercontinental movement of personnel and equipment to differentiate from tactical airlift, which has the primary aim of delivering personnel and equipment within a specific theatre of operations. This article will not use military definitions; instead, it will use strategic airlift to define what the airlift capability can achieve.

3. A. D. Harvey, "A Slow Start: Military Air Transport at the Beginning of the Second World War," *Air Power History* 62, no. 1 (Spring 2015): 6–15.

4. John Killen, *The Luftwaffe: A History* (Barnsley: Pen and Sword Books, 1967), 65.

5. Peter Oppenheimer, "From the Spanish Civil War to the Fall of France: Luftwaffe Lessons Learned and Applied," *The Journal of Historical Review* 7, no. 2 (Summer 1986): 134.

6. This paragraph cites Harvey, "A Slow Start," 11.

7. Harvey, "A Slow Start," 11.

8. Robert C. Owen, *Air Mobility: A Brief History of the American Experience* (Washington: Potomac Books, 2013), 33.

9. Owen, *Air Mobility*, 41.

10. Kenneth P. Werrell, "The Dark Ages of Strategic Airlift: The Propeller Era," *Air Power History* 50, no. 3 (Fall 2003): 23.

11. D. Fritz Morzik, *German Air Force Airlift Operations* (New York: Arno Press, 1961), 9.

12. Owen, *Air Mobility*, 39.

13. Owen, *Air Mobility*, 33–34.

14. William H. Tunner, *Over the Hump* (St. Clair County, IL: Airlift Operations School Headquarters, 1995), 35–36.

15. Tunner, *Over the Hump*, 112–13.

16. Morzik, *German Air Force Airlift Operations*, 25.

17. Morzik, *German Air Force Airlift Operations*, 25.

18. This paragraph cites Morzik, *German Air Force Airlift Operations*, 25.

19. Harvey, "A Slow Start," 12.

20. Harvey, "A Slow Start," 13.

21. Morzik, *German Air Force Airlift Operations*, 28. The use of transport aircraft for the transfer of wounded personnel to regions well behind front lines is described in the official histories of Germany, the US, Great Britain, Canada and Australia.

22. Carl A. Christie, "The Role of Ferry, Transport, and Civil Aviation in the Second World War," in *Sic Itur Ad Astra: Canadian Aerospace Power Studies*, ed. W. A. March, vol. 2, *Big Sky, Little Air Force* (Ottawa: DND, 2009), 2:29–41.

23. Carl A. Christie, *Ocean Bridge: The History of RAF Ferry Command* (Toronto: University of Toronto Press, 1995), 108.

24. Tunner, *Over the Hump*, 18.

25. Tunner, *Over the Hump*, 19, 27–28.

26. Owen, *Air Mobility*, 34. Crew-based scheduling works well when the mission can use any aircraft, in contrast with fighter and bomber missions where the crew are paired with specific aircraft.

27. Christie, "The Role of Ferry," 2:35.

28. Christie, *Ocean Bridge*, 50.

29. Christie, *Ocean Bridge*, 309. The total ferry losses for the British were 152 aircraft and 560 personnel.

30. Christie, *Ocean Bridge*, 30.

31. Harvey, "A Slow Start," 8.

32. Morzik, *German Air Force Airlift Operations*, 47.

33. Morzik, *German Air Force Airlift Operations*, 71.

34. Morzik, *German Air Force Airlift Operations*, 66.

35. Morzik, *German Air Force Airlift Operations*, 20.

36. Owen, *Air Mobility*, 46, 52.

37. Joel S. A. Hayward, "Stalingrad: An Examination of Hitler's Decision to Airlift," *Airpower Journal* 11, no. 1 (Spring 1997): 21–36.

38. Morzik, *German Air Force Airlift Operations*, 137.

39. Hayward, "Stalingrad," 24.

40. Hayward, "Stalingrad," 24.

41. Morzik, *German Air Force Airlift Operations*, 173.

42. Brereton Greenhous et al., *The Crucible of War 1939–1945: The Official History of the Royal Canadian Air Force* (Toronto: University of Toronto Press, 1994), 3:896.

43. Morzik, *German Air Force Airlift Operations*, 142.

44. Morzik, *German Air Force Airlift Operations*, 142.

45. Harvey, "A Slow Start," 6.

46. Harvey, "A Slow Start," 6.

47. Morzik, *German Air Force Airlift Operations*, 195.

48. Morzik, *German Air Force Airlift Operations*, 193, 195.

49. John F. Farrell, "The Bamboo Fleet: How a Ragtag Airlift Operation Supported Besieged U.S. Forces in the Philippines in World War II," *Air Power History* 59, no. 2 (Summer 2012): 16.

50. Farrell, "The Bamboo Fleet," 22.

51. Morzik, *German Air Force Airlift Operations*, 71.

52. Tunner, *Over the Hump*, 24.

53. Owen, *Air Mobility*, 34.

54. Douglas N. Gillison, *Australia in the War of 1939–1945: Series Three*, *Air* (Adelaide: The Griffin Press, 1962), 1:625.

55. Gillison, *Australia in the War*, 1:626.

56. Gillison, *Australia in the War*, 1:668.

57. Tunner, *Over the Hump*, 58.

58. In 1942, it was not envisioned that the US would be able to attack Japan from the Pacific theatre.

59. Tunner, *Over the Hump*, 59.

60. Tunner, *Over the Hump*, 43.

61. Owen, *Air Mobility*, 38.

62. Tunner, *Over the Hump*, 103.

63. Tunner, *Over the Hump*, 112, 116.

64. Owen, *Air Mobility*, 39.

65. Tunner, *Over the Hump*, 58.

66. Owen, *Air Mobility*, 41.

67. John D. Plating, "Cannon, Egg, Charlie and Baker: Airlift Links between World War II and the Chinese Civil War," *Air Power History* 53, no. 3 (Fall 2006): 6.

68. This paragraph cites Plating, "Cannon, Egg, Charlie and Baker," 6.

69. Plating, "Cannon, Egg, Charlie and Baker," 6.

70. Plating, "Cannon, Egg, Charlie and Baker," 10.

71. Plating, "Cannon, Egg, Charlie and Baker," 9.

72. Owen, *Air Mobility*, 41.

73. Owen, *Air Mobility*, 41.

74. Emma Peplow, "The Role of Britain in the Berlin Airlift," *The Journal of the Historical Association* 95, no. 2 (2010): 208.

75. Daniel F. Harrington, *Berlin on the Brink: The Blockade, the Airlift, and the Early Cold War* (Lexington, KY: The University Press of Kentucky, 2012), 53.

76. Chris Clark, *Operation Pelican: The Royal Australian Air Force in the Berlin Airlift, 1948–1949* (Australia: Air Power Development Centre, 2008), 9, 11.

77. This paragraph cites Tunner, *Over the Hump*, 152.

78. Harrington, *Berlin on the Brink*, 208.

79. Harrington, *Berlin on the Brink*, 268.

80. Clark, *Operation Pelican*, 66.

81. Peplow, "Role of Britain," 209. The USAAF was renamed the USAF on September 18, 1947.

82. Justin Giovannettone, "Airlifts in Time," *Air Power History* 52, no. 3 (Fall 2005): 28; and Peplow, "Role of Britain," 207.

83. Greg Donaghy, *Canada and the Early Cold War, 1943–1957* (Ottawa: Department of Foreign Affairs, Trade and Development, 1998), 53.

84. Giovannettone, "Airlifts in Time," 28. The author also argues that strategic success was only partially achieved as the airlift "helped prompt the devastating Arab oil embargo from October 1973 to March 1974."

85. This author participated in Canada's airlift to Sarajevo over four separate deployments and can attest to the risks to transport aircraft from Croatian and Serbian forces.

86. Owen, *Air Mobility*, 265.

87. Henry Harley Arnold, *Third Report of the Commanding General of the Army Air Forces to the Secretary of War* (Washington: Superintendent of Documents, November 12, 1945), 63.

88. Hew Strachan, *The Direction of War: Contemporary Strategy in Historical Perspective* (Cambridge: Cambridge University Press, 2013), 281.

Tactical Aviation within the Future Fight

By Major Greg Zweng, CD

408 Tactical Helicopter Squadron (Tac Hel Sqn) was fortunate to participate in Marine Air-Ground Task Force Warfighting Exercise (MWX) 1-20 at the Marine Corps Air Ground Combat Center, Twentynine Palms, California. This was the largest force-on-force exercise conducted by the United States Marine Corps (USMC) since the Cold War era. The exercise pitted the USMC 2nd Marine Division (2nd MARDIV) against the 7th Marines (reinforced), a regimental-sized advisory force with 40 Royal Marines Commando Battle Group (United Kingdom) and 408 Tac Hel Sqn (Royal Canadian Air Force [RCAF]) attached. The two forces were very capable adversaries, each with high-end capabilities as would be seen in any future near-peer conflict. The exercise was part of the direction given by the commandant of the USMC, General Berger, to "unshackle ourselves from previous notions of what war looks like and [to reimagine] how Marines will train, how we will operate, and how we will fight."[1]

Marine Corps Air Ground Combat Center is a 2,500 km² training area in the Mojave Desert of California. The associated airspace is an unrestricted surface to 40,000 feet [12,190 metres], with numerous military operating areas attached to extend the airspace beyond the ground training space.[2] The terrain is mountainous and devoid of water or any vegetation except for low scrub. The mountain relief limits fields of view and fire, and it canalizes ground and rotary-wing (RW) movement, while the contrasting open desert space provides few areas to hide and wide-open fields of view.

MWX was quite unique compared to similar force-on-force exercises that 408 Tac Hel Sqn has participated in. It was generally unscripted,[3] meaning there was no master-events list—just a few major events. Both sides were free to manoeuvre as they chose. Each side started with a blank map, the implication being they each had no idea of the other side's disposition at the start of hostilities. Any enemy situational awareness had to be earned through execution and was subject to the frictions of war. In the words of the 408 Tac Hel Sqn operations officer, "it was ominous looking over a blank map not even knowing where the enemy would even enter the battlespace."[4]

THE TWO FORCES WERE VERY CAPABLE ADVERSARIES, EACH WITH HIGH-END CAPABILITIES AS WOULD BE SEEN IN ANY FUTURE NEAR-PEER CONFLICT.

408 TAC HEL SQN PARTICIPATION

408 Tac Hel Sqn deployed six CH146 Griffons and 140 personnel (pers) to Twentynine Palms. Although participation in MWX was a driving factor to deploy the Sqn, the deployment was used to conduct other Sqn force generation (FG) as well as prepare the 408 Tac Hel Sqn–generated CH146 detachment for deployment to NATO mission Iraq Rotation-2 at the end of 2019. The FG plan was ambitious; in addition to MWX, 408 Tac Hel Sqn completed various FG activities, from degraded-visual-environment landings, aerial gunnery, GAU-21[5] qualifications as well as a survival, evasion, resistance, and escape (SERE) exercise to personnel-recovery training. For the purposes of this article, 408 Tac Hel Sqn's participation in USMC MWX will be the focus, although other experiences are referenced to highlight the experiences within MWX.

TASKS

Tactical aviation's three pillars—reconnaissance (recce), mobility and firepower—were employed daily during CH146 operations within MWX. In the near-peer fight, the CH146 demonstrated its versatility and survivability in the operating environment, contrary to the narrative that often accompanies tactical employment of the CH146. During the exercise, the CH146 was equipped with the MX-15 electro-optical/infrared sensor and either two 7.62 C-6 machine guns or two GAU-21 .50 calibre (cal) machine guns without ammunition due to the dry nature of the exercise, but simulating armour-piercing incendiary (API) rounds[6] depending on the task. Low-level tactics were predominately used by 408 Tac Hel Sqn aircrew. The CH146's ability to fly low (15 feet [4.5 metres(m)] above the ground during the day / 50 feet [15.2 metres] at night) was used to tremendous effect. Low-level tactics reduced the aircraft's audible signature and visual detection. Low flight further mitigated some of the effects of communications (comms) jamming, which was extensively used. Surprise was near total when overflying opposing-forces units during chance encounters and enabled the helicopter to stay inside anti-aircraft infrared missiles' (man-portable air defence system [MANPADS]) engagement cycles given the short exposure times at 15 feet [4.5 metres].

Members of 408 Tactical Helicopter Squadron fire their weapons on a range at Marine Corps Air Ground Combat Center, Twentynice Palms, California, on 14 Nov 2019, during escape and evasion training as part of Exercise Striking Bat.

RECCE

408 Tac Hel Sqn was predominately assigned recce tasks throughout MWX and conducted short-notice recce tasks as a part of other assigned missions. Without refuelling, missions would last two-and-half to three hours and would often cover a large part of the operating environment. Recce missions would cross the forward line of own troops (FLOT) to provide information of activity at and behind the forward line of enemy troops (FLET), especially to provide warnings of preliminary movements and to identify various command and support echelons. According to United States' doctrine, the assigned task given to 408 Tac Hel Sqn was armoured reconnaissance (AR), which normally came with expectation to transition to the attack if identified enemy targets met the criteria of the attack guidance matrix. Given the threats, size of the enemy and airspace congestion, the CH146 operated generally in the low-level environment (usually below 100 feet [30.5 metres] and as low as 4 feet [1.2 metres]) when conducting recce tasks. Recce was conducted using all four crew members as observers, plus the aircraft's sensor to observe and report. Unfortunately, crew members' gyrostabilized binoculars were not brought for the exercise; they would have enhanced observation. CH146 observations enabled the commander to make timely decisions based not only on raw observation (as with unmanned aircraft systems [UASs[7]]) but with narrative, such as an assessment of a unit's size, capability and intent.

The final 408 Tac Hel Sqn recce mission of the exercise resulted in the locating of the 2nd MARDIV command post (CP), as it had not been located for a week. Both sides employed strict light, emission-security and camouflage policies, which made locating enemy forces difficult. The CP sighting was immediately followed by a multiple-rocket-launcher system call for fire (CFF) [fire mission] from the CH146 that was assessed to have destroyed the CP. The strike was said to have "completely broken [2nd MARDIV],"[8] as reported by the advisory force higher headquarters (HHQ) and resulted in a full exercise reset. This single act demonstrated the extreme utility achieved during CH146 AR missions.

MOBILITY

On the opening night of "the war," the CH146 was used to insert 13 snipers (a six-pers team and a seven-pers team) behind the FLET. This was done using four CH146s and two different landing zones. The mission was conducted under EMCON 1,[9] which had the CH146 eliminate its radio frequency (RF) signature, including the use of lights (infrared or otherwise), radios and other systems with an RF signature. The route was conducted at 50 feet [15 metres] above the ground and was based on careful enemy and terrain analysis. The insertion was conducted successfully and entirely without the knowledge of 2nd MARDIV, as acknowledged specifically during the exercise debrief.[10] The two sniper teams provided invaluable intelligence for several days on the 2nd MARDIV disposition and called in several strikes. This mission validated the CH146's continued relevance moving small teams ahead and beyond the FLOT with highly trained and practised crews, even against technologically equivalent or superior adversaries.

SCAR IS ALL ABOUT SHORTENING THE KILL CHAIN BY ENABLING THE SENSOR (IN THIS CASE THE CH146) TO FIND A TARGET AND HAND IT OFF DIRECTLY TO ANOTHER PLATFORM TO CONDUCT THE STRIKE.

FIREPOWER

The experiences learned in Afghanistan proving the CH146 is a capable fires platform have faded from recent memory. Within the Canadian Armed Forces (CAF), mention of the CH146 integrated into the joint application of force often gets a muted response. During MWX, the CH146 used (simulated) fires on most of its missions to excellent effect. 408 Tac Hel Sqn aircrew were able to employ the GAU-21 .50 cal rounds with great success, paired with API .50 cal (12.7 millimetre) rounds, and most equipment could be defeated, less the heavy armoured vehicles; however, lightly armoured vehicles, like the light-armoured-vehicle family (as in CAF/USMC use), as well as the BTR series and BMP series are not protected sufficiently when engaged by the API .50 round. With a maximum effective range of 1,850 metres, the GAU-21 can maintain a suitable range to stand-off from common threat systems to enhance aircraft survivability. During MWX, 7th Marines assigned the CH146 priority targeting of logistics vehicles (i.e., fuel trucks), a task easily achieved while inflicting grave damage to the enemy.

The CH146 influence on kinetic effects went well beyond the direct engagement from the aircraft. 408 Tac Hel Sqn aircrew facilitated the application of force through numerous joint engagement methods.

STRIKE COORDINATION AND RECONNAISSANCE (SCAR)

SCAR is defined in B-GA-442-001/FP-001, *Tactical Aviation Tactics, Techniques and Procedures*, as the following:

> A mission flown for the purpose of detecting targets and coordinating or performing attack or reconnaissance on those targets. SCAR missions are flown in a specific geographic area and are an element of the [command and control (C2)] interface to coordinate multiple flights, detect and attack targets, neutralize enemy air defenses, and provide battle damage assessment (BDA). Once aircrew are tasked with SCAR by the air tasking order (ATO), or a C2 agency, no further authorization is required unless otherwise restricted/amended by the supported commander or rules of engagement (ROE).[11]

In essence, SCAR is all about shortening the kill chain by enabling the sensor (in this case the CH146) to find a target and hand it off directly to another platform to conduct the strike. During MWX, this was done between the CH146 to fixed-wing strike aircraft. SCAR is not close air support (CAS), which requires detailed coordination because targets are close to friendly forces.[12] SCAR is done far enough forward of own troops that it negates the need for cumbersome CAS procedures. Joint terminal attack controllers (JTACs) or forward air controllers (airborne) are required for CAS, as detailed in NATO standardization agreements; however, SCAR can be conducted by anyone in a suitable aerial platform.[13] SCAR is a foundational aviation task within the USMC; however, in the CAF there seems to be an institutional resistance to the concept and no mention of this capability within CAF Land Force doctrine. Institutionally, SCAR needs to be embraced as a tool to quickly match the sensor to the right strike platform/weapon, especially as the modern operating environment grows the range of the size/depth of the fight. SCAR enables commanders to apply fires against priority targets that are normally beyond the reach of their organic weapon systems and is reactive enough to engage fleeting targets not suitable for systems such as artillery.

CAF members participating in Exercise Striking Bat at Marine Corps Air Ground Combat Center, Twentynine Palms, California.

AERIAL OBSERVATION / CALL FOR FIRE

Throughout MWX, the CH146 was used to CFF from multiple-launch rocket systems and artillery units against targets normally discovered during the conduct of AR. Although the CAF has a long history of using aircraft for artillery spotting, from the First World War through to the retirement of the CH139 Kiowa, for various reasons this method of engagement is rarely planned for today, although it remains very much applicable. A CH146 equipped with an MX-15 can observe, with very good accuracy, targets and the fall of artillery out to 10-plus kilometres with ease. A battery's three associated forward-observation-officer parties can only observe a fraction of the area an M777 can strike with conventional ammunition and even less with improved munitions. Additionally, as the ranges of indirect fires increase and since comms systems have not kept pace, an elevated platform can extend the reach of comms systems to enable CFFs.

During live-fire training post MWX, 408 Tac Hel Sqn aircrew conducted live CFF with the Royal Marines to good effect, the only challenge being their use of high-frequency (HF) radios for their fires net. This was the same with the USMC; HF was common for ground-forces use, further demonstrating the accepted expansion of the tactical fight as very high frequency FM radios no longer have sufficient range to enable dispersed operations. CH146 comms suites were incompatible, requiring relay (and delay) through ground nodes. The CH146 was not equipped with HF due to long-term reliability issues; currently the HF is not identified for upgrade in the CH146 Griffon limited-fire extension.[14]

CLOSE COMBAT ATTACK

Since the initial use of the CH146 as a fires platform, close combat attack (CCA) has been the primary procedure to engage in close proximity of friendly forces. CCA is a soldier-centric method of engagement, designed to enable aerial fires support to the lowest level. CCA is enabled through flexibility as well as by exploiting the operating profile of a helicopter versus a fast jet. CCA can be employed by any soldier with a radio. CCA contrasts with CAS, which requires a JTAC to control and uses lengthy procedures based on the employment of fighter jets flying several kilometres above the operating environment, at close to 1,000 km/h. USMC doctrine is based on employment of CAS, even with helicopters. 408 Tac Hel Sqn's experience was that engagement times for simulated CAS attacks were, on average, 10 minutes from the receipt of the mission to effects on target as opposed to 1 minute for CCA. Further, CCA was conducted with units that did not have a JTAC, which greatly increased the number of units that could be supported.[15]

CCA continues to be contentious within the CAF. The Air-Land Integration Cell (ALIC) within the Canadian Army Doctrine and Training Centre has long advocated that 1 Wing transition to CAS.[16] This would effectively limit CH146 fires support to the few units that have JTACs resident to their units. Recent rules imposed by the Canadian Army (CA)—through the ALIC—now prevent live CCA training without a specialist-trained JTAC present. Although CCA had been practised with numerous CA units for about a decade without incident, this training is now effectively shut down, given the new CA rules and the less than 10 pers in the CAF who are available to fulfil the new training safety requirements. During live portions of MWX, live CCA was done with USMC ground forces and United Kingdom Royal Marine Commandos, while the attached CA infantry platoon was left behind due to CA training rules. JTAC density is a NATO-wide issue due to the training required and short duration that most hold the position, which is no different in Canada. It should be further noted that most of the CCA fire missions conducted in Afghanistan were done predominately without JTACs on the ground.[17]

CCA is the preferred employment method for the CH146 for numerous reasons, notably the flexibility and the ability to employ fires with any soldier (not dependent on a JTAC) with a reduced aircrew training bill. Given the CH146 does not employ complex forward-firing ordnance further simplifies fires from the crew-served weapon systems. USMC planners and commanders as well as Royal Marine Commandos were continually amazed by the flexibility CCA offered them versus their normal employment of CAS. CCA is used by many land aviation forces, including the United States Army AH-64s and the French Army Tigers, for the same reasons stated above. CCA needs to be protected from takeover by the JTAC enterprise, while live CCA training needs to return between 1 Wing and the CA.

MISSION COMMAND

408 Tac Hel Sqn would not have been able to operate if it were not exercising mission command. Mission command is often preached but rarely practised, even in tactical helicopter. Due to the operating environment, extended mission ranges, limitations in CH146 beyond-line-of-sight communications capability and RF spectrum denial, air mission commanders (AMCs) were restricted from reaching back to the Sqn tactical operation centre for command oversight. AMCs needed to understand the operating picture (enemy, friendly and airspace), their tasks and commanding officer's (CO's) intent before stepping up for a mission.

Once in the area of operations, AMCs operated within the framework of their planning; however, given the free nature of MWX no mission went as planned. AMCs had to make changes and react to the situation every time they flew. The FLOT was in constant flux, entire enemy units would be discovered where they were not expected, and our supported commander would have new, higher-priority tasks during the course of a three-hour mission. AMCs would react, understanding their arcs from the CO and their pre-approved mission sets, to include (simulated) use of force. This way of operating enabled a true flexibility to 408 Tac Hel Sqn mission execution, well within the normal task-plan-execute cycle.

Exercise Striking Bat, Marine Corps Air Ground Combat Center, Twentynine Palms, California.

To enable operating in such a fluid environment, AMCs would rehearsal-of-concept drill numerous contingencies with their formations (normally two aircraft). Tasks per aircraft would be coordinated in the event of retasking or when reacting to a change in enemy situation. In one example, a CH146 section was conducting AR when friendly forces were hit by a high-mobility artillery rocket system (HIMARS) strike. The formation was retasked airborne to find the HIMARS battery deep in the rear area in an attempt to call for counter-battery fires.

Most missions involved the (simulated) use of force. AMCs and individual crew members had to be extremely sure of their ROE and positively identify targets that were normally beyond the battlefield coordination line[18] and routinely without the benefit of calling back to the Sqn tactical operation centre or HHQ. This was accomplished via thorough mission planning and aircrew understanding the ground picture.

RF SPECTRUM DENIAL

During MWX, RF denial was used extensively by both sides. Relatively simple jamming systems were used, intended to disrupt radio communications on key command control nets and especially frequencies associated with the tactical control and direction of aircraft. These tactics, techniques and procedures (TTP) are being used frequently in current conflicts and can be expected in any future conflict, as RF-denial systems will be more common. RF jamming and spoofing were at times as simple as 2nd MARDIV aborting an aircraft targeting them by manipulating CAS TTP, or transmitting on a frequency using different cryptography, thus causing other users to be overwhelmed with static on their radios.

The 408 Tac Hel Sqn CH146s were targeted with comms jamming on several occasions during MWX. Initially, crews had difficulty identifying that the issues they were experiencing were beyond aircraft or formation technical issues but, rather, intentional acts by opposing forces, even though it was expected. Some missions were essentially wasted circling, attempting to reach tactical C2 agencies. In these cases "the enemy" was able to prevent aircraft from operating through non-kinetic electronic warfare effects. It can be expected that any near-peer future fight will use signals jamming to exploit the overdependence on the RF spectrum to command and control forces and manage the fight.

408 Tac Hel Sqn had to adapt quickly to the reality of RF spectrum denial. Given training and international operations over the past 15 years have lessened the emphasis on TTP that minimize voice communications. Some lessons and TTP had to be relearned, and for the younger aircrew, learned for the first time to remain in the fight. These included the following:

1. EMCON TTP. EMCON was used as a method to reduce CH146 missions' RF signature, as opposing forces were exploiting it for detection and targeting. Using EMCON procedures, however, affected every aspect of usual aviation operations, which normally use extensive radio communications, infrared light and various systems that give off radio waves (i.e., radio altimeter). To achieve this, changes were made to all aspects of 408 Tac Hel Sqn operations. This started at receipt of a mission, and the planning phase, airspace restrictions and updates on the battlefield situation were passed and understood prior to aircraft start to negate the need for radios once airborne. Entering the operating environment, CH146 aircrew would turn off all systems that had an RF or light signature (visible and infrared light) to further restrict the ability to detect the aircraft through passive electronic and night-vision-device detection.

2. Command direction. This was made clear prior to the mission, and the CO's intent needed to be well understood prior to the crews taking off, exercising true mission command. This represented somewhat of a change to contemporary application of mission acceptance and

launch authority–driven operations and oversight. Crews then reported their sightings and engagements either when departing the area of operations (far enough to the rear to be out of jamming) or on landing through Sqn operations to HHQ.

3. Frequency-agile comms. The CH146 is HAVE QUICK II capable and it was used on several missions. Some missions were too dynamic/reactive to do without comms, and HAVE QUICK[19] was used for interflight comms to allow for more resilience against jamming. None of these missions experienced RF interference, although crew proficiency varied and in some cases had to be relearned. Although not immune to RF interference, systems like HAVE QUICK and single channel ground and airborne radio system (SINCGARS) provide commanders with more options in an RF-denial environment and should be reinvigorated. Unfortunately, often the limiting factor is systems knowledge by the technical operators. As an example, none of the 408 Tac Hel Sqn signals sections knew how to use HAVE QUICK, even though Sqn-operations radios are capable, due to changing training priorities and emphasis over the preceding years.

4. Low-tech solutions. The use of low-tech solutions proved invaluable to remain active within a contested operating environment, including landing at forward CPs to receive real-time updates and tasks, light signals between aircraft and simple code words. These were utilized to good effect when secure communications could be used and were also used to reduce the amount of radio traffic. Simple code words were used in response to several fixed-wing strikes being aborted by forces being targeted over the radio; an abort code was implemented in place of the word "abort." After this change no further missions were aborted by the forces being targeted.

5. Global positioning system (GPS) denial. GPS denial was expected during MWX, although the CH146 did not experience it due to the limitation that only very-low-power jammers could be used. 408 Tac Hel Sqn planned for the loss of GPS. Again, low-tech maps, navigation procedures and positional awareness were used to mitigate the possible risk. It is realistic to expect that GPS systems in future conflicts will be at risk of jamming and spoofing. Aviation operations will need to be prepared to operate without GPS. This is a shift from some current RCAF teaching that opines that operations without GPS are not possible.[20]

NEVER IN THE EMPLOYMENT OF UASS WERE THEY INTENDED TO REPLACE THE HELICOPTER; THEY ARE INTENDED TO GIVE COMMANDERS A PERSISTENT METHOD OF OBSERVATION OR GIVE SMALL UNITS THE ABILITY TO QUICKLY DEPLOY "EYES-ON" DURING COMBAT.

UASS AND RW

Mini and micro UASs[21] (Group 1-2 generally operating at 2,000 feet [609 metres] above ground level and below) and helicopters operating together continue to be issues, and MWX was no different. Generally, RW and mini and micro UASs were deconflicted by time (meaning either one or the other was airborne at any time). Never in the employment of UASs were they intended to replace the helicopter; they are intended to give commanders a persistent method of observation or give small units the ability to quickly deploy "eyes-on" during combat. In reality, UAS use is tightly controlled several echelons above the end user in the interests of airspace deconfliction. From the perspective of a small-unit commander, as a non-direct benefactor, helicopter missions are often seen to interfere with UAS use. Conversely, a helicopter's ability to operate within the operating environment is curtailed through numerous airspace restrictions from potential UAS operations. Further complicating the issue is that C2 reach to the users of the UAS is slow, and their operators have only limited understanding of the air picture.

Solutions need to be found to enable concurrent, flexible mini and micro UAS and helicopter operations. The current one-or-the-other approach to sharing airspace will continue to stifle both operations and negates any benefit of having these systems. Through practice at MWX, but also during exercises like Exercise (Ex) MAPLE RESOLVE, there are still airspace breakdowns where UASs and RWs cross paths, even though current deconfliction practices plan to avoid it at all costs. The only practical solutions will need some acceptance of risk that mini and micro UASs and helicopters be deconflicted through less rigid methods by reducing altitude separation and allowing visual deconfliction (see and avoid). Risk acceptance should include a realistic study on the effects of a helicopter impacting a small UAS, much in the way that aircraft are studied and designed to survive an impact with a bird.

THE ELEPHANT IN THE ROOM

Ex WARFIGHTER was a near-peer conflict. There was no shortage of voices expressing the opinion that the CH146 had no part to play in such a conflict—exercise or real. The 408 Tac Hel Sqn experiences proved them wrong. There are newer and more capable helicopters, of course; however, the CH146 conducts tasks that some cannot do and others cannot do as well. The greatest key to the success of 408 Tac Hel Sqn during Ex WARFIGHTER was the crew and their level of training. Courses like the Advanced Tactical Aviation Course (ATAC) provided a foundation within the Sqn to train and mentor more junior aircrew at the tasks required for success within a near-peer fight.

CHALLENGES

As the commandant of the USMC stated about MWX, "[I am] ready to see everyone from lance corporals to his commanders fail, since that will be part of the process of getting better,"[22] 408 Tac Hel Sqn participation in MWX was not without its challenges. Primary challenges experienced were aircrew proficiency, operations within radar threat environment and CH146 mission equipment.

Two CH146s were assessed "shot down" during the exercise, one by a Stinger surface-to-air missile (SAM) and the other by a Javelin antitank missile. In the first case, the employment of the AAR-47 Missile Approach and Warning System (MAWS) was not factored into the adjudication of the kill. The Javelin kill was most likely an incorrect assessment that resulted from a misunderstanding of system capabilities. Regardless of the nature of these losses, the zero-loss view of aviation operations is not realistic in a peer-on-peer fight. Contrary to recent operations' outcomes, leaders and planners need to prepare for aviation losses.

Aircrew proficiency went two ways. Some missions were executed with highly proficient and trained crews, able to thrive within the operating environment; however, the inverse was true as well. Some crews were not prepared for operations within such a complex operating environment. The causes of and fixes for this are complex, but the current lack of advanced tactical training for the last three-plus years within 1 Wing has left 408 Tac Hel Sqn with only a few ATAC graduates, and current flight-lead upgrade training does not include education in some of the mission sets fulfilled in MWX, such as SCAR and high-threat scenarios with radar threats or radio jamming. Restarting these courses and adapting them to the emerging fight is important for the health of Canada's tactical-aviation capability.

There was a radar-based SAM threat during the exercise. It was not an integrated air defence system (IADS) threat, but it still constrained CH146 operations. Although the SPS-65 Radar Warning Receiver (RWR) installed in the CH146 is capable enough against most radar threats, the system is getting old and few serviceable units are available for training. In the past several years, 408 Tac Hel Sqn has only used the system in simulation and no units were available for MWX. Countering the potential radar SAM threat became a hypothetical exercise, and aircrew were not able to test their proficiency using the SPS-65 or counter-radar TTP in this exercise. Threat mitigating was achieved through deliberate stand-off and terrain masking. These TTP are introduced on advanced courses like ATAC and the Tactical Electronic Warfare Instructors Course (TEWIC), but few graduates are available to mentor at the Sqn level. Additionally, the suppression of enemy air defences (SEAD) was completely dependent on capabilities lacking within the CAF, which provides a view to future capability deficiencies.

The tactical CH146 fleet is dependent on various mission kits to configure the aircraft for tactical operations. The availability of mission kits continues to be severely strained for various reasons. During the exercise, not all aircraft were equipped with the MX-15 sensor, and those that were often experienced reliability difficulties. Likewise, as mentioned, no SPS-65 RWRs were available and some aircraft were not equipped with MAWS. These deficiencies, while mitigated, resulted in reduced operational effectiveness, and the systemic nature of these shortages gravely affects aircrew proficiency.

To mitigate these challenges, aircrew training needs to evolve for the future fight. Future war will be highly complex and technical in nature, with the need for a strong foundation in the basics to counter the loss of technical systems in a denial environment. Only through formalized training done at a high standard can tactical-aviation aircrew be prepared to win the next fight. Similarly, advanced aircraft systems need to be available for aircrew to maintain proficiency on and to learn to master.

CONCLUSIONS FROM MWX

There were numerous lessons identified during USMC MWX. First and foremost, the CH146 is very relevant in near-peer conflict. Operating in the contemporary and near-future operating environment will be a challenging fight, where the quality of the training and junior leaders who are able to operate with little more than commander's intent will be the deciding factors over the quality of equipment. TTP development needs to ensure relevance by being able to operate without uncontested use of the RF spectrum and GPS. Many of the TTP used by 408 Tac Hel Sqn were relearned after being unused since the end of the Cold War.

Short of fighting the next conflict, training opportunities like MWX should be continued and failures studied honestly to improve the CAF's warfighting capability. To enable the development of our leaders' collective training needs, unscripted training needs to be allowed to flow in unexpected directions to enable even a glimpse into future war.

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as well as OC Aviation Tactics Flight while at 403 HOTS. Prior to joining 1 Wing, his employment included development of the JTAC capability. He has had three deployments: Operation (Op) ATHENA (Afghanistan), Op APOLLO (Afghanistan) and Op PRESENCE (Mali).

ABBREVIATIONS

2nd MARDIV	2nd Marine Division
AMC	air mission commander
API	armour-piercing incendiary
AR	armoured reconnaissance
ATAC	Advanced Tactical Aviation Course
C2	command and control
CA	Canadian Army
CAF	Canadian Armed Forces
cal	calibre
CAS	close air support
CCA	close combat attack
CFF	call for fire
CO	commanding officer
comms	communications
DND	Department of National Defence
EMCON	emission control
Ex	exercise
FLET	forward line of enemy troops
FLOT	forward line of own troops
HF	high frequency
HHQ	higher headquarters
JTAC	joint terminal attack controller
MWX	Marine Air-Ground Task Force Warfighting Exercise
pers	personnel
recce	reconnaissance
RF	radio frequency
RW	rotary wing
SAM	surface-to-air missile
SCAR	strike coordination and reconnaissance
Tac Hel Sqn	tactical helicopter sqn
TTP	tactics, techniques and procedures
UAS	unmanned aircraft system
USMC	United States Marine Corps

NOTES

1. Paul McLeary, "Commandant: Marines 'Not Optimized for Great Power Competition,'" *Breaking Defense*, October 3, 2019, https://breakingdefense.com/2019/10/commandant-marine-not-optimized-for-great-power-competition-or/.

2. "Twentynine Palms: Marine Corps Air Ground Combat Center," Marines, https://www.29palms.marines.mil/.

3. McLeary, "Commandant: Marines 'Not Optimized.'"

4. Major A. Webb (Operations Officer 408 Tac Hel Sqn), interview with author, November 12, 2019.

5. The GAU-21 is a .50 cal machine gun capable of firing 800 rounds per minute to a maximum effective range of 1,850 metres.

6. API .50 cal rounds were first fielded on the CH146 in 2018 during Op PRESENCE (Mali).

7. An unmanned aircraft system is "an aircraft and its associated elements which are operated with no pilot on board." International Civil Aviation Organization, ICAO Circular 328-AN/190, *Unmanned Aircraft Systems (UAS)* [Montreal: ICAO, 2011], x.

8. Maj A. Webb, interview with author, November 12, 2019.

9. "Emission control (EMCON) policy is the selective control of emitted electromagnetic energy, with the aim of minimizing the enemies' detection of friendly emissions." Canada, Department of National Defence (DND), B-GA-443001/FP-001, *1 Wing Standard Operating Procedures* (Ottawa: DND, 2016), 2-12.

10. Lieutenant-Colonel D. W. Forbes (CO 408 Tac Hel Sqn), in discussion with author, November 2019.

11. Canada, DND, B-GA-442-001/FP-001, *Tactical Aviation Tactics, Techniques and Procedures* (Ottawa: DND, 2016), 3-36.

12. United States, Department of Defense, Joint Publication (JP) 3-09.3, *Close Air Support* (April 10, 2019).

13. Canada, DND, B-GA-442-001/FP-001, *Tactical Aviation Tactics, Techniques and Procedures*, 3-36.

14. Maj F. Roy (DAR 9-2), email message to author, January 17, 2020.

15. See Canada, DND, B-GA-442-001/FP-001, *Tactical Aviation Tactics, Techniques and Procedures*, 3-3.

16. Maj A. R. Foster (1 Wing A7 Tactics), interview with author, November 15, 2019.

17. The author was a deployed JTAC in Afghanistan, a JTAC instructor from 2005 to 2011 and a CH146 Pilot in Afghanistan in 2011.

18. Battlefield coordination line (BCL) is a supplementary measure, which facilitates the expeditious attack of surface targets of opportunity between the measure (the BCL) and the fire support coordination line. United States, Department of Defense, Joint Publication 3-52, *Joint Airspace Control* (November 13, 2014).

19. Canada, DND, *Defence Terminology Bank* (*DTB*), record 43973. "A function of a radio that makes it resistant to jamming because of its ability to frequency-hop."

20. 408 Tac Hel Sqn Electronic Warfare Officer Captain Ian McMillan, interview with author during Space Operations Course debrief, Canadian Forces Base Edmonton, September 23, 2019.

21. See the NATO UAS Classification Guide, Table 1, in Lieutenant Commander Dave Ehredt, "NATO - Joint Air Power Competence Centre," *2010–2011 UAS Yearbook - UAS: The Global Perspective – 8th edition* (June 2010), 62.

22. McLeary, "Commandant: Marines 'Not Optimized.'"

Major Michael Duong (right), seen here while a Canadian logistician captain deployed on Op IMPACT, observes as a Lebanese Armed Forces colonel (left) provides guidance to an Army supply officer at Logistics Brigade on December 16, 2019.

A BIRD'S EYE VIEW OF LOGISTICS IN LEBANON

BY MAJOR MICHAEL DUONG

I have always believed that all the knowledge acquired through training and experience over the course of one's career is meant as preparation to deploy at a moment's notice. Deploying on an overseas mission and being on foreign soil allow every soldier to execute that which has been practised and learned on exercises as well as through garrison and staff work within the daily regimen at home. It could be argued that, if asked, many would say the true purpose of a soldier's life is to make a difference wherever they can. This is how I felt when I was given the opportunity to deploy on a capacity-building mission in Beirut, Lebanon, to assist the Lebanese Armed Forces (LAF) with improving their logistics operations.

By way of background, between 2011 and 2017, instability in the Middle East led to clashes along the Lebanese-Syrian border. In fact, Daesh[1] even attempted to occupy Lebanese towns. Through Operation (Op) IMPACT, Canada seeks to contribute to stability by building partners' operational capabilities in the region. In Lebanon, this means enhancing the LAF's skills in areas such as winter and mountain operations, civil-military cooperation and logistics management.

It was exciting and extremely rewarding to be on a mission where the Logistics Enhancement Team and logisticians were the focus and leading the charge. Adapting to new surroundings and understanding how other militaries employ their logistical capability were interesting, challenging and enlightening. As a career student of logistics, I have spent my professional and academic careers understanding and providing logistic support; it is my mission, so that operators can complete their mission and win the fight. Our task was under the umbrella of Op IMPACT and, specifically, a capacity-building task in which a mobile training team (MTT) worked to help the host nation's military. In this case, we were directly working with the LAF while embedded inside their logistics brigade.

The Canadian contingent in Lebanon consisted of the Canadian Training Assistance Team Lebanon (CTAT-L) headquarters staff of approximately 13 personnel, including a commanding officer, which provided real-life support to the MTTs on the ground. During my tour, there were a total of three MTTs providing training to the LAF in Beirut: a winter MTT, a civil-military cooperation (CIMIC) MTT and our logistics MTT. The logistics MTT consisted of three subsections for a total of eight personnel from across various units in Canada. Our strength was in our diversity and individual experiences. The Roto 0 logistics MTT was led by a Royal Canadian Electrical and Mechanical Engineers School (RCEMES) lieutenant-colonel. The Doctrine Section consisted of a reservist finance major and a reservist combat engineer. The Training Section was comprised of a reservist logistics captain, a training development officer captain and a weapons technician master warrant officer. Lastly, I was part of the Materiel Management Section and the only Air Force member on the team; everyone else was from the land element, including my only subordinate—a supply technician warrant officer.

As lead of the Materiel Management Section, this experience was an opportunity of a lifetime. It took all of my military knowledge and experience to be able to impact the needed changes and offer the recommendations that we provided the LAF. It would have been easy to come up with the standard copy-and-paste ideas based on Canadian Armed Forces (CAF) standards for materiel management; however, what was challenging was being able to integrate ideas with the LAF way of doing business. For example, the LAF supply system shares many similarities with how the CAF manages its supply chain. Both militaries have a system of record, but there are stark differences. For instance, we observed that the LAF had challenges communicating laterally due to tightly controlled decision-making authority. We also discovered that a LAF supply-technician equivalent did not have visibility of their inventory. Nevertheless, it was fulfilling to use my accumulated experiences over the years from my postings in the Naval Reserve, Assistant Deputy Minister (Materiel), 12 Wing, 1 Wing (tactical helicopter), Joint Operational Support Group as well as my education in order to raise unique solutions that could be applied in a LAF context.

What I was most proud of, however, was the opportunity to work in this joint environment with my Canadian Army comrades and peers and to share a different (Air Force) but homogenous (military sustainment) perspective in order to build solid recommendations for the LAF and their lines of supply. Personal deployments on Op JAGUAR and Op IMPACT with 430 Tactical Helicopter Squadron provided me with great experience heading into the LAF mission. Even though my time in Iraq was supported by a joint task force support component (JTFSC) concept, on a daily basis my work involved supporting the detachment of helicopters on the ground. I would have never imagined that the first real joint mission would in fact be joint/combined in Lebanon as part of a mobile training team engaging with Lebanese soldiers. Our effects and deliverables had potential strategic implications.

Bringing an Air Force background to the team was humbling. My logistics MTT colleagues were highly professional, experienced and competent. In fact, the Materiel Management Section was challenged each day as the logistics-sustainment subject matter experts. We were like foot soldiers, walking into LAF lines to discover the nuances of their supply model, unique culture and working relationships. The Air Force has a definite place in joint operations, and in this MTT model our team took advantage of that fact. Although the Army's combat service support (CSS) doctrine is somewhat different than the Air Force's wing-supply and Air Force expeditionary capability (AFEC) constructs, the lines of effort are almost the same. For example, in a CSS model there are four lines of supply, with depots, JTFSC, brigades, battalions and unit-level companies all being fed up and down the supply chain; however, in the AFEC, the Air Force uses operations-support elements and mission-support elements that are combined with air detachments to form an air expeditionary wing, which all fall under an air task force that could have a JTFSC supporting it. The Air Force also moves supplies and supports up and down these lines, but they are categorized differently and have different types of customers from the Army CSS model. Please note that this is a highly simplified comparison, and those who would like to compare doctrine should seek out the publications from either element. My point is: even though I was surrounded by Army peers and even though we worked with the host nation inside a LAF Army brigade, I fit in.

Our logistics MTT had the highest esprit de corps of any mission I have been on. This was partly due to our size, but mainly, it was due to each of our personalities and professional competencies. I hope we continue to send diverse teams into joint missions because they are more effective and can have a greater impact on the ground. It was an honour to represent Canada and the CAF; I truly believe we made a difference in Lebanon.

Major Mike Duong joined the Naval Reserves at Her Majesty's Canadian Ship CHIPPAWA (Winnipeg) in 2005, and the Royal Canadian Air Force as a logistics supply officer in 2008. He has overseas deployments on Op JAGUAR (Jamaica, 2011) with the search and rescue (SAR) community, providing support for three CH146 SAR helicopters; Op IMPACT in Erbil, Iraq (2016), supporting four CH146 Griffons; and assisting the strategic team in New York City to negotiate Op PRESENCE equipment requirements with the United Nations. Major Duong is currently leading the newly hoisted 1 Canadian Air Division A4 Logistics Programs Section in Winnipeg.

ABBREVIATIONS

CAF	Canadian Armed Forces
CSS	combat service support
JTFSC	joint task force support component
LAF	Lebanese Armed Forces
MTT	mobile training team
Op	operation

NOTE

1. The group has also been known as the Islamic State of Iraq and Syria (ISIS), the Islamic State (IS) and the Islamic State of Iraq and the Levant (ISIL).

NEW DIRECTIONS IN THE STUDY OF CHINA'S FOREIGN POLICY

By Alastair Iain Johnston and Robert S. Ross

Stanford: Stanford University Press, 2006
482 pages
ISBN 0-8047-5363-6

Review by **Captain Hani M. Mustafa**

The year 2020 will be remembered for the impact that the coronavirus disease—commonly known as COVID-19—had on the world politically, socially and economically. Countries around the world have adopted different approaches to tackling the disease, but China has distinguished itself by mitigating COVID-19's spread in its population, resulting in a low infection rate on a per-capita basis. This has enabled China to work on restoring its economy and strengthen its ability to exert influence, ahead of other nation states, on international institutions and consortia to advance China's interests. At times, this ability can be backed by military deterrence via air power when necessary.

Canada continues to play important roles in multilateral systems of governance, such as the United Nations and NATO. Such roles are exercised with the employment of air power when required by Canada in times of peace and war. With China's recovery from the COVID-19 pandemic ahead of other nation states, it is inevitable that China's interests will make both direct and indirect contact with Canada's interests, such that military deterrence may become a necessary option to ensure peace is maintained between the two countries. As practitioners of air power, many of us will serve in a greater capacity to protect Canada and Canadians from China's interests when required. But what are China's interests, and how does China advance its interests militarily? Professors Alastair Iain Johnston and Robert S. Ross sought the answers to these questions.

New Directions in the Study of China's Foreign Policy is a collection of research—performed by several academics in the fields of political science, international affairs and security studies—that examines China's foreign policy. The majority of these academics work in institutions based in the United States (US), so the research comes from external perspectives. The book is comprised of four parts: security studies into China's foreign policy, China's involvement in globalization, the domestic politics within China and the country's perceptions of its relationship with the US. The book may seem like a difficult read, but the authors have written it in a manner that makes it accessible to anyone interested in Chinese foreign policy without the need for any prerequisite knowledge. All the research papers supporting the author's writings are referenced as notes, so the reader is free to examine the references further.

Military historians may be interested in the security studies section, as it covers the military conflicts and skirmishes that China has had with its neighbours since the proclamation of the People's Republic of China in 1949. Examples include the war between China and India in 1962, China's involvement in Vietnam throughout the 1960s and 70s as well as China's relationship with North Korea insofar as military deterrence against their East Asian neighbours and the US is concerned. The reader will appreciate that much of China's evolution in its foreign policy stemmed from its geography, in that its borders were highly porous and required the strengthening of China's military deterrence. The second section of the book, regarding China's involvement in globalization, covers the stances and positions that China took on matters pertaining to the multilateral international system, such as the United Nations Security Council resolutions that China supported, abstained from and opposed. This review of China's stances and positions helps to communicate how China executes its foreign policy and how other nation states in the multilateral systems react. A large part of the book's second section covers the economic strategies China has exercised since its accession to the World Trade Organization in November 2001.

With COVID-19 under control in China, it is anticipated that the advancement of China's interests in foreign policy, as well as its use of air power to support its foreign policy, will become more prevalent in the multilateral system. For readers who have a stake in military strategy or are interested in security studies and international relations, this book provides a greater understanding of this subject through ample research work.

Captain Hani M. Mustafa, an aerospace engineering officer, is currently working as a deputy aircraft engineering officer with the CC177 weapon system management detachment within the C-17 System Program Office at Robins Air Force Base in Georgia. He holds a Bachelor of Engineering Science in mechanical engineering and a Bachelor of Arts in economics from Western University in Ontario as well as a Master of Aeronautical Science from Embry-Riddle Aeronautical University. He was a technical investigator at the Quality Engineering Test Establishment in Gatineau, Quebec, and a CC177 aircraft maintenance officer with 429 Transport Squadron. He was also deployed in support of Operation IMPACT as a duty officer within the air task force.