
**LESSONS LEARNED FROM PAST
URBAN AIR OPERATIONS**

This report has investigated the conceptual, legal-political, physical, and technological underpinnings of present-day urban air operations. This appendix looks at the historical record to determine the role that aerospace forces have played in past urban battles, the tasks that they have been assigned, and the conditions that have contributed to their effectiveness or ineffectiveness. The result is an overview of urban air operations from World War II to Bosnia, focusing on battles in which a major purpose of aerospace power was to assist friendly ground forces and/or civilians in contested urban areas. We emphasize U.S. air operations but have sought to learn from any air force that conducted urban operations. The intention is to cover a range of operational examples from urban warfare to military operations other than war (MOOTW); include both successful and unsuccessful urban operations; incorporate a variety of aerospace power tasks; and examine the employment of fixed- and rotary-wing aircraft in an urban environment.

This appendix concludes that all four U.S. military services have accumulated considerable experience in providing air support to joint urban operations during periods of war and relative peace. Despite this extensive record, the effectiveness of U.S. aerospace power in urban operations has varied so much throughout the years that no general trend is discernible. Furthermore, although this appendix analyzes the circumstances where aerospace forces have and have not been effective, the wide array of past examples of urban operations makes it impossible to offer a formula for aerospace force success that would fit the majority of cases. That said, we should note

that the United States has not fought in a major urban battle since the real revolution in aerospace power occurred in the late 1980s and early 1990s. The capabilities demonstrated in Operations Desert Storm, Deliberate Force, and Allied Force—most notably the combination of battlefield intelligence collection, stealthy platforms, and precision munitions—would likely make aerospace forces much more effective in large-scale urban operations against conventional foes.

The appendix is divided into three main sections: close air support, air logistics support, and air interdiction and siege support. Each of these sections initially describes the performance of aerospace power in the given functional role and subsequently analyzes the factors contributing to aerospace power's success or failure. In the final section, some observations are made regarding the overall effectiveness of U.S. aerospace power in past urban operations with the hope that these insights will be useful for planning the use of aerospace forces in future urban operations.

CLOSE AIR SUPPORT

From Stalingrad to Grozny, close air support has compiled a mixed record of achievement in urban operations. Historically, aerospace power has performed best when supporting defensively organized ground troops, pitted against easily identifiable opposition forces, in fairly open terrain on the outskirts of small, isolated towns. Close air support has generally been less effective in offensive operations conducted within densely built urban metropolises, where adversary forces have been dispersed in well-fortified defensive positions or intermixed with local civilians. Since the 1970s, developments in command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) and weapon accuracy and lethality have significantly improved how well advanced aerospace forces have engaged hardened targets in urban areas, often close to friendly troops. Nonetheless, factors such as restrictive rules of engagement (ROE), poor visibility, inadequate air-ground cooperation, insufficient intelligence, potent adversary air defenses, and the opposition's clever use of urban terrain and noncombatants have degraded the effectiveness of CAS, particularly with respect to small, mobile targets, such as snipers, mortars, and rocket-propelled

grenade (RPG) launchers. In some cases, as in Panama in 1989, these factors have not altered the overall positive impact of close support. In other cases, as in Grozny in 1994–1995, they have not only posed insurmountable obstacles for CAS but have added to the negative view of the operation as a whole.

Results

With some notable exceptions, neither the Axis nor the Allied powers during World War II had much success in providing close air support in urban areas. As a rule, they employed air forces in the city massively and offensively to “soften up” and demoralize the enemy prior to a major ground assault. In such a role, aerospace power often destroyed countless civilian lives and property, without making a significant military contribution. For example, on July 23–24, 1942, German bombers mounted the equivalent of 2,000 sorties against the city of Stalingrad, killing approximately 40,000 people and, at least initially, causing widespread panic among the Russian population. By blocking roads with the rubble produced by fallen buildings, the preliminary air bombardment hampered the movement of Soviet military forces. But it also assisted the city’s defenders by impeding the German ground attack. For their part, Stuka dive-bombers strafed defenseless civilians caught in the open but generally could not provide effective fire support to friendly units attempting to dislodge small groups of Soviet troops from the remains of Stalingrad’s municipal buildings and factories.¹

On the Western Front, aerial bombardment contributed little to Allied assaults on the German-held towns of Cassino, Caen, and Aachen. Used for the first time in a close support role at Cassino, U.S. heavy bombers caused many casualties and undoubtedly demoralized many Germans defending the town. But these benefits were offset somewhat by all the rubble, which impeded the movement of friendly tanks and other vehicles, as well as by the fact that air strikes

¹William Craig mentions one German battalion commander during the initial stage of the Stalingrad battle who, having lost 200 of his men in one day, decided not to pursue a group of Russian snipers into the city’s main railway station. Instead, he called for an air strike. The Stukas, however, missed the target and dropped their bombs in the midst of friendly troops. See *Enemy at the Gates*, New York: Reader’s Digest Press, 1973, pp. 93–94.

only partially neutralized German machine guns and artillery.² In Caen, some friendly units were greatly hindered by rubble in the streets; others elsewhere in town were not affected at all. Nevertheless, the effect on the enemy was clear. After sacrificing up to a quarter of their manpower in the assault on Caen, British infantry units reported almost no evidence of German gun positions, tanks, or German dead in the area targeted by Allied bombs. Instead, what they discovered was a devastated town center and 5,000 dead French civilians.³ At Aachen, the bombing results were nearly as dismal. Despite the loss of 79 planes and the diversion of precious sorties from the interdiction mission, the U.S. IX Tactical Air Force did nothing to speed the capture of the German border town. Indeed, the German defenders of Aachen managed to hold out for 39 days against an assault force of five U.S. divisions.⁴

However, urban CAS did achieve a small measure of success in World War II. U.S. Army commanders at Cherbourg credited the air support they received from the 9th Air Force in particular with shortening the battle by 48 hr or more. Even so, U.S. Army Air Force intelligence analysts subsequently described the bombing's impact as more psychological than physical. "Flying artillery" had not replaced ground artillery, and, in many cases, Allied ground forces encountered stiff resistance from German strongpoints that had survived pre-assault bombing. Whereas air strikes contributed to the surrender of some German forts, other German garrisons continued to endure for days, giving the Germans time to sabotage the city's valuable harbor facilities.⁵

A more convincing demonstration of Allied air support occurred on the periphery of Bastogne, during the winter of 1944–1945. For a week after the weather finally cleared over the Ardennes on

²See Headquarters, Mediterranean Allied Air Forces (MAAF), "Air and Ground Lessons from the Battle of Cassino, March 15-27, 1944," Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency, May 4, 1944.

³Carlo D'Este, *Decision in Normandy*, New York: E. P. Dutton, 1983, pp. 228–230; and Alexander McKee, *Caen: Anvil of Victory*, New York: St. Martin's Press, 1964, p. 230.

⁴Thomas Alexander Hughes, *Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*, New York: The Free Press, 1995, pp. 260–261.

⁵"Air Force Operations in Support of Attack on Cherbourg, June 22–30, 1944," Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency.

December 23, P-47 fighter bombers from the XIX Tactical Air Command (TAC) carried out hundreds of precision strikes against German positions all around the besieged town, contributing greatly to the 101st Airborne Division's successful defense of this vital communications center.⁶

Even in the post-WWII period, close air support has usually been less useful when the enemy's main forces have seized the densely populated, built-up areas of a city. For example, because of poor weather and U.S. fear of civilian casualties and damage to the city's historic citadel, CAS was mostly unavailable to American and South Vietnamese troops attempting to retake Hue during the Tet Offensive in 1968. As a result, U.S. Marines could not employ aerospace power against the defending Communist Vietnamese to compensate for their lack of adequate artillery support, thus prolonging the siege and increasing the risk of allied casualties. Still, four CAS missions flown against the southeast wall of Hue's Citadel enabled the Marines to capture an enemy position they had previously failed to seize.⁷ During the 1972 Easter Offensive in Vietnam, aerospace power proved essential to the defense of An Loc and Kontum, among other places. At An Loc, U.S. Air Force gunships broke up numerous Communist assaults on the town's perimeter before they were even organized. In addition, B-52 ARC LIGHT strikes destroyed enemy troop formations and eliminated artillery and anti-aircraft positions.⁸

During the Persian Gulf War Battle of Khafji, coalition air forces and Army/Marine helicopters provided effective close support for friendly ground forces around Khafji, especially during efforts to re-

⁶10th Armored team commander Colonel William Roberts described the P-47's fire-power on December 23 as equivalent to that of two to three divisions. See S. L. A. Marshall, *Bastogne: The First Eight Days*, Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency, 1988, p. 146.

⁷Headquarters, 1st Battalion, 5th Marines, 1st Marine Division, "Command Chronology for Period 1-31 March 1968," Washington, D.C.: Marine Corps Historical Center; and Eric Hammel, *Fire in the Streets: The Battle for Hue Tet 1968*, Pacifica, Calif.: Pacifica Press, 1991, pp. 341-347.

⁸U.S. Air Force, Headquarters PACAF, *The Battle for An Loc, 5 April-26 June 1972: Project CHECO*, Hickam AFB, Hawaii, January 31, 1973, pp. 59-66.

take the town.⁹ Much less effective was the close support provided by Russian Fencers and Frogfoots during the Battle for Grozny in 1994–1995. Aside from killing civilians and contributing to the city’s ruin, inaccurate Russian air strikes reportedly caused as many casualties to Russian ground troops as did rebel Chechen mortar fire.¹⁰

Since the 1980s, U.S. close air support assets have participated in a number of other-than-war operations in urbanized locales such as Grenada, Panama, Mogadishu, and Tirana. In most of these, CAS demonstrated its value to American troops and civilians on the ground. But special MOOTW considerations—in particular, those relating to U.S. military and noncombatant casualties—sometimes reduced the effectiveness of CAS. During the 1983 invasion of Grenada, for example, Air Force gunships ensured the safety of 82nd Airborne Division paratroops at Salinas Airfield and protected Navy Sea, Air, Land (SEALs) trapped inside the governor general’s compound.¹¹ For their part, Marine AH-1 Cobras covered the seizure of Pearls airport and supported Army operations on the south end of the island.¹² However, these achievements were offset by the loss of two Marine Cobra helicopters at Fort Frederick and accidental strikes by Navy A-7s on a mental hospital and brigade command post.¹³

⁹Rick Atkinson, *Crusade: The Untold Story of the Persian Gulf War*, Boston: Houghton Mifflin, 1993, pp. 198–213; Rebecca Grant, “The Epic Little Battle of Khafji,” *Air Force Magazine*, February 1, 1998, pp. 28–34; and Mike Williams, “Battle for Khafji,” *Soldier of Fortune*, May 1, 1991 pp. 48–52.

¹⁰NATO, “Frontal and Army Aviation in the Chechen Conflict,” gopher://marvin.nc3a.nato.int/00/secdef/csarc/adv1020%09%09%2B, December 19, 1995 (downloaded November 13, 1998).

¹¹Major Mark Adkin, *Urgent Fury: The Battle for Grenada*, New York: Lexington Books, 1989, pp. 183–185, 209–210.

¹²During one action, a flight of two Cobras used 20mm cannon and tube-launched, optically tracked, wire-guided (TOW) missiles to destroy a 90mm recoil-less rifle position, along with the house in which it was located and an adjacent support vehicle. See Timothy A. Jones, *Attack Helicopter Operations in Urban Terrain*, Ft. Leavenworth, Kansas: U.S. Army, Command and General Staff College, December 20, 1996, pp. 7–8; and Lt. Col. Ronald H. Spector, *U.S. Marines in Grenada*, Washington, D.C.: Headquarters, U.S. Marine Corps, History and Museum Division, 1987, pp. 8, 10.

¹³Ronald H. Cole, *Operation Urgent Fury: Grenada*, Washington, D.C.: Office of the Chairman of the Joint Chiefs of Staff, Joint History Office, 1997, pp. 4–5; and Adkin, 1989, pp. 243, 285–287.

In 1989, during Operation Just Cause in Panama, U.S. Army and Marine attack helicopters and Air Force AC-130 gunships provided effective close support in both rural and urban settings.¹⁴ They suppressed anti-aircraft and sniper positions around *La Commandancia*, the main Panamanian Defense Forces (PDF) headquarters complex, as well as the Tocumen and Rio Hato airports, and provided cover for 82nd Airborne Division air assaults against Panama Viejo, Tinajitas, and Fort Cimarron.¹⁵ On the downside, communications difficulties hindered AC-130 support to the SEAL assault on Paitilla Airfield¹⁶ and an AC-130 responding to a request for fire accidentally fired on a friendly ground unit near *La Commandancia*.¹⁷

During the summer and fall of 1993, U.S. forces participating in the UN mission in Somalia employed helicopter gunships in a number of high-profile CAS operations.¹⁸ On June 5, 1993 one AH-1 Cobra may have saved hundreds of Pakistani and American lives during a road-clearing operation by establishing a cordon of fire around UN troops. On September 10, Cobra gunships fired on Somali gunmen swarming around UN forces. Most famously, on October 3–4, 1993, four AH-6 Little Birds prevented U.S. Ranger Task Force troops pinned

¹⁴In its lessons-learned volume, the U.S. Army observed that “all major units involved in *Just Cause* used the AC-130. It provided precise direct fire, night surveillance and navigation assistance. . . . The AC-130 is an excellent fire support system. Precision fire control and accurate weapons systems fit well within restrictive ROE and reduction of collateral damage.” See *Operation Just Cause Lessons Learned: Volume II: Operations*, Ft. Leavenworth, Kansas: Center for Army Lessons Learned, October 1990, p. II-8.

¹⁵Later, Cobra and Apache attack helicopters supported ground units involved in clearing operations in Panama City and Colon. Jones, 1996, pp. 9–11.

¹⁶Malcolm McConnell, *Just Cause: The Real Story of America's High-Tech Invasion of Panama*, New York: St. Martin's Press, 1991, p. 66.

¹⁷Soldiers belonging to the 2nd platoon of D Company, 6th Regiment, 5th Infantry Division claim that half of their members were wounded by Spectre cannon fire as they attempted to breach a fence surrounding the PDF headquarters. See Thomas Donnelly, Margaret Roth, and Caleb Baker, *Operation Just Cause: The Storming of Panama*, New York: Lexington Books, 1991, pp. 150–152.

¹⁸John R. Murphy, “Memories of Somalia,” *Marine Corps Gazette*, April 1998, pp. 22–23; Jones, 1996, p. 12; and Colonel William C. David, “The United States in Somalia: The Limits of Power,” *Viewpoints*, Vol. 95, No. 6, June 1995, p. 9.

down in the vicinity of Mogadishu's Bakara Market from being overrun by supporters of Mohammed Farah Aideed.¹⁹

In the only serious incident of the Tirana NEO in 1997, U.S. Marine Cobras used cannon and rocket fire to take out two threatening Albanian air defenders, one equipped with an SA-7 launcher and the other manning a 12.7mm machine gun, on a ridgeline near the U.S. Embassy compound. From that point on, the Marines had no problems with Albanian gunmen attempting to disrupt airlift operations.²⁰

Effectiveness Factors

The following is a list of factors that have contributed to the effectiveness (or ineffectiveness) of the preceding urban CAS operations. They are grouped into performance categories: weapons and equipment, command and control, rules of engagement, intelligence, tactics and training, logistics, ground-force cooperation, opposition countermeasures, atmospheric and light conditions, and geography and terrain.

In most cases, no one factor or performance category has been responsible for the overall effectiveness of a given urban operation. Nonetheless, certain conclusions can be drawn from the available historical evidence:

- Technological advances since the 1970s have generally enhanced the performance of CAS-related weapons and command and control systems in urban environments.
- Strict or complex ROE in effect since the Vietnam War have sometimes offset technological advances in urban CAS.

¹⁹The most comprehensive account of the Ranger Task Force engagement on "Bloody Sunday" is Mark Bowden's *Black Hawk Down: A Story of Modern War*, New York: Atlantic Monthly Press, 1999. See also Jonathan Stevenson, *Losing Mogadishu: Testing U.S. Policy in Somalia*, Annapolis, Md.: Naval Institute Press, 1995.

²⁰LtCol. Jon T. Harwick, CO HMM 365, *Operation Silver Wake*, Oral History Interview, Washington, D.C.: Marine Corps Historical Center, Marine Corps Oral History Program, June 12, 1997, p. 14. See also Jon R. Anderson, "Rescue 911: On the Ground with Marines in Albania," *Navy Times*, March 31, 1997, p. 13.

- Passive and active countermeasures employed by opposing forces have degraded urban CAS performance from WWII on, despite advances in weapons and C2.
- Adverse weather and urban terrain have remained significant obstacles to close air support; however, improvements in precision guided munitions and aircraft navigation and targeting have reduced their impact to some extent.

Weapons/Equipment:

- At Cassino and Aachen, U.S. air forces lacked heavy, delayed-action bombs that could reach into cellars and penetrate concrete emplacements occupied by German troops.²¹
- Napalm proved to be the most effective ordnance at Hue because of the enemy's dug-in positions, proximity to friendly ground troops, and cover of well-constructed cement buildings. Useful also was the delayed-action Snakeeye bomb, which could be released at low altitude without knocking down the aircraft that dropped it.²²
- Employed for the first time in an urban CAS role at An Loc,²³ the AC-130's 105mm howitzer and PAVE AEGIS targeting system proved invaluable in that city's close-quarters fighting. Provided with a map of the city, Spectre crews were able to follow detailed instructions from ground controllers as well as break up enemy assaults and destroy buildings close to friendly troops.²⁴
- The Grenada operation highlighted certain deficiencies in the tools that the United States was then employing for urban CAS, including the AH-1 Cobra's lack of armor protection and the inability of the Navy's A-6 and A-7 aircraft to accurately acquire and hit targets in a built-up area.

²¹Headquarters, MAAF, 1944, p. 6; and Hughes, 1995, p. 63.

²²Hammel, 1991, p. 59.

²³Prior to An Loc, the AC-130 Spectre's mission in Indochina had been primarily night interdiction and armed reconnaissance, with less support of troops in contact. U.S. Air Force, Headquarters PACAF, 1973, pp. 59–60.

²⁴U.S. Air Force, Headquarters PACAF, 1973, pp. 59–60.

- In Panama, the Hellfire missile launched from the AH-64 Apache helicopter proved ineffective against the steel-reinforced walls of *La Comandancia*.²⁵
- At Khafji, the nighttime navigation and targeting capability of American close support aircraft, both fixed-wing and rotary-wing, was key to preventing Iraqi armored forces from entering the city en masse.²⁶
- In Somalia, the small and agile AH-6 gunship proved itself an ideal close support platform in Mogadishu's densely populated urban environment.²⁷
- When bombing through clouds, although equipped with a limited number of PGMs, Russian Su-24 Fencers at Grozny were still not accurate enough to avoid considerable collateral damage or fratricide.²⁸ Lacking guided missiles and bombs, the Su-25 Frogfoot's delivery was generally less accurate than the Fencer's.²⁹

Command and Control:

- Under heavy pressure from General Dwight Eisenhower and Prime Minister Winston Churchill to produce results, Field

²⁵Donnelly et al., 1991, pp. 119, 157; and McConnell, 1991, p. 66.

²⁶Williams, 1991, p. 50.

²⁷Bowden, 1999, p. 340. Throughout the night of October 3–4, Little Bird helicopters prevented Somali fighters from overrunning isolated U.S. positions, laying down fire as close as 20 feet from friendly troops. By contrast, Cobra pilots had difficulties identifying targets designated by ground controllers. See CPT Drew R. Meyerowich, Commander, Alpha Company, 2/14 Infantry, 10th Mountain Division, Interview, Washington, D.C.: U.S. Army Center of Military History, April 18, 1994, pp. 38, 46–48.

²⁸NATO, 1995, p. 2. With better weather and a more extensive network of ground controllers, LGB-equipped Su-24s performed much better against the smaller Chechen strongholds of Argun, Gudermes, and Shali during spring 1995. See Sean J.A. Edwards, "Mars Unmasked: The Changing Face of Urban Operations," unpublished RAND research, p. 73.

²⁹Still, the most notable Russian air force success during the first battle of Grozny was the bombing of the Presidential Palace on January 17, 1995, by seven Su-25s. Two of the 3000-lb concrete-piercing bombs penetrated the palace from top to bottom, leaving the Chechens inside in shock and probably causing the building to be evacuated. See Benjamin S. Lambeth, *Russia's Air Power in Crisis*, Washington, D.C.: Smithsonian Institution Press, 1999, p. 125.

Marshal Bernard Montgomery hastily requested heavy bombers for use against Caen. Although there were a number of worthwhile German targets in the city, none was apparently included in the target area selected by the army.³⁰

- The entire air operation during the Battle of Bastogne was carefully systematized and supervised. After directing flights to the town, the air force ground controller brought fighter-bombers straight over the target, eliminating the need to search. Planes were then ordered to reconnoiter Bastogne's perimeter, providing targets for succeeding flights.³¹
- At An Loc, the air commander established a so-called King Forward Air Controller (FAC) to sort out the myriad aircraft on the scene associated with different commands, services, and countries. Furthermore, the diversion of B-52 strikes to higher-priority targets became standard operating procedure at An Loc.³²
- Early CAS operations in Grenada exhibited poor command, control, and communications: Attacks by Navy fighters were not well coordinated with Rangers and Special Forces on the ground; furthermore, Marine Cobra pilots had difficulty making radio contact with Air Force C-130s or Army ground units.³³
- During the gun battle between the Navy SEALs and the PDF at Paitilla Airport in Panama, the Air Force Combat Control Team (CCT) was unable to make radio contact with the AC-130 Spectre overhead that had been assigned to provide close air support.³⁴
- In Khafji, air liaison officers working with Marine and Arab units and airborne observer-controllers were generally able to direct

³⁰D'Este, 1983 p. 311.

³¹Marshall, 1988, pp. 145–146.

³²Over 90 percent of B-52 missions were changed at the last minute by the local FAC. U.S. Air Force, Headquarters PACAF, 1973, pp. 18–19, 64–65.

³³Close air support was also complicated by Marine pilots and Army Rangers using different maps. Cole, 1997, pp. 65–66; and Adkin, 1989, pp. 217–218.

³⁴McConnell, 1991, p. 63.

air assets against attacking Iraqi units in the early hours of the battle.³⁵

- Soldiers of the 10th Mountain Division quick-reaction force (QRF) in Somalia were equipped with infrared strobes, which effectively enabled attack-helicopter pilots to distinguish them from adversaries during periods of close-in combat at night.³⁶
- As a consequence of an overly complex air control system and the threat posed by Chechen gunfire to air controllers, Russian air forces operated virtually independently of ground units during the Battle of Grozny. This lack of communication resulted in many fratricides.³⁷

Rules of Engagement:

- During the Battle of Hue, allied concern for the safety of the city's remaining civilian residents initially resulted in restrictive ROE, which, along with the bad weather, countered U.S. and Army of the Republic of Vietnam (ARVN) advantages in aerial fire support.³⁸
- In Grenada, the likelihood of civilian casualties led to the selection of the AH-1 Cobra (over Naval gunfire or carrier aircraft) for the fateful attack on Fort Frederick, during which gunship pilots flew a fixed course for a risky length of time. As a result, one Cobra was shot down and another was lost while providing fire support for the rescue of the downed pilots. Both Cobras were destroyed, and three crewmembers died.³⁹
- The ROE in Beirut permitted U.S. forces to shoot only in self-defense, and then only if the target could be positively identified and accurately engaged. Consequently, very few Marine Cobras were even allowed to fly over the beach; and, although transport

³⁵Williams, 1991, p. 50.

³⁶Meyerowich, 1994, p. 47.

³⁷NATO, 1995, p.5.

³⁸MAJ John C. Latimer, "Considerations for Operations on Urban Terrain by Light Forces," Master's thesis, Ft. Leavenworth, Kansas: U.S. Army Command and General Staff College, 1985, p. 108.

³⁹Adkin, 1989, pp. 242-245.

helicopters were armed with .50-caliber machine guns, their gunners never fired a round.⁴⁰

- Tactical air operations in Panama were often tightly controlled by ground force commanders. When civilians were present, the employment of AC-130 tube- or rocket-launched weapons was prohibited without the permission of a ground commander with at least the rank of lieutenant colonel. Close air support in civilian areas required approval from at least division level. The commander of Operation Just Cause, Lt Gen Carl Stiner, authorized air strikes for fighter aircraft.⁴¹
- Because of ROE restrictions on the use of mortars, Cobra attack helicopters were often the only fire support available to the United Nations Task Force commander in Somalia. To help reduce collateral damage, the Cobras' 20mm cannons were fitted with an AIM-1 laser designator, permitting the gunner to score first-round hits at night, when the laser was visible to night-vision goggles.⁴²
- While they were in effect, Russian ROE in Chechnya restricted the use of air-to-ground munitions in civilian areas. However, these ROE were eventually violated because of the limited supply of precision-guided weapons, poor weather, and a lack of training. Heavy civilian casualties resulted.⁴³
- The local Marine commander's insistence that ROE be loosened to permit the use of Cobra gunships at Tirana proved essential to

⁴⁰Although these restrictions precluded close air support for troops on the ground, they may have limited the number of aircraft targeted by the Lebanese militia. LtCol. Larry Medlin, CO, HMM-162, November 20, 1983, pp. 13–14; and LtCol. Amos R. Granville, CO, HMM-261, Oral History Interview, Washington, D.C.: Marine Corps Historical Center, Marine Corps Oral History Program, May 22, 1984, pp. 7–8.

⁴¹Jennifer Morrison Taw, *Operation Just Cause: Lessons for Operations Other Than War*, Santa Monica, Calif.: RAND, MR-569-A, 1996, p. 24.

⁴²Jones, 1996, p. 12.

⁴³Nevertheless, most of the 10,000 to 40,000 civilian deaths in Grozny by August 1995 were caused by artillery fire, not aerospace power. See "The Casualties of Chechnya," *The New York Times*, August 10, 1995, p. 18.

protecting transport helicopters involved in evacuating the U.S. Embassy compound there in 1997.⁴⁴

Intelligence:

- In Grenada, U.S. intelligence failed to anticipate the degree of initial resistance by Cuban advisers. Anticipating a short military intervention, planners were forced to put together a Tactical Air Control system on the fly.⁴⁵
- The complexity of the political-military situation during the U.S. peacekeeping operation in Beirut in the early 1980s made it extremely difficult to know whether any one position would be targeted and, if it was, who lay behind the attack.⁴⁶

Tactics and Training:

- The tendency of XV Air Force bombers at Cassino to drop their munitions from too high an altitude, given the slight anti-aircraft threat and good visibility, meant that bombing accuracy was worse than it might otherwise have been.⁴⁷
- Low-altitude dive-bombing and strafing, in close coordination with troops on the ground, proved effective in suppressing German defenses at Cherbourg.⁴⁸
- In an attempt to avoid hitting friendly troops through “backsliding,” many aircraft at Caen ended up bombing ahead of the target, thus adding to the devastation of the city center while causing little harm to the enemy.⁴⁹

⁴⁴LtCol. Dan E. Cushing, X0-HMM-365, *Operation Silver Wake*, Oral History Interview, Washington, D.C.: Marine Corps Historical Center, Marine Corps Oral History Program, June 12, 1997, p. 13.

⁴⁵Adkin, 1989, p. 140.

⁴⁶Hammel, 1991, p. 196.

⁴⁷Headquarters, MAAF, 1944, p. 10.

⁴⁸“Air Force Operations in Support of Attack on Cherbourg,” 1944, p. 5.

⁴⁹*Backsliding* refers to the tendency of a bomber pilot as he neared the drop zone to drop his load as soon as was acceptable. When the majority of bombs were dropped on the near edge of the zone, the zone itself would begin to slide back from the target. Because “backsliding” at Caen would have meant bombing friendly ground forces,

- In Grenada, AC-130s were not earmarked specifically to support Navy SEAL operations in the vicinity of St. George's. This failure contributed to U.S. and prisoner casualties resulting from People's Revolutionary Army armored personnel carrier (APC) and mortar fire.⁵⁰
- In attempting to minimize casualties and collateral damage in the crowded residential areas of Quarry Heights and Albrook Air Station, U.S. forces in Panama successfully employed a "graduated response" technique. This technique involved loud-speaker appeals to surrender, combined with a nearby firepower demonstration by AC-130 gunships, threatening imminent destruction unless the adversary gave up.⁵¹
- The AC-130 fratricide incident in Panama might have been avoided had AC-130s exercised more frequently with heavy forces in urban environments.⁵²
- Although subsequently provided, air cover (and armored support) to the 10th Mountain Division's Quick Reaction Force was lacking during the evening of October 3, 1993. This lack contributed to the unit's initial failure to break through a Somali ambush and enact a timely rescue of the Rangers pinned down in the vicinity of Mogadishu's Bakara Market.⁵³

Logistics:

- Because the movement of fighter groups had not kept pace with the Allied ground advance, U.S. fighter-bombers were forced to operate from airfields over 100 miles from the front lines during the Battle of Aachen. The resulting logistics difficulties cost IX TAC almost one-third of its striking power.⁵⁴

many airmen overcompensated and actually dropped on the far side of their target. McKee, 1964, pp. 228–230.

⁵⁰Adkin, 1989, p. 183.

⁵¹In both cases, the PDF soldiers either surrendered or fled. See Donnelly et al., 1991, pp. 143–144, 153.

⁵²Donnelly et al., 1991, p. 405.

⁵³Col. David Hackworth, "Rangers Ambushed in Somalia," *Soldier of Fortune*, Vol. 19, January 1, 1994, pp. 93–94.

⁵⁴Hughes, 1995, p. 262.

- When military operations commenced in Chechnya, supplies of food, fuel, ammunition, and spare parts amounted to 50 percent of those required. The shortage in material resources compromised the ability of Russian aircrews to operate in adverse weather and to employ their weapons effectively.⁵⁵

Ground-Force Cooperation:

- At Stalingrad, Luftwaffe General Wolfram von Richthofen berated the German commander, von Paulus, for not taking better advantage of the suppressive power provided by von Richthofen's Stukas and Junker bombers so that ground assaults could be launched into the city.⁵⁶
- Likewise, U.S. Army Air Force's reports on the Battle of Cassino are critical of the infantry for not advancing quickly enough under barrage, as well as for relying too heavily on bombardment to neutralize German defensive positions.⁵⁷
- In the defensive battle of Bastogne, U.S. ground units and Army Air Force fighter-bombers performed as part of a well-honed combined-arms team, breaking up numerous German armored attacks.⁵⁸
- Following the Grenada invasion, U.S. infantrymen were criticized for their failure to advance in the face of light opposition without overwhelming air and artillery support.⁵⁹

Opposition Countermeasures:

- At Stalingrad, Soviet commander Lieutenant General Vasily Ivanovich Chuikov's tactic of employing squad-sized "storm groups" in strategic buildings, a city-hugging tactic, hampered

⁵⁵NATO, 1995, p. 1.

⁵⁶Craig, 1973, p. 133.

⁵⁷Headquarters, MAAF, 1944, p. 8.

⁵⁸See Michael D. Doubler, *Closing with the Enemy: How GIs Fought the War in Europe, 1944–1945*, Lawrence, Kansas: University Press of Kansas, 1994, pp. 220–221.

⁵⁹Adkin, 1989, p. 339.

the Germans' ability to coordinate artillery and air support because doing so risked engaging their own troops.⁶⁰

- By contrast, the German practices at Bastogne of keeping their armored and support vehicles on the roads and, at least initially, refraining from using their anti-aircraft guns increased the effectiveness of American close air support.⁶¹
- During the Battle of Hue, Communist Vietnamese anti-aircraft fire drove helicopter gunships from the city and made conditions extremely difficult for airborne observers.⁶²
- In Grenada, the enemy had no air force or radar-controlled air defenses with which to challenge the attack helicopters and those AC-130 gunships providing close support to invading U.S. ground forces.⁶³
- Most of the anti-aircraft fire directed at Marine helicopters during the Beirut peacekeeping mission was limited to small arms and some RPGs. However, even that minimal opposition was sufficient to severely restrict gunship operations over the city.⁶⁴
- In Panama, the opposition's lack of effective air defenses contributed greatly to the success of aerospace power.⁶⁵ However, the PDF's use of human shields limited the ability of attack helicopters to return fire during the 82nd Airborne operations at Panama Viejo and Tinajitas barracks. At Panama Viejo, PDF soldiers ducked into a crowd of civilians after firing. At Tinajitas, they fired from civilian buildings near the objective.⁶⁶

⁶⁰Colonel Michael Dewar, *War in the Streets: The Story of Urban Combat from Calais to Khaffi*, New York: David & Charles, 1992, p. 21; and Craig, 1973, p. 91.

⁶¹Marshall, 1988, p. 144.

⁶²Jones, 1996, p. 5.

⁶³Adkin, 1989, p. 197.

⁶⁴Maj. Dick Gallagher, USMC OpsO, HMM-261, Oral History Interview, Washington, D.C.: Marine Corps Historical Center, Marine Corps Oral History Program, May 22, 1984, pp. 12–13.

⁶⁵Even so, 30 percent of the Special Operations aircraft in Panama were damaged or shot down, including the AH-6 carrying American civilian Kurt Muse; Taw, 1996, p. 21.

⁶⁶Unlike the Apaches, Cobra gunships did engage some PDF positions at Tinajitas with rockets and cannon. See Jones, 1996, p. 10; and Donnelly et al., 1991, pp. 222–223.

- In Mogadishu, the distinction between combatants and non-combatants became very murky. Both when they moved toward the Task Force Ranger helicopter crash sites and when they fired on U.S. personnel, Somali fighters, who wore no uniforms or distinctive clothing, hid behind mobs of unarmed men, women, and children. Further complicating matters, much of Mogadishu's population in the Bakara Market area and along relief-convoy routes rose up at this time against U.S. forces.
- Chechen rebels in Grozny countered Russian air superiority by deploying their tanks and guns in residential areas; attacking from hospitals, schools, and apartment blocks; and even breaking into Russian radio transmissions and directing Russian aircraft over the Russian's own troops.⁶⁷ Furthermore, the Chechen air defenses—which included SAMs (SA-13s and SA-16s) and radar-controlled AAA, in addition to heavy machine guns and RPGs—proved highly lethal to helicopters. As a result, the Russians used helicopters mostly for noncombat missions.⁶⁸

Atmospheric and Light Conditions:

- During the first two days of the Bastogne battle, fog served as a protective screen for the American defenders and created confusion in the German ranks. However, the fog prevented Allied aircraft from providing support to engaged U.S. forces.⁶⁹
- At Hue, however, consistently low cloud ceilings, combined with restrictive ROE, prevented most close-support operations for three weeks. When aircraft were permitted to fly, they often did so at low altitudes, making it impossible to track targets.⁷⁰

⁶⁷NATO, 1995, pp. 2, 6.

⁶⁸By May 1996, a total of 14 Russian helicopters had been lost and 30 damaged. Several more were shot down during the final battle for Grozny in 1996. See Anatol Lievan, *Chechnya: Tombstone of Russian Power*, New Haven and London: Yale University Press, 1998, p. 278.

⁶⁹Marshall (1988, pp. 140, 145) notes that the winter weather also helped the Allies by allowing aircraft to identify enemy armored positions in the forest by their tracks in the snow.

⁷⁰Hammel, 1991, pp. 58–59.

- Before the beginning of Operation Just Cause, a North Carolina ice storm delayed the departure of the 82nd Airborne Division. This delay caused airborne assault operations in the vicinity of Panama City that had been scheduled to be conducted under cover of darkness to be done in daylight, putting paratroopers at greater risk from adversary ground fire.⁷¹
- Following the Panama invasion, AC-130 pilots indicated that smoke and fire may have obscured their targeting systems during the battle for *La Commandancia*, possibly contributing to the friendly-fire incident there.⁷² It also appears that ambient light in Panama City washed out the reflections from identification tape on U.S. vehicles, making them look like Panamanian armored vehicles.⁷³
- During the initial assault on Grozny, poor weather—blowing snow, ice, and low cloud ceilings—ruled out visual bombing, as well as the use of electro-optical or laser-guided weapons. As a result, Russian Su-24 Fencers were forced to radar-bomb from medium altitude, which led to inaccurate deliveries and many Russian losses to friendly fire.⁷⁴ In addition, Russian helicopters were grounded for most of the month of February 1995 because they lacked all-weather capabilities.⁷⁵

Geography and Terrain:

- At Cassino, the Germans made good use of the town's cellars and existing tunnels. Furthermore, their position atop Monte Cassino gave them unobstructed observation of Allied movements in the town, no matter how heavy the artillery fire or bombing.⁷⁶

⁷¹The weather also forced a change of plan with regard to the 82nd's arrival at Torrijos International Airport. Rather than landing on the airport runway, the transport aircraft dumped the paratroopers from the air in three waves. In the process, paratroopers became intermixed with Rangers involved in clearing operations on the ground, some of whom were still engaged in minor firefights with the PDF. Fortunately, the 82nd did not suffer any casualties during the drop. Donnelly et al., 1991, pp. 200–203.

⁷²Donnelly et al., 1991, p. 152.

⁷³Interview with USAF pilot who flew on *La Commandancia* mission.

⁷⁴Lambeth, 1999, p. 124.

⁷⁵Edwards, unpublished research, p.74.

⁷⁶Headquarters, MAAF, 1944, pp. 6, 8.

- An integral part of the German Siegfried Line, Aachen had numerous strongpoints on each town flank and bunkers built of solid concrete that could stand up under a direct hit with a 500-lb bomb.⁷⁷
- In Beirut, Marine helicopter pilots claimed that they flew too fast to identify or hit targets in densely populated neighborhoods, even with the assistance of airborne FACs and gyro-stabilized binoculars.⁷⁸
- U.S. forces stationed in Panama had the good fortune of fighting over familiar terrain, thus reducing the psychological stress and uncertainty inherent in combat.
- With its open layout—of mostly low, modern buildings, practically devoid of civilian inhabitants—Khafji was a particularly favorable venue for the limited urban CAS conducted during that battle.⁷⁹
- On the one hand, the generally low-rise environment around Bakara Market, and the fact that most of the fighting was conducted in the open or from just inside buildings, provided relatively good fields of fire for attack helicopters flying close support operations on “Bloody Sunday.” On the other hand, the low-rise environment and the neighborhood’s narrow streets may have increased the danger to helicopters from RPG launchers.⁸⁰

LOGISTICS SUPPORT

From Leningrad to Sarajevo, aerial resupply and transport have played an important role in major urban operations. However, the inherent vulnerability of most logistics support aircraft has limited their employment and effectiveness in highly contested urban environments, particularly when the opposition has possessed significant air defenses. During WWII, aerial resupply operations were con-

⁷⁷Hughes, 1995, p. 258.

⁷⁸Medlin, 1983, pp. 14–15.

⁷⁹Dewar, 1992, p. 82; Williams, 1991, pp. 48–49.

⁸⁰For a drawing and description of the Mogadishu battle site, see Bowden, 1999, pp. 3, 12.

strained by adverse weather, the unavailability of appropriate aircraft, long distances between air bases and the landing (or drop) zones, insufficient intelligence on the locations of friendly and enemy forces, and the lack of a precise airdrop-delivery mechanism.

Since the 1970s, technological advances have enabled airdrops to be made with great accuracy from high altitudes, at night and in poor weather. Even so, ensuring that the right people get the supplies has remained a problem. Furthermore, even well-executed airdrop operations cannot match the volume of cargo that can be moved through airport, sea, or ground alternatives.

Since WWII, the effectiveness of air-transport operations in contested urban areas has relied on one element: surprise. Prior to the 1960s, getting ground forces to the objective as quickly as possible—before the opposition had time to mount a coordinated defense—required either that they be air-dropped or air-landed by transport plane or glider, preferably close to the target. To be effective, such an operation usually needed good weather, an exceptionally well-trained infantry force, a relatively weak opposition, and a large amount of luck.

Since the Vietnam War, helicopters have performed most troop-transport missions within urban areas. Their small size and maneuverability relative to transport planes—and, more recently, their aerial-refueling and nighttime capabilities—have enabled helicopters to drop off and pick up hundreds of individuals in fairly close urban terrain and to transport them safely over considerable distances. These characteristics have made helicopters especially useful in urban-related NEOs. Nonetheless, recent U.S. engagements in Somalia have demonstrated that even armored transport helicopters can be brought down by relatively unsophisticated weapons such as RPGs, making their employment problematic in nonpermissive urban situations.

Results

Most of the major WWII air resupply operations conducted in urban areas ended in failure. During the siege of Leningrad, the early Soviet attempt to bring in emergency supplies by air transport fell far short of meeting the city's needs. The Soviet Air Force was able to fly in a

mere 3,357 tons of food during the last two and a half months of 1941, even though the city's requirement for flour alone was 1,000 tons a day. Partly as a consequence, Leningrad seldom had more than one or two days of food in reserve before the Soviet government organized the massive resupply operations across Lake Ladoga.⁸¹

During the winter of 1942, the German Luftwaffe launched an impressive number of airlift sorties in an attempt to replenish the stores of the beleaguered Sixth Army at Stalingrad. However, many of the aircraft had to be diverted, and only one-sixth of the supplies needed ever reached the troops.⁸² Mounted with minimal Soviet support and at a great cost in aircraft and aircrews, the Allied airdrop operation during the Polish uprising in Warsaw failed to redress the balance of forces in the city. Indeed, many of the containers fell into enemy hands.⁸³ On the plus side, the huge aerial resupply during the second week of the Battle of Bastogne helped ensure the town's successful defense, primarily by refilling the 101st Airborne Division's dwindling stocks of artillery ammunition and medicine.⁸⁴

Since WWII, the United States and its allies have conducted several moderately effective air resupply operations in embattled urban areas. After Communist anti-aircraft fire halted low-level transport flights into An Loc, U.S. experts improved high-level radar delivery techniques and also successfully tested a new Adverse Weather Aerial Delivery System (AWADS). As a result, allied aircraft were able to meet An Loc's requirements of about 28 short tons per day, breaking the Communist siege.⁸⁵ During the recent war in Bosnia, the United States and its NATO allies carried out the longest humanitarian airlift in history—three and a half years—primarily to help sustain the

⁸¹Leon Gouré, *The Siege of Leningrad*, Stanford, Calif.: Stanford University Press, 1962, p. 153.

⁸²Craig, 1973, p. 234. See also Joel S. A. Hayward, "Stalingrad: An Examination of Hitler's Decision to Airlift," *Airpower Journal*, Vol. 11, Spring 1997, pp. 21–37.

⁸³Polish volunteers lost 30 percent of their aircraft during initial Warsaw resupply operations. Jozef Garlinski, *Poland in the Second World War*, New York: Hippocrene Books, 1985, pp. 285–288.

⁸⁴Marshall, 1988, pp. 138–139.

⁸⁵See U.S. Air Force, Headquarters PACAF, *Airlift to Besieged Areas, 7 April–31 August 72: Project CHECO Southeast Asia Report*, Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency, pp. 1–48.

Muslim population of Sarajevo and eastern Bosnia.⁸⁶ The impact of this massive endeavor was most obvious in the Bosnian capital. For many months during the Serbian siege of Sarajevo, 85 percent of the aid reaching the city arrived via airlift, saving tens of thousands of residents from starvation.⁸⁷

More difficult to assess, however, are the airdrops that occurred over eastern Bosnia. Although accurately delivered in most cases, supplies were mistakenly dropped into Serbian hands at Cerska and Konjevic. These airdrops certainly helped alleviate the suffering caused by the war, but they did not achieve the more-ambitious goal of breaking sieges of towns such as Srebrenica.

The U.S. and its allies have had mixed results with regard to airborne and air assault operations in urban areas. During World War II's Operation Market-Garden in Holland, the British 1st Airborne Division suffered a disastrous defeat at Arnhem Bridge, losing all but 17 members of its original 509-man assault force.⁸⁸ By contrast, the U.S. 82nd Airborne Division not only captured all four bridges in the vicinity of Nijmegen, but also defeated every enemy attempt to re-take them.⁸⁹

The two airborne rescue operations in the Congo, jointly conducted by the United States and Belgium in November 1964, were only partly successful. Although these troops achieved their primary purpose of rescuing a large number of hostages and refugees from rebel forces, in the Stanleyville mission, Congolese rebels managed to kill 27 Americans and Europeans before the rescue force arrived at the Victoria Residence Hotel; at least another 50 hostages were soon executed elsewhere, probably in revenge for DRAGON ROUGE. In addi-

⁸⁶By January 1996, 12,895 sorties had been flown as part of Operation Provide Promise, bringing in more than 160,000 metric tons of food, medicine, and other relief supplies. Master Sgt. Louis A. Arana-Barradas, "A 'Promise' of Peace: Sarajevo Humanitarian Airlift Ends, New Hope Begins," *Airman*, March 1996, p. 43.

⁸⁷Arana-Barradas, 1996, p. 43.

⁸⁸Eric Niderost, "Gallant Defense at Arnhem Bridge," *World War II*, Vol. 11, January 1, 1997, p. 81.

⁸⁹Although follow-on ground forces failed to cross the Waal River in strength, the 82nd's presence on the south bank provided a springboard for the final Anglo-American offensive that began in spring 1945. James M. Gavin, *On to Berlin: Battles of an Airborne Commander, 1943-1946*, New York: Viking Press, 1978, pp. 190-191.

tion, unexpectedly strong international opposition to the U.S.–Belgian intervention led U.S. leaders to cancel rescue operations planned for the towns of Bunia and Watsa.⁹⁰

More recently, the Ranger assault operation in Mogadishu against Mohammed Farah Aideed's clan stronghold succeeded in its assigned task of arresting approximately a dozen of the warlord's top lieutenants. Nevertheless, the unanticipated downing of two UH-60 Blackhawk transport helicopters by members of Aideed's militia contributed to the deaths of 18 American soldiers, as well as to the Clinton administration's decision to pull U.S. troops out of Somalia.

Over the past several decades, NEOs in various corners of the world have tested U.S. airlift capabilities. Although no U.S. transport aircraft suffered combat damage during the evacuation from Saigon in 1975, poor contingency planning resulted in thousands of mostly Vietnamese evacuees being left to face the victorious Communist army.⁹¹ More-recent NEOs have gone considerably better. In the early 1990s, the 22d Marine Expeditionary Unit (MEU) helicopters evacuated more than 2,400 people from the Liberian capital of Monrovia. Despite constant fighting in the vicinity, the 7-month-long mission was completed without casualties.⁹² In January 1991, Marine CH-53E and CH-47 helicopters flew over 400 nautical miles at night to rescue 281 persons from 30 countries in war-torn Mogadishu. Although two Marines were nearly left behind, the Mogadishu operation was conducted without loss of life or injury. Furthermore, all participating U.S. military forces were back on

⁹⁰Fred E. Wagoner, *Dragon Rouge: The Rescue of Hostages in the Congo*, Washington, D.C.: National Defense University Research Directorate, 1980, pp. 197–199. See also Major Thomas P. Odom, *Dragon Operations: Hostage Rescues in the Congo, 1964–1965*, Fort Leavenworth, Kansas: Combat Studies Institute, U.S. Army Command and General Staff College, 1988, pp. 153–160.

⁹¹U.S. Air Force, Office of PACAF History, *The Fall and Evacuation of South Vietnam*, Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency, April 30, 1978, pp. 161–163. See also Oliver Todd, *Cruel April: The Fall of Saigon*, trans. Stephen Becker, New York and London: W. W. Norton, 1990, pp. 346–369.

⁹²LtCol. Glen R. Sachtleben, "Operation SHARP EDGE: The Corps' MEU (SOC) Program in Action," *Marine Corps Gazette*, Vol. 75, November 1991, pp. 77–86. See also LtCol. T. W. Parker, "Operation Sharp Edge," *U.S. Naval Institute Proceedings*, Vol. 117, May 1991, pp. 103–106.

station prior to the commencement of Desert Storm operations against Iraq.⁹³

Effectiveness Factors

The following is a list of factors that have contributed to the effectiveness (or ineffectiveness) of the preceding urban air logistics support operations. They are grouped into performance categories: equipment, command and control, political factors, intelligence, tactics and training, opposition countermeasures, atmospheric and light conditions, and geography and terrain. As with close air support, no one factor or performance category dominates. Nevertheless, the historical evidence appears to support the following conclusions:

- Aerial resupply technology has performed quite well since the Vietnam War; however, the vulnerability of transport aircraft remains a significant problem in contested urban areas.
- Political factors are important in special operations and NEOs that involve air transport.
- Superior tactics and training have played a large role in the success of air transport operations in urban areas.
- The presence or absence of significant adversary air defenses has remained a critical factor in urban air logistics operations since World War II.
- Although they have often created difficulties, adverse atmospheric and geographic conditions have generally not had a decisive effect on urban air logistics operations.

⁹³Adam B. Siegel, *Eastern Exit: The Noncombatant Evacuation Operation (NEO) from Mogadishu, Somalia, in January 1991*, Alexandria, Va.: Center for Naval Analyses, 1992, pp. 41–42.

Equipment:

- That only 20 or so transport aircraft (out of 64) were operational at any time substantially diminished the ability of the Soviet military to supply the city of Leningrad by air.⁹⁴
- The unreliability and vulnerability of the German Ju-52 transports contributed to the failure of the Stalingrad airlift. Although these aircraft were later supplemented by He-111 bombers, weather problems prevented the latter from being employed extensively.⁹⁵
- The airborne portion of Operation Market-Garden was hindered by a shortage of troop-carriers and the inability of American aircrews to operate with assured accuracy at night.⁹⁶
- For daytime, high-altitude airdrops during the Battle of An Loc, the U.S. Air Force relied on the Ground Radar Aerial Delivery System (GRADS) to guide C-130 transport planes to a Computer Aerial Release Point (CARP) aligned with the drop zone inside the town.⁹⁷ In part to counter the threat to the resupply effort posed by SA-7s, the USAF began using the Adverse Weather Aerial Delivery System for high-level drops in conditions of low visibility or even total darkness.⁹⁸
- All but invulnerable to small-arms fire, the armored Blackhawk helicopter, used to transport troops during Ranger Task Force operations in Mogadishu, proved unexpectedly vulnerable to

⁹⁴Gouré, 1962, p. 109.

⁹⁵Craig, 1973, pp. 220–221, 226.

⁹⁶However, the U.S. 82nd and 101st Divisions took better advantage of their limited transport resources than did the British 1st Division. Thus, the Americans ended up with three brigades in action on their first day of battle, whereas the British had less than two brigades immediately available for combat. See Maurice Tugwell, *Arnhem: A Case Study*, London: Thornton Cox, 1975, pp. 26–27.

⁹⁷Initially, however, parachute malfunctions and improper rigging caused most of the supply bundles to drift outside the narrow confines of the drop zone. U.S. Air Force, Headquarters PACAF, 1972, p. 10.

⁹⁸U.S. Air Force, Headquarters PACAF, 1973, pp. 58–59.

Somali RPG fire. During the October 3–4 firefight, two helicopters were shot down and three were damaged and forced to retire.⁹⁹

- In Bosnia, Kevlar armor was added to prevent small-arms rounds from penetrating the flight decks of allied transport aircraft.¹⁰⁰ In addition, most countries involved in the Sarajevo airlift used C-130s, which meant that little materiel could be brought in on each flight.¹⁰¹
- AWADS was used for the first time since Vietnam during allied airdrop operations in Eastern Bosnia. There, airdrop accuracy was increased even further by a Global Positioning System (GPS) receiver, which provided an aircraft's exact longitude and latitude and information on winds at drop altitude. However, whereas these systems are very effective for traditional, low-altitude (e.g., 1500 ft) parachute drops, in Bosnia the concern over shoulder-fired infrared missiles had forced the C-130s to drop from altitudes between 10,000 and 24,000 ft. At these altitudes, the potential for substantial wind drift was great. Since winds at lower altitudes can vary greatly, it was enormously difficult to predict the exact landing spot. Thus, for accurate parachute delivery from medium altitudes, the parachute itself needs a guidance system, not just the aircraft.¹⁰²

Command and Control:

- Periodic breakdowns in radio communications prevented German meteorologists from obtaining eyewitness information

⁹⁹Overall, three U.S. Blackhawk helicopters were shot down by RPG fire in Somalia. A 101st Division Blackhawk attached to the Quick Reaction Force was brought down on August 25, 1993, killing three crewmembers. See Jones, 1996, p. 13.

¹⁰⁰Jeffrey M. Lenorovitz, "U.N.-Sponsored Airlift to Sarajevo Succeeds in Face of Frequent Attacks," *Aviation Week & Space Technology*, July 27, 1992, pp. 60–61.

¹⁰¹Although C-5s could have landed at Sarajevo, airlift organizers were concerned that the planes' huge cargo load and servicing requirements might overwhelm ground crews. Steve Vogel, "Provide Promise Takes Supplies to Sarajevo," *Air Force Times*, Vol. 52, July 20, 1992, p. 16.

¹⁰²Tony Capaccio, "Bosnia Airdrop," *Air Force Magazine*, July 1993, pp. 52–55; and Julie Bird, "Airdrops Set for Remote Regions of Bosnia," *Air Force Times*, March 8, 1993, p. 8.

on weather conditions in the vicinity of Stalingrad, further complicating resupply operations there.¹⁰³

- The failure of communications was, in large part, responsible for the lack of reinforcement and resupply (as well as of close air support) provided the British 1st Division at Arnhem. The range of battalion, brigade, and divisional radios was insufficient, and some signallers were inadequately trained. Moreover, there were misunderstandings regarding frequencies, call signs, codes, etc.¹⁰⁴
- At Bastogne, the capability of airborne pathfinders, equipped with fluorescent panels, beacons, radios, and radar, in guiding the delivery of the initial airdrops and in warning ground crews of the approach of Allied planes helped to ensure the success of the resupply effort.¹⁰⁵
- A command rivalry between the U.S. European Command (USEUCOM) and the U.S. Strike Command (USSTRICOM) left the latter with only 48 hours of planning time prior to the airborne assault on Stanleyville in 1964. On the plus side, the U.S. and Belgian militaries mostly operated very well together, even though the two had never before conducted combined airborne operations.¹⁰⁶
- By contrast, the ground convoy en route to Stanleyville was unable to report a delay in its planned link-up with paratroopers in that city, which probably reduced the effectiveness of the DRAGON ROUGE operation.¹⁰⁷
- In Bosnia, the United Nations had the day-to-day responsibility for nominating airdrop targets, which meant that the JFACC often had insufficient lead time to task national assets for current target information. The need to integrate the French and

¹⁰³Craig, 1973, p. 242.

¹⁰⁴Christopher Hibbert, *The Battle of Arnhem*, London: Batsford, 1962, pp. 204–205.

¹⁰⁵Doubler, 1994, p. 220.

¹⁰⁶Odom, 1988, pp. 156–157.

¹⁰⁷Other C2 difficulties arose from a communications system that was overloaded with classified information and from the five different languages being spoken by friendly forces. Odom, 1988, pp. 158–159.

German allies into the Bosnian operation, as well as the lack of standardized equipment for communications, navigation, and targeting, further complicated the U.S.-led resupply effort.¹⁰⁸

Political Factors:

- For a long time, the Soviet government resisted dropping arms to the Polish Home Army during the WW II Warsaw rebellion, and it refused to allow British and U.S. planes to land on airfields under its control, dooming whatever slim chance the Allied airdrop operation had to succeed.¹⁰⁹
- U.S. and Belgian politicians in 1964 were sensitive to charges, by the Eastern bloc and other African states, of neo-colonialism with regard to the Congo, which delayed the initial airborne rescue operation in Stanleyville. After Paulis, that sensitivity was an important factor in preventing any further attempts to rescue European and American citizens caught up in the Congolese civil war.¹¹⁰
- At the end of the Vietnam War, the U.S. ambassador's decision to delay the final evacuation of American citizens from Saigon left little time to notify and assemble those wishing to depart. Although planners provided for only a very limited number of helicopter sorties from the U.S. Embassy building, several thousand would-be evacuees showed up at that location, swamping the available transport.¹¹¹
- After six weeks of failure and a couple of bungled attempts, the commander of the Ranger Task Force in Mogadishu was under

¹⁰⁸James J. Brooks, *Operation Provide Promise: The JFACC's Role in Humanitarian Assistance in a Non-Permissive Environment—A Case Study*, Newport, R.I.: Naval War College, June 14, 1996, pp. 4–5.

¹⁰⁹Wilfred P. Deac, "City Streets Contested," *World War II*, Vol. 9, September, 1, 1994, pp. 43–44.

¹¹⁰Wagoner, 1980, pp. 189–191.

¹¹¹Prior to the final evacuation, aircraft and ships often departed South Vietnam only partially filled with passengers. One reason was Ambassador Graham Martin's preference for avoiding a dramatic expansion of the evacuation effort that might demoralize the South Vietnamese military and cause it to become uncooperative with U.S. authorities. U.S. Air Force, Headquarters PACAF, 1978, pp. 127–128. See also Todd, 1990, pp. 366–367.

severe political pressure to capture warlord Aideed. This pressure probably contributed to the risky daylight air assault against the Somali leader's stronghold near the Bakara Market.¹¹²

Intelligence:

- At Arnhem, confusion over the location of German armored units and a mistaken belief that gliders could not land on polder (drained marshland) contributed to the British 1st Airborne Division's unfortunate selection of a staging site that was not only far from the intended target but turned out to be a rest area for an entire Panzer division.¹¹³
- By contrast, inaccurate intelligence led the 82nd Airborne Division to plan for substantial armored resistance at Nijmegen, thereby assisting General Gavin's troops in dealing with less formidable German opposition.¹¹⁴
- Because of the U.S. Embassy's initial overstatement of the threat to U.S. citizens and property in Monrovia, U.S. Marines received sufficient training and preparation time to carry off a remarkably smooth NEO when one became necessary during the summer of 1990.¹¹⁵
- While not fatal to the operation, initial uncertainty about the location of the U.S. Embassy in Somalia hampered rescuers involved in the 1991 Mogadishu NEO. The embassy had moved from the center of Mogadishu to the suburbs 18 months before, but Marine amphibious forces in control of rescue helicopters had only a 1969 map of the city. Fortunately, the lead CH-53E pi-

¹¹²Bowden, 1999, pp. 23–27.

¹¹³Hibbert, 1962, pp. 202–203; and Alexander McKee, *The Race for the Rhine Bridges, 1940, 1944, 1945*, New York: Stein and Day, 1971, p. 144. In a retrospective interview, General John W. Vogt recalled that he lost half of his fighter-bomber squadron trying to protect paratroopers pinned down in the Arnhem drop zone. See Richard H. Kohn and Joseph P. Harahan, eds., *Air Interdiction in World War II, Korea, and Vietnam*, Washington, D.C.: U.S. Air Force, Office of Air Force History, 1986, pp. 36–38.

¹¹⁴McKee, 1971, pp. 144–145; and Tugwell, 1975, p. 22.

¹¹⁵Sachtleben, 1991, pp. 78–79.

lots were able to spot the embassy compound from the air after flying around town for 15 minutes.¹¹⁶

Tactics and Training:

- The Luftwaffe refused to allow army quartermasters to supervise the loading of transports. As a result, famished German soldiers at Stalingrad opened cases of worthless goods.¹¹⁷
- During Operation Market-Garden, British and U.S. paratroopers employed different airborne landing tactics, with markedly different results. At Arnhem, airborne landings were spread out over three days, and 1st Division paratroopers were dropped 6 to 8 miles from their intended target of Arnhem Bridge.¹¹⁸ By contrast, most of the 82nd Airborne infantry and artillery arrived in Nijmegen together, and the drop zone was sited on the main target.¹¹⁹
- The two Congo operations also featured a crucial difference in tactics. During the initial operation at Stanleyville, Belgian paratroopers waited for armored Jeeps to arrive at the airfield before moving into town, thus providing the rebels' time to begin killing their hostages. At Paulis, one company of paratroopers immediately moved out in search of hostages, probably saving a number of lives.¹²⁰
- At An Loc, the USAF's use of GRADS in an attempt to resupply the town from high altitudes was initially stymied by ill-trained Vietnamese parachute packers. Until the U.S. Army sent in packing specialists from Okinawa, parachutes regularly malfunctioned, causing bundles to drift outside the drop zone and into enemy hands.¹²¹

¹¹⁶Siegel, 1992, pp. 23–24.

¹¹⁷These goods included tons of marjoram and pepper, and millions of contraceptives. Craig, 1973, p. 242.

¹¹⁸Hibbert, 1962, pp. 201–202; and Tugwell, 1975, pp. 23–28.

¹¹⁹Gavin, 1978, pp. 155–161.

¹²⁰Wagoner, 1980, pp. 187–188.

¹²¹U.S. Air Force, Headquarters PACAF, 1973, pp. 28–29; and U.S. Air Force, Headquarters PACAF, 1972, pp. 25–26.

- To a large extent, a high state of readiness and advanced training in NEO procedures accounts for successful results at Mogadishu and Monrovia in the early 1990s. In Liberia, a Marine advance team, in coordination with U.S. Embassy personnel, physically sited and evaluated all potential helicopter landing zones and evacuation assembly areas.¹²²
- The proximity of Desert Storm to the Mogadishu NEO meant that the requisite ships and aircraft were already in the vicinity of Somalia. In addition, the well-trained deck crews on the Marine amphibious ship *Guam* moved transport helicopters quickly and efficiently. Finally, the U.S. Embassy staff in Somalia was fully prepared to cooperate with Marine and SEAL personnel in the evacuation.¹²³
- In their months-long hunt for warlord Aideed, the members of Task Force Ranger had conducted the same basic operation in Mogadishu six times previously,¹²⁴ which contributed to the loss of surprise in the October 3 air assault. In addition, “the Nightstalkers” of the 160th Special Operations Aviation Regiment (SOAR) specialized in high-speed, low-flying nighttime missions, not in hovering over congested urban areas in mid-afternoon.¹²⁵
- Task Force Ranger’s most serious tactical planning failure was the inadequate size of its rescue force. The crew of the one CSAR bird placed on standby in case of a helicopter crash was instrumental in rescuing personnel in the first downed Blackhawk. Nonetheless, there was no immediate reaction force to assist the members of Michael Durant’s crew when his Blackhawk was brought down 20 minutes later.¹²⁶

¹²²Sachtleben, 1991, p. 81.

¹²³Siegel, 1992, p. 42.

¹²⁴The only significant tactical variation was that sometimes the forces would arrive by helicopter and leave in vehicles, and sometimes they would arrive in vehicles and leave on helicopters. Bowden, 1999, p. 23.

¹²⁵Bowden, 1999, pp. 21, 79, 89.

¹²⁶Bowden, 1999, p. 338.

Opposition Countermeasures:

- During the German airlift at Stalingrad, the Soviets reinforced their anti-aircraft batteries and sent fighters to harass German supply planes.¹²⁷
- During the Warsaw Uprising, German AAA made precision air-drops by the Allies impracticable. Further complicating precision, the insurgents occupied only small and widely spread enclaves by the time the resupply operation got seriously under way.¹²⁸
- Although enemy air defenses managed to knock down a number of airlifters, the first phase of the air resupply effort at Bastogne was assisted by the Germans, who directed very little fire on the drop zone itself.¹²⁹ During the second airlift operation, heavy flak and smoke, presumably employed by the Germans, obscured the drop zone, preventing 9 planes in the 50-aircraft serial from effectively releasing their gliders over the target area.¹³⁰
- The poor marksmanship of airfield defenders facilitated U.S. air transport operations in the Congo in 1964.¹³¹
- At An Loc, the low-altitude Container Delivery System (CDS), initially employed to provide supplies to the besieged population, relied on surprise and limited adversary air defenses. However, the Communists quickly positioned AAA, and later SA-7 missiles, on all possible air approaches to the town. As a

¹²⁷Latimer (1985, p. 48) attributes most of the success in interdicting the German air resupply effort to the constant operation of Soviet pursuit planes. See also Craig, 1973, p. 237.

¹²⁸Garlinski, 1985, pp. 292–293.

¹²⁹Marshall, 1988, p. 137.

¹³⁰Still, it was estimated shortly after the fact that 82 percent of the supplies dispatched by the 50th Troop Carrier Wing on December 23 and 26, 1944, were delivered to the Bastogne defenders. Headquarters, 50th Troop Carrier Wing, Office of the A-2, "Analysis of Bastogne Resupply by Units of This Command," Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency, January 18, 1945, pp. 2–3.

¹³¹Wagoner (1980, pp. 187, 197), an analyst of the Congo rescues, refuses even to speculate about what might have happened had the rebel Congolese soldiers effectively employed the automatic weapons emplaced around Stanleyville's airport during the airlift phase of DRAGON ROUGE.

result, several allied aircraft were lost, and transport planes were forced to fly above 10,000 ft in order to survive.¹³²

- In Mogadishu, Aideed's forces possessed seemingly unlimited supplies of ammunition and hundreds of RPGs in the early 1990s, rendering Blackhawk operations extremely hazardous. This danger was exacerbated by the adversary's perceptions of the political advantages of shooting down U.S. helicopters and dragging dead American soldiers through the streets in full view of the international media.¹³³
- During the Bosnian War, the Serbs possessed many large-caliber weapons that could have been employed to disrupt the international air resupply effort in Sarajevo. This potential was particularly serious because the Serbs controlled the mountainous terrain surrounding the Bosnian capital. Although small-arms fire remained a problem, the threat of retaliation by the NATO allies seems to have constrained the Serbs from targeting airlifters with AAA and SAMs.¹³⁴

Atmospheric and Light Conditions:

- Low clouds, fog, and blizzards appeared in the vicinity of Stalingrad in 1942, forcing German transport aircraft to detour to bases hundreds of miles away and leaving the increasingly isolated 6th Army without access to the planes' cargoes for several days at a time. This problem was exacerbated by winter ice—which tore up aircraft engines—and cold—which made it difficult for mechanics to perform necessary aircraft maintenance.¹³⁵
- Bad weather or a full moon during the Warsaw Uprising caused a majority of nights (37 out of 60) to be lost to Allied airdrop operations.¹³⁶

¹³²U.S. Air Force, Headquarters PACAF, 1973, pp. 29–30.

¹³³Stevenson, 1995, p. 102.

¹³⁴During the airlift, 93 aircraft were fired on. Only one, an Italian transport, was shot down and its crew of four killed as it was headed into Sarajevo. Arana-Barradas, 1996, p. 45; and Lenorovitz, 1992, p. 60.

¹³⁵Craig, 1973, p. 242.

¹³⁶Garlinski, 1985, p. 295.

- A break in the weather during the second week of the siege of Bastogne permitted effective air resupply to commence.¹³⁷
- At An Loc, nighttime operations involved less risk to aircrews from hostile anti-aircraft fire than operations occurring during the day. However, they were generally less accurate, and ground parties and FACs had trouble observing where the packages were falling.¹³⁸
- By the time of the Bosnian War, night and adverse weather permitted allied transport aircraft to hide from optically or IR-guided Serbian air defense weapons without degrading airdrop accuracy. However, deep snow made it difficult for besieged Muslims to recover fallen parcels.¹³⁹

Geography and Terrain:

- Warsaw was at the maximum range of Anglo-American bombers attempting to resupply Polish insurgents during WWII. Without Soviet landing rights, Allied aircraft were forced to return to bases in Italy during daylight, over German-occupied Hungary and Yugoslavia, where the heavy planes were easy pickings for Nazi fighters.¹⁴⁰
- The availability of a large, clear, gently sloping field directly west of town was a positive factor in successful U.S. resupply operations at Bastogne.¹⁴¹
- The small size of the drop zone at An Loc meant that many airdrops that just missed the target ended up in the hands of the enemy.¹⁴²

¹³⁷Charles B. MacDonald, *A Time for Trumpets: The Untold Story of the Battle of the Bulge*, New York: William Morrow, 1985, p. 521.

¹³⁸U.S Air Force, Headquarters PACAF, 1973, p. 30.

¹³⁹Steve Vogel, "Bosnia Airdrop Crews Glad for Dark, Clouds," *Air Force Times*, March 15, 1993, p. 4.

¹⁴⁰Overall, the Allies lost about 13 percent of the aircraft that flew in support of the Warsaw Uprising. Garlinski, 1985, pp. 285–287.

¹⁴¹Marshall, 1988, p. 135.

¹⁴²U.S. Air Force, Headquarters PACAF, 1973, p. 31.

- During the Saigon NEO, the U.S. Embassy rooftop, which was used throughout the embassy evacuation as a landing zone for CH-46 transport helicopters, could not support the weight of the larger CH-53s. Consequently, CH-53 operations took place in the embassy parking lot. This location and the larger-than-expected number of evacuees caused the evacuation process to be extended far beyond the planned completion time.¹⁴³
- The location of the U.S. raid on “Bloody Sunday,” in the heart of Habr Gidr clan’s territory in central Mogadishu, led to the unraveling of the operation after Task Force Ranger became pinned down. With hundreds of thousands of clan members living in the vicinity, it was one of the few places where Aideed’s forces could quickly mount a serious fight. In addition, the urbanized terrain of densely packed buildings and narrow streets offered few landing zones large enough for helicopters to extract ground troops.¹⁴⁴
- In Bosnia, the mountainous terrain limited the number of suitable drop zones while providing good cover for forces opposed to the resupply operation.¹⁴⁵

INTERDICTION AND SIEGE SUPPORT

Although not often considered as instruments of urban operations, air interdiction and aerial siege support have affected the outcome of city battles from Leningrad to Khafji. When successful, interdiction¹⁴⁶ has helped to isolate the urban battlefield, metering or disrupting the flow of opposition reinforcements and supplies and providing friendly forces with the long-term advantage in the close-in battle. Historically, effective urban interdiction operations have required air superiority, an abundance of available bombers, good weather, moderately open terrain, and a mechanized opposition force with long and constricted lines of communication (LOC). Major

¹⁴³U.S. Air Force, Headquarters PACAF, 1978, p. 153.

¹⁴⁴Bowden, 1999, pp. 20–21.

¹⁴⁵Brooks, 1996, p. 12.

¹⁴⁶*Interdiction* is attacks on enemy lines of communication to slow or stop the movement of vehicles, personnel, and supplies.

factors inhibiting interdiction in the past have included the ability of some opponents to off-load supplies onto ever smaller conveyances and to perform logistics operations under the cover of darkness. However, the development of precision air-ground weapons, advanced C4ISR systems, and nighttime attack capabilities has added significantly to interdiction's effectiveness in recent years—to the point where coalition ground forces during the Battle for Khafji were able to quickly turn back a two-brigade Iraqi attack.

By contrast, aerospace power has had only moderate success as an instrument of siege warfare. Barring a sudden and massive attack on a city, urban residents generally appear to become accustomed to the terror and destruction of aerial bombing, sometimes to the extent that their suffering becomes a source of pride, fueling their desire to resist. This appears to have been the case during the Germans' 3-year siege of Leningrad during World War II. The experience of the Israelis with aerial bombardment during the 1982 siege of Beirut was somewhat more positive, possibly because they used aerospace power in a more discriminating fashion: as a means for dividing PLO fighters from the local Lebanese population. Still, Israel lacked the forces and the will to destroy the PLO through conventional bombing alone.

Results

Attempts by both sides in the European theater during WWII to interdict the supply lines of forces moving toward urban combat zones proved more effective on the Western Front than on the Eastern Front. Although the Luftwaffe strafed and bombed Leningrad's "ice bridge" (a frozen lake that supplies were driven across in winter), particularly where large fissures in the ice caused a pileup of supply vehicles, it failed to halt traffic for long or, more important, to destroy the loading and unloading facilities on Lake Ladoga's shores.¹⁴⁷ At Stalingrad, German dive-bombers disabled or sunk many Russian ferries used to transport troops and supplies across the Volga River. In addition, German artillery and aircraft struck Russian footbridges,

¹⁴⁷Gouré, 1962, p. 152.

making daytime river crossings nearly impossible. Nonetheless, nighttime resupply and reinforcement continued.¹⁴⁸

The impact of interdiction on the Anglo-American campaigns in Normandy and the Ardennes in 1944–1945 was quite different. As the Allies established themselves in Normandy, air interdiction slowed the advance of German armored reinforcements to a crawl, primarily by destroying French rail centers and bridges.¹⁴⁹ Without interdiction's help, it is questionable whether the Allies could have overcome stubborn German resistance at places such as Brest, Cherbourg, and Caen. Likewise, aerospace power disrupted German LOCs in the vicinity of the Ardennes, relieving pressure on Allied ground units, such as the 101st Division at Bastogne. Over 1,000 heavy bombers targeted railroad bridges and marshaling yards behind the German lines, almost wiping out the region's rail system. In addition, Allied fighter-bombers knocked out hundreds of enemy armored vehicles on their way to the front.¹⁵⁰

Subsequent efforts by the U.S. Air Force to support urban operations by striking enemy forces located on city approaches have proven moderately successful. In An Loc, despite considerable efforts to spot and destroy enemy artillery being moved into position, a large force arrived on the town's periphery undetected and was employed with great effectiveness by the Communists during the siege. By contrast, U.S. air attacks against enemy forces interdicting Highway 13 and blocking a South Vietnamese relief column from reaching An Loc eventually paid off. In particular, a B-52 ARCLIGHT strike caught elements of the North Vietnamese Army's 7th Division in the open and obliterated them, permitting the ARVN 46th regiment to enter the town.¹⁵¹ During the Persian Gulf War, coalition aerospace forces successfully thwarted the Iraqis' attempt to move reinforcements at

¹⁴⁸Latimer, 1985, pp. 52–53; and Craig, 1973, p. 161.

¹⁴⁹Even when enemy troops reached the front, they arrived too tired and demoralized from the bombing to immediately take up their positions. See Eduard Mark, *Aerial Interdiction: Air Power and the Land Battle in Three American Wars*, Washington, D.C.: Center for Air Force History, 1994, pp. 245–250.

¹⁵⁰Hughes, 1995, p. 283.

¹⁵¹Still, even after the siege of An Loc was broken, small pockets of Communist forces continued to sporadically interdict the highway, forcing aerial resupply to continue. U.S. Air Force, Headquarters PACAF, 1973, pp. 63–66.

night toward the Saudi town of Khafji, thus avoiding a potentially large and bloody battle over the city. According to a soldier from the 5th Iraqi Mechanized Division—one of two second-echelon divisions employed—his brigade underwent more damage in 30 minutes from allied aerospace power than it had in eight years of the Iran-Iraq War. The Iraqi battalion that did manage to get into the city either withdrew or surrendered to Arab coalition forces two days after entering Khafji.¹⁵²

In contrast to interdiction, modern militaries have not often used aerospace power to support urban sieges. When they have, the results have been mixed at best. Having been ordered by Hitler not to directly assault Leningrad, the Wehrmacht sought to win the city through a siege that denied food and supplies to the residents and by air and artillery bombardment. Although the raids and shellings directed at the Russian city were not intensive by World War II standards, they were spaced out to interfere as much as possible with the activities of the Russian inhabitants. Moreover, they caused substantial damage to the city's industrial installations and killed and wounded many civilians, especially factory workers. Still, following the initial shock, Leningrad's population rather quickly managed to adjust to the dangers of German bombardment.¹⁵³ During the Lebanon War of 1982, the Israelis were somewhat more successful with their modified siege operations against PLO strongholds in Beirut, which featured air strikes, overflights, and other forms of aerial intimidation. Although the majority of the Palestinian fighting force survived the siege, Israel achieved its operational objective of expelling the PLO from Lebanon. However, the Israeli Defense Forces suffered almost a quarter of their total campaign losses in Beirut, despite their refusal to take part in extensive house-to-house fighting. Furthermore, the prolongation of the siege, combined with rising casualties, created public pressure on the Israeli cabinet to halt the conflict and pull Israeli troops out of central Lebanon.¹⁵⁴

¹⁵²Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report*, Washington, D.C.: U.S. Department of the Air Force, 1993, p. 109.

¹⁵³Gouré, 1962, pp. 100–105.

¹⁵⁴Richard A. Gabriel, *Operation Peace for Galilee: The Israeli-PLO War in Lebanon*, New York: Hill and Wang, 1984, pp. 167–168.

Effectiveness Factors

The following is a list of factors that have contributed to the effectiveness (or ineffectiveness) of the preceding urban interdiction and siege-support operations. They are grouped into performance categories: weapons and equipment, command and control, intelligence, tactics and training, ground-force cooperation, opposition countermeasures, atmospheric and light conditions, and geography and terrain. In general, the results indicate that the technical ability of first-class aerospace forces to conduct urban interdiction and siege-support operations has improved considerably since the 1980s. Furthermore, incomplete intelligence information and misguided tactics have decreased operational effectiveness in recent decades, but usually not to a fatal degree. Finally, although quite significant during WWII, performance categories such as ground-force cooperation, opposition countermeasures, and atmospheric and geographic conditions appear to have mattered less in recent decades.

Weapons/Equipment:

- Once the Eighth Air Corps had been withdrawn from the battle, German forces outside Leningrad were left with few dive-bombers and only about 300 planes of all types. As a result, German aircraft could not bomb with sufficient intensity to significantly disrupt Soviet resupply operations.¹⁵⁵
- By contrast, with the exception of the British Bomber Command, every Allied air force spent considerable effort in the early weeks of Operation Overlord interdicting German forces. For example, during the first half of June 1944, Eighth Air Force strategic bombers devoted almost all their sorties to tactical interdiction.¹⁵⁶
- Still, Anglo-American aircraft during WWII had to expend a substantial amount of ordnance to destroy fixed interdiction targets

¹⁵⁵Gouré, 1962, p. 99.

¹⁵⁶Hughes, 1995, p. 149.

such as bridges.¹⁵⁷ Fighter-bombers, such as the P-51 and the A-36, were more accurate than bombers and could fly when the latter were grounded by weather; however, they lacked the bombload capacity to destroy massive targets and were vulnerable to light-caliber AAA when dive-bombing.¹⁵⁸

- In Beirut, the Israeli Air Force largely accomplished its delicate mission of pressuring the PLO to leave while avoiding substantial collateral damage, through a careful targeting process involving the use of aerial photographs, highly accurate Maverick missiles, and small iron bombs.¹⁵⁹
- By permitting accurate attacks from medium altitudes (13,000 to 30,000 ft), the Persian Gulf War confirmed the superiority of PGMs over dumb bombs. Although the GBU-12 constituted nearly 50 percent of all smart bombs dropped by American forces, the Maverick missile, fired primarily from A-10s, proved highly effective in interdicting Iraq's mechanized forces outside of Khafji.¹⁶⁰

Command and Control:

- By the time of the Ardennes counteroffensive, IX TAC had developed a highly efficient control system for fighter planes. That system included forward director posts, radar centers, fighter

¹⁵⁷According to U.S. Air Force General John Vogt, a 450-ft circular error probable (CEP) was considered good. See Kohn and Harahan, 1986, p. 9.

¹⁵⁸F. M. Sallager, *Operation STRANGLE (Italy, Spring 1944): A Case Study of Tactical Air Interdiction*, Santa Monica, Calif.: RAND, R-0851-PR, February 1972, pp. 34–35; and Martin van Creveld with Steven L. Canby and Kenneth S. Brower, *Air Power and Maneuver*, Maxwell AFB, Ala.: Air University Press, July 1994, p. 194.

¹⁵⁹Nevertheless, IAF operations did cause a significant number of civilian casualties, in part because many Lebanese residents of West Beirut chose to remain in their homes (in spite of Israeli warnings to evacuate), out of fear that their property might be stolen. See Gabriel, 1984, p. 160.

¹⁶⁰See the interviews with General Charles Horner and Maj. General Thomas Olsen (CENTAF commander and deputy commander, respectively, during Operation Desert Storm) and Major Michael Edwards (Operation Desert Storm A-10 pilot) in Major Daniel R. Clevenger, study director, *"Battle of Khafji," Air Power Effectiveness in the Desert*, Vol. 1, Washington, D.C.: U.S. Air Force, Studies and Analyses Agency, July 1996, pp. 57, 69–70, 82; and Richard Hallion, *Storm over Iraq: Air Power and the Gulf War*, Washington, D.C.: Smithsonian Institution Press, 1992, p. 203.

control stations, and a combat command.¹⁶¹ Furthermore, Maj Gen Pete Quesada's fighter command was the first to integrate the Microwave Early Warning (MEW) radar and the SCR-584 anti-aircraft radar to provide navigation and precise control to fighter-bombers during ground-attack missions.¹⁶²

- Khafji provides an example of how a well-oiled command and control system can help ensure successful urban interdiction operations. Once Iraqi offensive intentions were apparent, the Coalition Air Operations Center moved quickly to redirect already-scheduled sorties toward moving enemy forces. Air attacks were funneled into the Kuwaiti Theater of Operations (KTO) from different altitudes and directions using a grid of designated "kill boxes"¹⁶³ as a control measure.¹⁶⁴
- Much of the night-interdiction effort in southern Kuwait was directed by Marine Fast FACs in F/A-18D aircraft, who identified and marked targets for other planes carrying weapons. Having penetrated over 5 miles inside Kuwait, a Marine Air/Naval Gunfire Liaison Company (ANGLICO) team also called in air strikes against hundreds of Iraqi vehicles preparing to move south.¹⁶⁵

¹⁶¹Hughes, 1995, p. 294.

¹⁶²The wide-band MEW was used for long-range and area control; the SCR-584, with its narrow beam, was used for close-range, precision work. Radar operators helped fighters get under and through the weather both in the target areas and at recovery bases and validated targets by correlating ground locations with tracked fighter positions. Quesada's command used the SCR-584 to blind-bomb through overcast skies and to direct aerial reconnaissance flights. However, the blind-bombing method had some problems. Small shifts in temperature had a significant effect on delicate ground radar equipment, creating the potential for large bombing errors on the battlefield. Furthermore, the process of entering bombing data into the control stations proved too lengthy. See William R. Carter, "Air Power in the Battle of the Bulge: A Theater Campaign Perspective," *Airpower*, Vol. 3, Winter 1989, pp. 26–27; and Hughes, 1995, p. 294.

¹⁶³The KTO was divided into many zones, called kill boxes, to organize and control air attacks against forces in somewhat featureless terrain.

¹⁶⁴Planners managed to push a four-ship flight of aircraft through each kill box every 7 to 8 minutes during the day and every 15 minutes at night. Grant, 1998, p. 31; and Clevenger, 1996, pp. 20–21.

¹⁶⁵Rebecca Grant, 1998, pp. 31–32.

Intelligence:

- Following the withdrawal of the South Vietnamese army from the main fire-support base outside An Loc in 1972, the surrounding area was left devoid of friendly ground troops, which severely hampered allied intelligence efforts. USAF forward air controllers and remaining elements of the U.S. 1st Air Cavalry regiment were spread so thinly that they could provide little definite information about the locations of the three Communist divisions moving in the direction of the provincial capital.¹⁶⁶
- Subsequently, however, South Vietnamese intelligence sources provided accurate information on Communist plans to intercept an ARVN unit coming south from An Loc to assist forces attempting to relieve the town. This information resulted in a B-52 ARCLIGHT strike that totally decimated a North Vietnamese regiment.¹⁶⁷
- In Khafji, U.S. JSTARS MTI sensors detected and recorded the initial preparations for movement of Iraq's 5th Mechanized Division and 3rd Armored Division before they crossed the Kuwaiti-Saudi border. Apparently, however, coalition analysts did not at first understand the significance of the data; only later did it become clear that the Iraqi buildup portended an attack on the town of Khafji. Nonetheless, once the invasion had begun, JSTARS' ability to detect and pass along information on Iraqi reinforcements proved to be an essential element in the coalition air force's effort to isolate Iraqi units inside the town.¹⁶⁸

Tactics and Training:

- In Beirut, the Israelis made a distinction between PLO-controlled areas and camps in the southwest and the northwestern part of the city, where Lebanese Sunnis predominated. For example, PLO areas were subjected to numerous flyovers, flare drops, and

¹⁶⁶U.S. Air Force, Headquarters PACAF, 1973, p. 2.

¹⁶⁷U.S. Air Force, Headquarters PACAF, 1973, p. 53.

¹⁶⁸During Desert Storm, JSTARS was most useful for providing overall situational awareness. However, precise targeting with JSTARS was difficult, because of the lack of a reliable, accurate interface with coalition attack assets. Clevenger 1996, pp. 56, 65.

sonic booms intended to intimidate the families of PLO members.¹⁶⁹

- With the notable exception of the massive aerial bombardment of PLO camps on August 12, 1982, the IAF did not carry out systematic terror bombing, even in areas of Beirut with a Palestinian majority. The exception to the rule resulted in an enormous public outcry, both internationally and domestically, against Israeli policies in Lebanon. The outcry prevented Israeli Defense Minister Ariel Sharon from realizing his personal vision of destroying the PLO as a fighting force.

Ground-Force Cooperation:

- The Finns' refusal to close the Lake Ladoga corridor to Leningrad early on, and the subsequent failure of the German Tikhvin offensive, probably doomed any chance Germany had to halt the flow of supplies to Russia's second-most important city.¹⁷⁰
- In Beirut, the relative inexperience of the Israeli army in urban warfare, and the refusal of the Lebanese Christian faction to take on the bloody job of house-to-house fighting, led Israeli commanders to pursue a modified siege strategy with respect to the PLO. In such a situation, aerospace power came to play a central role in driving Palestinian forces out of Lebanon.¹⁷¹
- For Khafji, friendly ground forces in the area were limited to primarily border reconnaissance teams and the U.S. Marine Task Force Shepherd, a two-battalion screening force¹⁷² for the 1st Marine Division down at Kibrit.¹⁷³ Coalition air forces did provide close support to these and other friendly ground forces, and

¹⁶⁹Gabriel, 1984, pp. 136–139, 157–159. See also R. D. McLaurin and Paul A. Jureidini, *The Battle of Beirut, 1982*, Aberdeen Proving Ground, Md.: U.S. Army Human Engineering Laboratory, January 1986, p. 48.

¹⁷⁰Paul Carell, *Hitler Moves East, 1941–1943*, Boston: Little, Brown, 1963, p. 267; and John Erickson, *The Road to Stalingrad: Stalin's War with Germany*, Vol. 1, New York: Harper & Row, 1975, pp. 270, 277–278.

¹⁷¹McLaurin and Jureidini, 1986, p. 30; and Gabriel, 1984, pp. 130–132.

¹⁷²A *screening force* is put in front of or to the side of a main force to provide early warning of and some defense against a major enemy attack.

¹⁷³Atkinson, 1993, p. 198.

the ground combat units and reconnaissance teams also assisted the interdiction effort by directing fire on enemy forces not yet in contact. That said, the interdiction effort was largely an independent air operation with JSTARS and airborne FACs (both Marine and USAF) directing most strike aircraft in on the Iraqi 5th Mechanized and 3rd Armored Divisions as they moved south toward Khafji.

Opposition Countermeasures:

- To counter direct enemy bombardment during the siege of Leningrad, the Soviets relied on significant air defenses, including over 100 fighters, numerous anti-aircraft guns, barrage balloons, and searchlights.¹⁷⁴
- The success of the Soviet “ice bridge” operation, in the face of German bombardment and severe weather, was ensured only after the truck convoy system was abandoned. That system hampered drivers willing to make several trips in a row across Ladoga. Egged on by local Communist Party, Komsomol, and NKVD officials,¹⁷⁵ individual truck drivers were able to make as many as four round trips a day during shifts lasting from 16 to 18 hours.¹⁷⁶
- At Stalingrad, German attempts at interdicting the Soviet LOC across the Volga and the Don rivers were hindered by several Soviet countermeasures, including protecting the railway lines with fighters and AAA, unloading supplies from trains onto trucks as far as 150 miles from the front, employing large numbers of troops to hand-carry supplies, and constructing pontoon bridges just beneath the river’s surface to hide them from accurate artillery fire and dive bombers.¹⁷⁷

¹⁷⁴Gouré, 1962, p. 99.

¹⁷⁵The Komsomol was the youth branch of the Soviet Communist Party (literally, the Young Communist League). The NKVD was a Stalin-era Soviet intelligence and internal security organ, a predecessor to the KGB.

¹⁷⁶Moving supply bases forward and extending the railroad to the lake shore also speeded up the resupply operation and countered the effects of German interdiction. Gouré, 1962, pp. 206–209.

¹⁷⁷Erickson, 1975, p. 411; Craig, 1973, p. 161; and Latimer, 1985, pp. 52–53.

- In 1982, the Palestinians had no air forces and insignificant numbers of AAA and SAMs with which to confront the Israeli Air Force in Beirut. They were able to compensate somewhat for these shortcomings through the use of clever tactics. For example, after deliberately placing its positions in civilian areas, the PLO provoked outrage among the international public and in Israel when Israeli Air Force bombs killed civilians or destroyed homes.
- In addition, the Palestinians in Beirut protected themselves from air attack by keeping their units small and highly mobile and by constantly changing their locations. Moreover, having had plenty of time to prepare for Israeli bombardment, they developed an extensive network of underground tunnels and trenches.¹⁷⁸

Atmospheric and Light Conditions:

- Bad weather turned out to be a more effective interdiction asset against the Soviet resupply operation across Lake Ladoga than German air or artillery. For example, snowstorms and blizzards occurred on 22 days during the month of February 1942, requiring nearly constant snow-removal operations to keep the ice road open.¹⁷⁹ Nevertheless, the Soviets could not have survived the German siege if Ladoga had remained unfrozen.
- The weather worked against the German interdiction effort at Stalingrad. When the Soviets finally broke through the Don River barrier, both Soviet and German air forces were grounded by the weather.¹⁸⁰
- During the initial period of the Ardennes offensive, low cloud ceilings and snow prevented Allied fighter-bombers from making any substantial strikes against German columns. But as soon as the clouds cleared, U.S. and British planes took to the sky in large

¹⁷⁸Gabriel, 1984, pp. 132–133, McLaurin and Jureidini, 1986, p. 33.

¹⁷⁹In all, 1,004 Russian trucks were smashed or lost while navigating the road, the majority due to the weather, and most trucks required repairs after each trip. Gouré, 1962, p. 152.

¹⁸⁰Craig, 1973, p. 187.

numbers, just when German supply lines were stretched to the limit.¹⁸¹

- During the Khafji operation, aerospace power operated almost as effectively at night as during the day. The Low Altitude Navigation and Targeting Infrared for Night (LANTIRN)-equipped F-15E scored first-pass kills against individual Iraqi vehicles at night and in bad weather.¹⁸² However, the venerable AC-130 gunship and the A-10 Warthog were the most lethal nighttime performers.¹⁸³

Geography and Terrain:

- In the battles of Leningrad and Stalingrad, the Soviets possessed certain geographical advantages that frustrated German interdiction efforts. Owing to the failure of the Finns to press their initial advantage against the Red Army and link up with German forces in the south, the Soviets retained a 50-mile-wide corridor between the city of Leningrad and the far shore of Lake Ladoga. As suggested earlier, this became a significant advantage in re-supplying the city once the lake froze and the “ice bridge” was constructed.
- The location of Stalingrad on the west bank of the Volga River permitted the east bank to be utilized as a fairly secure supply base and location for indirect-fire artillery. Because that artillery required vast quantities of ammunition, the Soviets may not have been able to meet their overall logistics needs in the initial period of the battle if the artillery had been forced to move across the river.¹⁸⁴
- The hilly terrain of the Ardennes, traversed by narrow rural roads with few exits, benefited Allied fighter-bombers attempting to interdict German armored reinforcements. Allied pilots were able to block entire columns with solitary strikes aimed at lead

¹⁸¹Hughes, 1995, pp. 280–283.

¹⁸²Hallion, 1992, pp. 314–315.

¹⁸³Still, as the A-10 loss rate began to climb, Central Air Force (CENTAF) commander Horner greatly scaled back Warthog operations. Clevenger, 1996, p. 27.

¹⁸⁴Latimer, 1985, p. 52.

vehicles, taking out the remaining enemy vehicles at their leisure.¹⁸⁵

CONCLUSION

What does the historical record have to say about the overall performance of U.S. aerospace forces in past urban operations? To begin with, it must be acknowledged that all four military services have accumulated substantial experience, from World War II to Kosovo, in providing air support to joint urban operations during periods of war and relative peace. That support has included providing close air support to embattled ground troops in such diverse places as Cherbourg, Hue, and Mogadishu, as well as to friendly civilians during noncombatant evacuation operations in Saigon and Tirana. It has included providing logistics support to friendly troops and civilians in airdrop and airlift operations, as conducted during the battles of Bastogne, An Loc, and Sarajevo, and in transport operations, as occurred at Arnhem, Stanleyville, and Monrovia. Moreover, it has included air interdiction operations during the Normandy offensive and the Battle of Khafji, as well as C4ISR and psychological warfare activities in Grenada, Panama, and Somalia.

Despite this extensive record, the effectiveness of American aerospace power in urban operations has varied so much throughout the years that no general trend is discernible. With regard to close air support, Cherbourg, An Loc, and Panama can be counted as successes, and Aachen, Hue, and Grenada as failures. Whereas CAS difficulties during World War II often stemmed from the inability of existing air weaponry to destroy fortified defenses, in recent times, they have had more to do with a heightened concern over friendly military and noncombatant casualties.

As to logistics support, U.S. air forces have been successful in resupplying besieged cities, such as An Loc and Sarajevo, but have had serious problems with troop transport in cities such as Mogadishu, where the opposition possessed numerous, albeit rather unsophisticated, means of air defense. For its part, the Air Force has demonstrated considerable success in observing and interdicting the

¹⁸⁵Hughes, 1995, p. 284.

movement of enemy forces and supplies bound for such urban battlefields as Cherbourg, Bastogne, and Khafji.

Because of the variety of examples, no simple formula for aerospace force success can be derived from past urban operations. Nevertheless, a few general historical observations can be made:

- Urban close air support has usually been easier to conduct when friendly ground forces were on the defensive (e.g., Bastogne and An Loc) rather than on the offensive (e.g., Cassino and Hue).
- Urban airdrops have at times been very precise and useful but, unless the target population was highly concentrated as at An Loc, usually have not replaced other means of resupply.
- Helicopter transport within contested urban areas has become quite hazardous.
- At least in conventional conflicts, interdiction of the approaches to a city occupied by hostile forces has often been the most effective means of aerial fire support.
- Employing aerospace forces to support siege operations, such as the Israelis did in Beirut, has become militarily feasible, but would probably be politically unwise for a democratic country like the United States.

Most of the same factors that have contributed to effective air operations in other environments have been successfully applied in urban settings as well, including the following:

- Careful mission planning to ensure that air assets are used appropriately
- The ability to suppress or circumvent opposition air defenses
- Close coordination between friendly aerospace and ground forces
- Precision weapons and tactics
- Most important, identifiable and targetable adversary forces (i.e., not too dispersed, hidden, fortified, or intermixed with civilians and/or friendly troops).