Cargo Gliders for Complex Emergencies and Operations Other Than War

New Uses for an Old Neglected Warhorse

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Introduction

In the past several years, relief operations in war-torn or underdeveloped nations have shared a common denominator: each depended on air traffic controllers and engineers (as well as expensive privately contracted civilian logisticians) to open, operate, and rehabilitate dilapidated airport and harbor facilities. Once operational, unloading critical items in a permissive (peaceful) or non-permissive (hostile) environment can consume precious time, especially if sealift and airlift assets are urgently needed elsewhere. Poorly maintained lines of communication and a lack of all-terrain vehicles add to the confusion and further slow down getting aid into hands of a displaced person (DP); until said equipment arrives in-theater and engineers repair the road and rail network, perishable food commodities and critical and essential medicines to sustain life accumulate in a warehouse or rot in the open air.[1]

Parachute drops and the use of transport helicopters are the only alternatives for the delivery of aid in such cases; the former is inefficient while the latter expensive to procure, maintain, and operate, and contributing nations make too few available for detached service in operations of that kind for fear of them being shot down. Current options for meeting the logistical challenge are in need of a tune up as the tempo and diversity of natural- and man-made disasters — Complex Emergencies — spreads from underdeveloped nations — the traditional epicenter — to developed nations. Thus, international and domestic relief organizations require an alternative capability to respond to such outbreaks since both constitute the vanguard of Complex Emergency management.

The answer necessitates fielding an aviation design that integrates a genuine stealth capability; a simple, yet sophisticated fuselage economical to manufacture; payload dimensions capable of deploying abundant quantities of aid workers and relief packages; and, a radius enabling it to travel over extended distances and terrain barriers. Such an aviation design once existed in the inventory of some militaries — the glider. Cost-effective and combat-proven in diverse geographic regions accents the credentials of these silent wings and makes it an attractive candidate for contemporary procurement and deployment in Complex Emergencies and other operations other than war (OOTW), an argument that this article intends to prove.

Military Background: From Pinnacle to Nadir

Born out of myth as an outlet for genuine scientific investigation into the feasibility of human flight, gliding or soaring, as it is commonly known, emerged at the turn of the century as a pastime and competitive sport for the aviation enthusiast, domestic and international.[2] Overnight the trademark of this endeavor, the glider, evolved from a cottage industry to an entrepreneurial venture as manufacturing plants sprang up to fill orders as improved designs came on the market. The outbreak of the First World War stifled glider development though as production lines shifted to a wartime economy and the military demanded propeller-driven aircraft for front-line service. Consequently, interest in soaring waned as newspapers chronicled the heroics of aerial combat over the Western Front. After the war, many industrialists from the allied powers poured funds and expertise into the development of a competitive aviation industry dedicated to powered flight; a move that did little to restore the glider's pre-war reputation as research and development (R&D) focused instead on building high-performance aircraft. On the other hand, a defeated Germany — the cradle of modern glider development — used the art of soaring as the perfect subterfuge to circumvent the Treaty of Versailles.[3] Since treaty restrictions did not prohibit the operational use of gliders, the truncated Reichswehr under the leadership of General Hans von Seeckt sought to improve aeronautical technology and skill resources *vis-a-vis* subsidized R&D and civilian training programs; the goal: a cadre of pilots for a future air force.[4] Inadvertently, the Allied Control Commission furthered this subterfuge when they relaxed the most stringent treaty constraints, in 1923, on aircraft manufacturing in a move to stimulate industrial recovery; soon mass quantities of affordable gliders of high-quality design and construction were coming off the assembly lines.

However, the thought of using the glider as a cargo and personnel transport traces its origins to the Treaty of Rapollo negotiated by the Reichswehr and Nikolai Lenin in 1921; this clandestine agreement among other things permitted technical exchanges between the German and Russian general staffs. Of those Reichswehr officers to benefit from this provision was an avid gliding instructor, Colonel Kurt Student. Having unprecedented access to Soviet military maneuvers during the early 1930s Student observed Russian advances in parachute operations were offset by the fact that the technology for delivering heavy weapons to the battlefield was non-existent. In his final tour of duty report, Student recommended the general staff take advantage of this deficiency by employing gliders as a resupply vehicle, a proposal answered with a reply of skepticism and ridicule. Not until the advent of National Socialism could Student, now a major general and Inspector of Airborne Forces, turn his vision into reality. Working with other proponents at the Darmstadt Airborne Experimental Center, akin to the Lockheed Skunk Works, Student co-wrote the milspecs for the first dual-purpose combat glider: the DFS-230.[5]

The very tactics and techniques arrived at by this early investment in glider development paid handsome dividends later on, in furthering the concept and conduct of the "blitzkrieg." As the sensational assault and capture of the supposedly impregnable Belgian fortress of Eban Emael by commandos landed by glider made headlines in 1940, the British enthusiastically reacted to the pivotal role it played in this conquest by forming the Glider Pilot Regiment.[6] The United States War Department, on the other hand, was quick to file intelligence dispatches from its attachés stationed in occupied Europe mentioning the glider's importance as a combat weapon. Only after America entered the Second World War did the U.S. Army cease neglecting the potential of these motorless aircraft for use in its newly organized airborne divisions that went on to see combat in Europe and the Pacific. After the war, demobilization eradicated most American and British

Army glider infantry regiments and field artillery battalions.[7] By the end of the 1940s both nations phased out the glider in favor of multipurpose transport helicopters, aircraft, and heavy cargo parachutes then entering service.

Why Gliders? Why Now?

Perhaps the only successful platform employed in combat and later abandoned after an intensive *ad hoc* development program a decision by the United Nations (U.N.) to procure these silent wings would face minimal opposition from financial contributors if the merits attributed to the glider were brought to light. In order to do so though, it is important first to delineate the shortcomings of parachute drops and transport helicopters.

From a technical standpoint bulk airdrops by parachute are inefficient for several reasons. Container delivery systems (CDS) for high-velocity or free drops are labor intensive to build and create a lot of refuse.[8] In a non-permissive environment, cargo aircraft drop these CDSs at 10,000 feet, more than ten times higher than pilots prefer to insure accuracy. Subsequently, fierce wind currents can alter calculated parachute trajectories and deposit CDSs in remote terrain or in the hands of the perpetrators of the crisis. Consequently, 2,000 pound bundles hurtling downward at 45 to 70 miles per hour or tumbling down a rocky slope dragged by wind and gravity can cause collateral damage as easily as precision-guided munitions. Furthermore, the heavier bundles can bounce some five to six feet in the air after impact and significantly damage the contents, especially if glass vials are onboard. Because of the DZs dangerous location, parachutes and CDSs are unrecoverable; the U.S. Army lost $30 million worth of aerial delivery systems during air drops over Bosnia from 1993 to 1995.[9] Finally, without supervised distribution on the ground a melee and subsequent stampede could ensue as civilians congregating around larger bundles are easy targets for ambush by hostile guerrillas or bandits.[10]

On the other hand, transport helicopters are of little value to a relief operation until heavy cargo aircraft can ferry them to the nation in need. Three to seven helicopters is the limit the C-17 and C-5B respectively, can haul in a single flight and these have to be partially disassembled to fit into the cargo bay. Once in-theater, certification of airworthiness entails mandatory test flights after reassembly — a time consuming process. Furthermore, for every hour of operational use, a helicopter (like a cargo aircraft) requires several hours of maintenance and a large pool of technicians to keep it flying. Alternatively, a helicopter can self-deploy (fly directly from point A to point B under its own power), but only if the location of its staging area is directly adjacent to the nation in question and the weather permits safe passage; attempting this feat by leap frogging through several countries is hardly cost-effective: during the crisis in Kosovo it took several weeks for 24 Apache helicopters to deploy from Germany to Albania. In addition, the location of landing zones (LZs) and DZs in high-altitude environments affect helicopter (and aircraft) fuel consumption and weight allowances thereby restricting the quality and quantity of aid packages distributed. Altitude density may also preclude some varieties of heavy equipment used in the construction of permanent DP camps and forward airfields from moving to remote areas via helicopter. Instead, engineers must helicopter to the site and the driver must move the equipment by way of an overland route, conditions permitting.

Gliders do not face these difficulties and could support future operations (at home and abroad in land-locked or littoral nations) in situations where the economic, social, and political

infrastructure has disintegrated to the point it geographically isolates a segment of the population from outside assistance.[11] The former Soviet Union came to that conclusion in the early 1930s, unbeknownst to the outside world at that time, and exploited the glider at first for its commercial value in terms of hauling cargo and passengers into the inaccessible hinterland. "Military use became a coincidental offshoot." Economical to mass produce using few raw materials, the Soviets found gliders offset their lack of technical know-how and an industrial infrastructure needed to turn out enough transport planes demanded of a strained economy.[12] In practical terms, this means such a capability is today within the means of even the poorest of nations, an advantage that may become a necessity as several member states of the U.N. that are major financial contributors, notably the U.S., are or were in arrears in the past and have held back payments to fund such operations.

Precision glider landings would prove highly effective for accessing these remote areas without resorting to inefficient high-altitude parachute drops; "negotiating" (in other words, buying protection) with the warring factions; or, laying the logistical groundwork for a massive intervention to guarantee the security of convoys. Pre-deployment logistical evaluations and rehabilitation of host nation support facilities are unnecessary since gliders can execute spot landings on terrain that does not require preparation, including built-up areas.

Bearing this in mind, there have been several Complex Emergencies in the 1990s alone, as shown in Figure One, where the utility of a glider may have proved useful. If this decade is an indicator of what the next millennium has in store, like the Y2K problem, then it is only logical that the capabilities of the United Nations High Commission for Refugees (UNHCR) and non-governmental organizations (NGOs) receive a boost in capabilities since they are the first on the scene of a humanitarian crisis. Those skeptical should take heed that procuring gliders makes sense for several reasons.

Date	Type of Disaster	Location	Circumstances	Status
1990-	man-made	Liberia	civil war	unresolved
1991-	man-made	Angola	civil war	unresolved
1991-	man-made	northern Iraq/Turkey	civil war	unresolved
1991-	man-made	Sierra Leone	civil war	unresolved
1992-1995	man-made	Bosnia-Herzegovina	civil war	ended/recovery underway
1992-1995	man-made	Croatia	civil war	ended/recovery underway
1994	man-made	Rwanda	civil war/genocide	ended/recovery underway
1997-	man-made	Congo (Zaire)	civil war	unresolved
1999	man-made	Albania/Macedonia	civil war/genocide	ended/recovery underway
1999	man-made	Yugoslavia (Kosovo)	civil war/genocide	ended/recovery underway
1991	natural	Bangladesh	typhoon	recovered
1992	natural	southeast U.S.	hurricane	recovery underway
1997	natural	Montserrat	volcano	unresolved
1998	natural	Honduras	hurricane	recovery underway
1999	natural	central U.S.	tornado	recovery underway
1992-	man-made/natural	Somalia	civil war/famine	unresolved

Figure 1. Complex Emergencies in the 1990s

1. Gliders and glider landings dovetail the individual capabilities in parachute drops and helicopter relief flights while minimizing the associated hazards. While parachute drops offer an

alternative to land convoys, the trade-off is vulnerability, as airlift assets are in jeopardy of being shot down, and disorganization as the contents of such drops scatter over the target area. In turn, helicopters integrate precision landings, mobility, and heavy payloads, while trading-off stealth and surprise, as engines and rotorblades disclose the direction of approach and departure, for vulnerability to air defense artillery (ADA) or field artillery fire during loading and unloading. Comparatively speaking, gliders and glider landings prove superior to either technique thanks to several inherent traits.

Stealth and Surprise — In a non-permissive environment, the moment an unarmed cargo plane or helicopter approaches a DZ or LZ is the point where pilots face the greatest danger of being shot down. Ejecting flares during approach or departure to confuse and divert incoming heat-seeking surface-to-air-missiles (SAMs) is the only countermeasure available to a pilot, provided the aircraft has the gear for such a contingency, unlikely for U.N. flights contracted out to third-parties, but these are not 100 percent foolproof. However, successfully concealing a relief flight in transit to the target area can negate the potential for detection and offset the lack of armament for self-defense. Stealth is the key determinant in maintaining total surprise. Without the former, one cannot exploit the latter to its fullest potential. Since a glider's wind-driven propulsion system can maneuver into a gradual or swift descent and has a low metal-content fuselage that does not emit infrared heat its radar signature is negligible. This means it can quietly land without attracting too much attention and is invulnerable to fixed and man-portable SAMs. Hence, these "silent wings" offer the distinctive characteristic of being the only true "stealth aircraft," whose value enhances the survivability for NGOs undertaking unilateral relief flights, as in the case of Mercy Corps International's air drop campaign over Kosovo in the latter stages of Operation *Allied Force*.

Payload — As a workhorse during the Second World War, gliders served as an immediate force-multiplier for combat units thanks to its payload capacity; an inherent trait useful and necessary for Complex Emergencies. Credit went to its cost-effective heavy-lift design. By all accounts, gliders of that era adhered to the principle of constructing a simple, yet durable aircraft since most had fuselages constructed of air-tight canvas wrapped around welded steel tubes and honey-combed plywood, "...a construction technique that provided strength with minimal weight." A lack of complicated flight instrumentation and engines meant very little maintenance and kept costs down resulting in a potentially reusable airframe without diminishing, but rather increasing its lift capability. Most had cargo and personnel capacities comparable to every model of transport helicopter (and some heavy cargo aircraft) currently in service throughout the world. Furthermore, the inclusion of hinged cargo doors on the nose or tail assembly kept loading and unloading times to a minimum.

Performance — Combat gliders did not yield to the opinion that once separated from its tow aircraft, the entire action necessarily had to unfold according to some predetermined schedule without taking into consideration unforeseen contingencies. Debriefings of personnel who participated in such landings noted that if tow release occurred at an altitude above 700 feet the pilot could "make a proper approach and come in slow," an option that afforded him the time to select and divert to an alternate LZ if necessary.[13] Unlike the sports glider though, a fully loaded cargo glider was unable to use atmospheric currents or thermals to remain aloft for a considerable amount of time or even be made to climb due to its weight, construction, and design, all it could

do was soar back to earth. However, that glider could execute some exceptional maneuvers to land on target depending on the method of soaring: gliding or diving flight.[14]

Perfected by the German Luftwaffe with exceptional results, "dive gliding" produced speeds in excess of 125 miles an hour based upon the angle of descent. If spotted, evading ground fire with this method required deploying a braking parachute and making frequent changes in the diving angle or spinning for a short time which refutes accusations that gliders were "compact targets." Furthermore, if release occurred at the right altitude, 13,000 feet, a glider could coast to the target area from as far away as 20 miles before going into the dive.[15] This radical innovation in tactics is still useful because gliders can execute spot landings in clearings only yards long. In contemporary terms, this means hostile elements bent on shooting down a relief flight as a warning to halt further operations cannot anticipate and identify as easily a glider LZ compared to parachute DZs.

Recyclable — One myth that gave the glider a bad reputation during the Second World War was it had a life expectancy of only one mission. Critics contend that most airborne assaults left the powerless aircraft destroyed beyond repair or unsalvagable. This statement is true as far as those gliders shot down or that skidded to a halt after hitting natural or man-made obstructions. These cases are in the minority the vast majority were recyclable; after-actions reports confirmed most gliders and cargo landed in serviceable condition and few casualties occurred.[16] Other circumstances, all of them preventable, contributed to the myth. First, retrieval of gliders had a low priority due to combat requirements and hundreds sat on secured LZs for several weeks before recovery aircraft or repair teams received permission to enter the area; by then, exposure to the elements had already taken its toll. Just to give an example, 97 percent of the gliders used by American forces in the Normandy landings were left to rot in narrow pastures in which they landed. Second, limited numbers of qualified recovery crews and pick-up equipment proved insufficient for handling the thousands of gliders involved in a major airborne operation. Third, lax security measures around LZs after an operation led to damage by vandals or theft by civilians who chopped up the plywood fuselages for fuel. Fourth, glider pilots whose job it was to help clear the LZs and prep the fuselages for recovery returned to their staging areas in England, in most cases, three days after landing. Finally, because of a wartime economy tooled up for mass output, logisticians found it easier to replace than recover used stocks with new inventory taken right from the production line.[17]

2. Gliders have seen combat in a variety of geographic regions varying in terrain and climate where relief operations are currently underway or may deploy to in the future. Few words are in order to describe the applicability of the glider for deploying in situations deemed as Complex Emergencies on a global scale. Its service record denoted in Figure Two speaks for itself. Historical accounts record gliders participated in some sixteen major and minor airborne operations and thousands of other landings in 14 nations with different terrain and climates. Primarily used for airhead and seizure and linkup operations gliders also took part in missions judged by today's standards as special operations or low-intensity conflict.

In some instances, planners favored using the glider for two reasons: first, a conventional ground assault against a fortified objective could cost several thousand casualties before capitulation; and second, objectives located in high-altitudes or outfitted with sound-ranging equipment precluded the use of parachutists. Most troops and equipment landed by glider

accomplished their D-Day tasks on schedule. While operational failures were few, those that did occur did so mainly because of poor tactical judgment inconsistent with accepted airborne doctrine.

Western Europe ~
- Belgium
- France
- Germany
- Holland
- Norway
Eastern Europe *f*
- Hungary
- Soviet Union
Balkans †
- Italy (Sicily)
- Greece
- Yugoslavia
North Africa *f*
- Tunisia µ
South/Southeast Asia †
- India µ
- Burma
East Asia/Pacific †
- Philippines

Countries of these regions are characterized by one or more of the following: *Terrain*: flat plains, rolling hills, rugged mountains, coastal lowlands, uplands, reclaimed inundated land, glaciers, plateaus, valleys, tundra, deserts, dry, and semi-arid, jungle, fjords, and forests; *Climate*: temperate, rainy, humid, cloudy, cold, arctic, hot, dry, and tropical monsoon. Take note that the diversity of the terrain and climate listed above also makes the glider suitable for use in the Caribbean and Latin America, North America, the Middle East, Sub-Saharan Africa, Greenland, and Antarctica. ~-former regional hotspot *f*-potential regional hotspot *v*-current regional hotspot *µ*-staging area

Figure 2. Geographic deployment of the glider during the Second World War[18]

3. Adapting the glider to the rigors of Complex Emergencies, demands the merger of proven equipment designs and innovations introduced during the Second World War with technology currently in service to create a truly cost-effective platform. The best course of action for rapidly fielding a humanitarian glider capability is to manufacture and modify off-the-shelf designs from the Second World War for contemporary use. Several Allied and Axis models stand out as candidates for adoption below in Figure Three based on lift capacity and have cargo bay dimensions to accommodate a variety of cargo as well as an assortment of modern wheeled and tracked all-terrain vehicles. The majority of the gliders underwent rigorous field testing and refinement; the payload capabilities are comparable to heavy-lift helicopters and even tactical and strategic transport aircraft at one-tenth or less of the unit cost of either; and, background studies and after-action reports on performance in non-permissive environments exist. Moreover, several of these models, patterned on those used in competitive gliding, "had so-called 'breaking points,' that is, joints of purposely weak construction, which would break first in crash landings or collisions with natural or artificial obstacles. This method brought about a substantial economy in construction...[and] procurement of spare parts..."[19] Modification does not entail a massive redesign of the fuselage (unless the intent is to stretch the cargo bay or improve upon

aerodynamics, speed, and maneuverability of the airframe to handle the stress of jet-glider tows) rather the uniting of technology from two different historical periods.

Model	Weight (Empty)	Cargo (Tons)	Personnel Capacity	Service Record
ME-321*	26,000 lbs.	24	200	Europe
Ju-322	56,000 lbs.	13	100	N/A
XLRN-1**	N/A	10***	80	N/A
CG-16A	9,500 lbs.	5	42	N/A
Hamilcar	18,000 lbs.	10	40	Europe
CG-10A	12,150 lbs.	5.5	40	N/A
CG-13A	8,700 lbs.	5	40	Europe/Pacific
Ku-8-II	10,000 lbs.	8	32	Pacific
Horsa	8,370 lbs.	4	32	Europe
XLRG-1**	N/A	N/A	24	N/A
Go-242	7,000 lbs.	4	23	Europe
CG-15A	4,000 lbs.	2.5	15	Europe/Pacific
DFS-230V	1,800 lbs.	2	15	Europe
XLRQ-1**	N/A	N/A	12	N/A

*Designated the "Giant," Messerschmitt Aircraft built 200 ME-321s in anticipation of Operation *Sealion* — the invasion of Great Britain — and it is considered the largest operational glider ever in existence with a cargo capacity equal to Boeing's 707-320B jet and a personnel capacity comparable to the C-17, C-130, and C-141. **Amphibious-capable ***Capable of carrying 3,000 gallons of fuel.

Sample heavy-equipment loads: *ME-321:* a 20-ton vehicle; *JU-322*: a light vehicle; *Hamilcar*: two jeeps with trailers, or, a seven-and-a-half-ton vehicle deployable within 15 seconds upon landing; *Horsa*: two one-quarter-ton 4x4 jeeps; *CG-10A*: one two-and-a-quarter-ton truck; *CG-13A*: one one-and-a-half-ton 6x6 truck, or, a tracked vehicle; *KU-8-II*: an eight-ton vehicle, or, a bulldozer.

Figure 3. Second World War gliders suitable for contemporary service[20]

Furthermore, Allied and Axis ingenuity pulled off some of the most simple, yet extraordinary innovations in terms of braking systems, crash-protection, an aerial retrieval system, and jet-assisted take-off (JATO) that still has an essential role to play. Whereas portable and compact off-the-shelf technology developed for civilian and defense applications during the Cold War exist that add minimal weight and can be reversed engineered into the fuselage to bridge the gap between those problems solved and those remaining after the military discontinued interest. These include: night vision goggles, global positioning satellite (GPS) receivers, video guidance systems, composite materials, etc. Still, the trick to constructing the gliders within budget at a low cost per unit and ensuring delivery on schedule is to award all contract and sub-contract work *only* to companies possessing intimate knowledge on the day-to-day manufacturing process of civilian gliders. The reason is simple. Companies in this field are 50 years ahead of the traditional military-industrial complex in terms of technology and design.

Second World War Innovations

Braking System — An *ad hoc* braking system invented by the Germans in 1940 helped achieve a minimal landing distance during operations confined to target areas restricted geographically. Experiments found that barbed wire wrapped beneath the fuselage solved the dilemma. Later adaptations of this method involved the use of a tailhook, (similar to an anchor)

burrowing into the earth upon landing. An alternative method the Germans developed for landing on short, unprepared fields involved the installation of automatic braking rockets situated on the nose assembly. The subsequent backwards thrust created by the activation of the rockets allowed a glider to come to a halt on an LZ only 35 yards long. The super-secret "Credible Sport" short take off and landing aircraft conceived for a second rescue attempt of the American hostages in Iran (and its existence only made public 18 years later in 1997) applied the braking rocket idea.[21]

Crash Protection — The "Griswold Nose" developed in 1943 was a steel battering ram incorporated onto the exterior of a glider's nose. The degree of protection offered by this device allowed the occupants to survive collisions with natural and man-made obstacles with minimum loss of life. Complimenting it was the "Corey Skid" a curved segment of laminated wood affixed underneath the cockpit that prevented the glider from flipping over during landings on soft terrain and protected the fuselage from punctures. Both proved an effective combination in saving numerous lives during airborne assaults over France, Holland, and Germany.[22]

Aerial Retrieval System — Known as the M-80 Glider Pick-Up Mechanism, an aircraft flying overhead could retrieve a fully loaded glider from the stationary position. Mounted to the exterior of an aircraft, the M-80 used the "fishing rod and reel" principle by means of a boom to ensnare the glider's tow line suspended between two poles. Originally used by the U.S. Postal Service in the late 1930s for rural mail pick-up, the M-80 demonstrated its practicability for glider retrieval in both Europe and Asia by medevacing the wounded from the frontlines.[23]

JATO— A heavy-cargo glider faced a predicament: it demanded sufficient thrust to get airborne as quickly as possible, in some cases, up to 4,000 feet of runway to obtain the necessary speeds for it and the tow aircraft to lift off. The installation of ejectable rocket motors under the wings, a technique also developed by the Germans, provided the necessary thrust at modest *g* forces (under 2*g*'s) considered acceptable for human tolerance.

Modern Innovations

Night Vision — What Second World War glider pilots lacked in terms of a night vision capability, they made up with skill, determination, and bravery (not to mention fear) in carrying out exploits in pitch darkness where there was little margin to compensate for errors or ill-fortune. However, through the miniaturization of electronics and enhanced all-weather magnification, the current generation of portable night vision goggles offers a degree of safety and accuracy for executing a twilight landing.

GPS — With an array of satellites encircling the globe in various orbits, hand-held receivers can compute exact geographic locations to the nearest meter. In practical terms, this means a safe touch down in a tight LZ. A precision landing GPS system in service with some civilian airports uses a series of fixed antennas installed at a designated LZ which transmits approach coordinates to incoming aircraft with onboard GPS receivers.[24] U.N. military observers or forward air controllers (FACs) outfitted with a portable version of this system could position it before the arrival of GPS-equipped gliders to permit round-the-clock precision landings in any environment and climate.

Video Guidance Systems — Used to direct unmanned aerial reconnaissance vehicles, gliders outfitted with similar equipment could serve as a remotely piloted CDS (controlled from

the tow aircraft or ground-based FACs). Early NASA space shuttle flight trials proved the idea is feasible: glide tests performed by the shuttle *Enterprise* in the late 1970s included a "hands off" maneuver with the orbiter on autopilot while it descended from 8,000 to 3,000 feet under the control of a ground-based microwave guidance system.[25]

Composite Materials — Light-weight, but hard-wearing tubular components not prone to disintegrating under excessive fatigue and stress (i.e., titanium, used in prosthetic arms and legs, or carbon fiber alloys), would constitute the structural frame of the fuselage. Detachable Kevlar-based bullet-proof body panels or insulation could reinforce the interior at points where personnel and cargo are most vulnerable to small-arms fire. The composition of the exterior components depends upon whether the model of glider selected for service used the traditional canvas on the frame or all-wood method. As mentioned earlier, the failure to immediately recover expended gliders from the battlefield rendered many permanently unusable because the canvas exterior deteriorated in the wind, rain, and humidity. Preventative measures could entail using a synthetic water- and wind-proof material such as Gore-Tex, commonly used in the manufacture of rugged outdoor clothing, to encapsulate the fuselage. Another alternative is to update the design using a fiberglass exterior, as used in contemporary civilian models, which may improve aerodynamics with less weight.

Crash Protection — To overcome the shock of landing, a cargo-restraint system developed for the "Credible Sport" aircraft should be given consideration for inclusion as a standard feature. Intended for a compliment of 150 passengers, this special pallet incorporated aft-facing seats that would give "impact support" rated at 9g's on touch down.[26] Adapting this system to those gliders mentioned above for possible reintroduction would improve upon passenger survivability and comfort during aerial retrieval.

Other Features: A wide range of portable add-on options is feasible: commercial air bags, bulletproof plexiglas, drag parachutes, and inflatable flotation devices to enable emergency amphibious landings.

Other Advantages

From several vantage points, beneficial side-effects are thus obtainable with the introduction of the glider. As an effective and cheaper alternative to contracting out multi-million dollar helicopter and cargo planes, gliders would pay dividends in the form of lower annual fuel and maintenance expenditures as U.N. budget allocations decrease. If you refer to the comparison in Figure Four, adopting an off-the-shelf design such as the German ME-321 that had a payload capacity exceeding the C-130H/J cargo aircraft means the latter could tow two or three of the former in a single sortie (400 to 600 aid workers or 48 to 72 tons of supplies) thanks to its light-weight construction.[27] If the C-17, C-141B, or C-5B serves as the accompanying tow aircraft, the greater engine thrust of these jet transports could possibly convey more than three ME-321s at once, thereby multiplying the overall lift capability while halving the financial outlay. Jet-glider tow combinations have yet to be verified with military versions, but the space shuttle, which is also part glider, did conduct trials. From August to October 1977, the space shuttle *Enterprise* conducted five free flight tests with glide release occurring from atop a Boeing 747 at altitudes ranging from 17,000 to 24,000 feet and executing turns under no power.[28]

Model	Payload	Personnel	Tow Aircraft	Engines	Weight (empty/max)
ME-321	24 tons	200	Heinkel-111Z	N/A	26,000/75,825 lbs.
C-130H	20 tons	92	N/A	Allison T56	72,892/175,000 lbs.

The Heinkel-111Z's five Junkers Jumo 211D-2 liquid-cooled inverted V-12 engines generated a total of 6,000 horsepower to tow a fully-loaded ME-321. The C-130H/J Hercules powered by four Allison T56-A-15 or 2100D3 engines rated at 4,508 hp and 4,591 hp each respectively could generate up to 18,032 hp and 18,354 hp.

Figure 4. ME-321/C-130H comparative data[29]

Furthermore, glider familiarization training for UNHCR and NGO personnel should cost little since instruction deals primarily with the procedures of bracing oneself for a landing. In addition, there are ample numbers of glider pilots worldwide who pursue soaring as a competitive sport and could be contracted out to serve with a mission. These individuals are an adventurous lot and may find the prospects of employment for what they do best in a hazardous environment tempting; there would be little doubt over their skill and training since the U.N. would get the best in the field. During the Second World War, soaring champion John Robinson assisted the U.S. Army Air Corps in writing the 30-hour instructional course that trained the initial cadre of glider pilots and became the standard for every one of the 6,000 recruits graduated from the program.[30]

In a Class by Itself

Whether in single or tandem tows gliders can be pre-stocked and prepositioned, something cargo aircraft or helicopters cannot duplicate. Low cost per unit makes this possible. This requires a more detailed explanation. The sole function of transport aircraft and helicopters is to load, shuttle, and unload personnel and material. With multi-million dollar price tags paid for courtesy of the taxpayer, both cannot loiter for any length of time on the ground as "hangar queens." Thus, neither can serve as a pre-stocked and prepositioned cache for either payload because both are high-priority platforms requisitioned and deployed on a daily basis in a variety of support roles that overtax a finite fleet with a different cargo manifest for each sortie.

Delivering aid by an intercontinental or intra-theater airbridge in the initial stages of a Complex Emergency therefore demands preparation of detailed aircraft movement and loading timetables by the contributing country that owns the transports. These plans must further take into account the transit time for sufficient airlifters to arrive from various points of origins. Though pre-rigged equipment pallets facilitate a rapid response, it takes time to properly load an airlifter in a configuration that efficiently makes maximum use of the entire cargo bay. Furthermore, if discrepancies in the flight manifest exist unforeseen delays may arise and the airlifter may not ready be for immediate loading — again, a time consuming process, especially when coordinating responsibilities between countries that do not share a common language.

Thought should be given to the establishment of regionally-prepositioned, self-deployable "emergency response packages" or ERPs, containing several hundred pre-stocked heavy-, medium-, and general-purpose gliders. ERPs would be co-located on property covering many acres that has support infrastructure (runways, hangars, and control towers) already in place such as derelict air force bases (AFBs); an initiative that may find acceptance with nations experiencing military downsizing and soliciting investment proposals for the reutilization of these facilities.

This would go along way in reducing the pressure on overcrowded active AFBs and allow for the concentration of combat aircraft where and when needed in an emergency. *Allied Force* illustrated this problem when the U.S. Air Force could not locate idle bases in the Balkans to serve as reinforcement holding units for newly deployed fighter and bomber wings. Though, until perspective host nations tabled a formal memorandum of intent to earmark such facilities, active NATO or U.S. air bases would have to do in the interim. Figures Five and Six represent select AFBs suitable as homes for ERPs distributed on an international and domestic basis by region.

Location	AFB	Area of Responsibility
Germany	Frankurt	Eastern Europe
Italy	Aviano/Brindisi*	the Balkans and North Africa
Indian Ocean	Diego Garcia	East Africa and South Asia
Japan (Okinawa)	Kadena	East Asia
U.S. (Puerto Rico)	Ramey	Central and South America/the Caribbean
Turkey	Incirik	Middle East
U.S. (Guam)	Andersen	Southeast Asia and Pacific Basin
the Azores	Lajes Field	West Africa

*U.N. Logistical Depot

Figure 5. Potential sites for ERPs configured to international complex emergencies

Location	AFB	Area of Responsibility
California	Travis	Western U.S./Alaska and Hawaii
New Jersey	McGuire	Northeast U.S.
Illinois	Scott	Central U.S. and Great Lakes Region
Arkansas	Little Rock	Southeast U.S.

Figure 6. Potential sites for ERPs configured to domestic complex emergencies, U.S. as model

Housed in hardened temperature-controlled hangars next to the runway ready to deploy each glider in an ERP would contain a minimum of 10 to 24 tons of one or more of the following: Meals Ready to Eat (MREs) or Humanitarian Daily Rations (HDRs), medical kits, tents, plastic bedding mats, blankets, bottled water, generators, and cold-weather clothing.[31] Empty gliders would also be set aside for to ferry aid workers. To handle and contain single or multiple crises (a maximum of one major and two minor) in a region, ERPs would contain on-site at least 36,000 tons of food, enough to feed a maximum of 500,000 people for 90 days; comparable stockpiles of other supplies would augment this total.[32] Days, if not weeks, could be shaved off the estimated time of arrival of aid in-theater via this method because pre-stocked gliders eliminate the proverbial middleman — the loadmaster — from the planning cycle. UNHCR logisticians no longer have to consider, "how many hours to pack the goods," rather, "how many tow aircraft can an airbase logistically support, receive, and launch at once?"

A complex emergency scenario involving an ERP would look something like this. At the onset of a crisis, support trucks would preposition the gliders next to the flight line according to a pre-determined layout either functional or organizational. UNHCR and NGO personnel would marshal at a holding area and marry up with their designated gliders. As tow aircraft land, each would taxi up to an assigned serial of gliders where technicians would fasten and inspect the tow cables and then transit to the flight line for departure, a procedure that should last no longer than one to two hours on the ground, unless the tugs need to refuel. Once airborne, the glider convoy would proceed to a release point conducive towards safeguarding powered airlift assets from

unnecessary risk and enhancing a rapid reaction response. Since glider release can occur a significant distance away from the target area, a reduced threat exists from hostile ADA or fighter interceptors across an unfriendly border, as air traffic controllers may never pick up the tow aircraft's radar signature. The advantage of a distant release also means fuel consumption is minimal and the tow aircraft can return to its staging area earlier to linkup with the next set of gliders already prepped for follow-on landings.

Under its own control, the ERPs would glide to and land in areas typical for DPs to gather: remote border sites or deep into an interior where road networks are beyond repair, inadequate, or non-existent; selection of the LZ coordinates would be determined by DP congregation patterns identified using remote sensing imagery. After unloading is complete, the UNHCR and NGOs could turn the fuselages over to DPs as temporary shelters until retrieved or depending on on-site circumstances (infectious diseases or the need for fuel) burn the glider; again, simple components and low-cost per unit make this possible. Follow-on glider landings — "emergency support packages" or ESPs — would deploy workshops, field kitchens, mobile army surgical hospitals (with the fuselages serving as a makeshift surgery or recovery ward), and sanitation and water purification teams to construct permanent DP camps. For DPs in need of specialized medical care, evacuations by glider are possible by aerial retrieval.

Once the situation on the ground has stabilized and aid starts flowing from rehabilitated port, rail, and airfield facilities, the gliders can be retrieved, restocked, and repositioned for the next crisis. One recovery aircraft can retrieve multiple gliders in a single sortie, due to the latter having an inherent light-weight fuselage stripped of intricate avionics, engines, extensive wiring, fuel, oil, and lubricants. By daisy-chaining the gliders together, like a computer network, with high-tension cable the recovery aircraft can swoop down and snatch the "glider train." As this airborne convoy approaches an airfield, the recovery aircraft would make separate passes to allow each glider pilot to initiate release and land. Since a glider requires fewer man-hours for assembly and routine upkeep, diagnostic tests and preventative maintenance would stress certifying the structural integrity of the fuselage as airworthy before its next deployment.[33]

Costs for ERPs could be minimized if undertaken as a joint project with the U.N. (procuring the gliders) and say, the U.S. Department of Department (donating or leasing the airbase) and NGOs or other international organizations purchasing the materials to pre-stock the gliders and providing the pilots to maintain and fly them. The establishment of ERPs could also lead to better coordination among aid groups (to prevent overlapping) in doling out tasks if detailed contingency plans developed before the outbreak of a crisis spell out what organizations are paired up with what serial of gliders; their order of departure; and, their assigned responsibility once on the ground: surveying and marking out camp perimeters, building temporary infrastructure, in-processing DPs, medical attention, food distribution, and sanitation.

Other Useful Roles

Though the focus of this paper has dealt with the use of the glider for Complex Emergencies it can handle a wide spectrum of contingencies defined as OOTW.

Peacekeeping/Non-Combatant Evacuation (NEO) — In support of North Atlantic Treaty Organization (NATO) and U.N.-sponsored operations, glider landings and retrievals can quietly

reinforce, resupply, rotate, or evacuate contingents besieged in an enclave without alerting the warring factions or subjecting overland convoys to sectarian fighting, bureaucratic entanglements, ambushes, hijackings, mines, checkpoints, or its passengers becoming human shields.[34] Gliders played a similar tactical and strategic role in the Second World War for reinforcing and evacuating besieged garrisons, American and German.[35]

Bearing this in mind, incidents of genocide in Srebrenica and Zepa may have been thwarted had the United Nations Protection Force (UNPROFOR) Commander had an ace up his sleeve, unbeknownst to the Bosnian Serb Army, for secretly reinforcing these and other U.N.-designated safe-areas.[36] Still, if UNPROFOR's position became untenable, "black" gliders could have landed at night and evacuated by aerial retrieval the most isolated or threatened contingents (and civilians in danger) as well as recover sensitive equipment. To do otherwise, NATO forces would have been hard-pressed to successfully conduct a NEO of the 24,000 peacekeepers scattered throughout Bosnia-Herzegovina through traditional points of entry and departure: ports, airfields, and frontier crossings, a scenario that was on the desks of contingency planners in 1995. As a former UNPROFOR intelligence section chief related to the author:

> The ugly little open secret was that such an operation could not have been conducted...without leaving behind major end items of equipment — something none of our major allies was willing to do...The population as well as the government always took careful note of UNPROFOR troop movements and would quickly have realized if something out of the ordinary had been planned...The Bosniacs, I am quite certain, were prepared to stage demonstrations in front of U.N. compounds or along routes...Obviously, UNPROFOR/NATO troops would have been forced to physically remove the civilian demonstrators...It would have been too difficult for the force to get in — let alone help UNPROFOR fight its way out. Imagine a [river] crossing operation being conducted under [winter] combat conditions...The British and French would have been forced to send their reinforcement units through the Bosnian Dinaric Alps [from the ports of] Split and Ploce to reach...Sarajevo.[37]

Arms Control and Monitoring and Verification — Instead of relying on aircraft and helicopters provided by the host nation under investigation for transportation quick response teams of weapons, border, election, and human rights monitors deployed by glider could arrive without delay or hassles. The use of double or triple tows by a single aircraft, (also furnished by the U.N.) can facilitate the landing of teams at multiple sites to conduct surprise or scheduled on-site inspections. The stealth of the glider also offers the possibility these teams could catch a nation without warning in the act of covering up evidence of weapons of mass destruction or ethnic cleansing; this inherent trait would have given the U.N. or the Organization for Security and Cooperation in Europe the capability to slip a clandestine survey team from the International War Crimes Tribunal into Kosovo to document atrocities and contact internal DPs right under the nose of the Serb internal security apparatus if necessary.[38]

Biological and Chemical Terrorism — Pre-stocked with vehicle and individual detection and decontamination kits, gliders could offer civilian and military special response teams the opportunity to land in urban or rural areas suspected of undergoing a chemical attack and inoculate and give first aid to casualties. Planners do not have to give thought to decontaminating

the fuselage upon completion of the task: again, low-cost per unit makes it disposable and can be burned on the spot — an economic benefit not afforded to transport planes or helicopters.

Hostage Rescues/Prisoner Snatches — A soundless, low-level glider approach in hostile airspace, especially in a nighttime operation, can inflict a state of paralysis and psychological shock, including paranoia, upon an adversary's economic, social, military, and political infrastructure. For example, in the motion picture, *Escape from New York*, the protagonist infiltrates his objective by landing a miniature glider — the "Gullfire" — atop the World Trade Center in an attempt to rescue the President. Fictional as this account is, more plausible scenarios are possible based on historical fact: the rescue of Italian fascist dictator Benito Mussolini[39] and the attempted capture of Yugoslav partisan leader Josef Broz Tito.[40] In modern day terms this means special operation forces (SOFs) could swoop down on the safe-houses of indicted war criminals, like Radovan Karazdic, Ratko Mladic, and Slobodan Milosevic whose bodyguard would be caught off balance by such an assault, and apprehend them. Civilian casualties and collateral damage would be limited and the media reaction favorable, unlike the NATO Stabilization Force's run-in with a low-level Serb suspect in July 1997 that ended in a botched arrest on a street corner with the individual shot dead.[41] Without overemphasizing the point too much, had the glider served as the platform of choice for similar scenarios involving SOFs (Iran, Panama, and Somalia) the final tally in casualties for each operation may have been different.[42]

Conclusion: Any Takers?

One final thought comes to mind. If gliders have a purpose in supporting Complex Emergencies and OOTW someone would have already thought of it? The answer to such a question comes down to a disclosure made by American army officer in 1943 assigned to the command responsible for conducting field trials on the glider. His remark is telling and still accurate: "...one of our basic troubles has been the failure to properly evaluate this new weapon from the topside down."[43] This disclosure explains why the glider is perhaps the only category of equipment in modern military history discarded after an exceptional combat record overseas. Though to reiterate, there are still worthwhile roles for the glider should the international community, whether collectively or individually, wish to rethink the utility of these silent wings for use in the next millennium. Remember, it is fashionable these days to go "retro" and acquire the accouterments of an earlier, in some ways, more imaginative era for contemporary use and some countries appear to be drawing that conclusion too.[44] Windows of opportunity like this always demand two participants: a master and an apprentice. The master is the visionary who opens his or her mind to an object's potential while the apprentice must come full circle before doing the same. When you consider the problem of the UNHCR and NGOs continuing to rely on expensive and ineffective means of delivering aid while operations and maintenance accounts dwindle and Complex Emergencies multiply the usefulness of exploiting the glider becomes clear.

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Notes

[1]"Normally," according to defense journalist Francis Tusa:

> prolonged truck convoys — whose speed is set for the slowest vehicle — move at about 20km per hour, with a stop of 10 minutes per hour and a rest period of 1 hour after every 4 of travel. On this basis [in Bosnia], movement from Saravejo [along poorly maintained winding roads] to [the port of] Ploce [a distance of some 126 miles] would take of about 17 hours; Tuzla to the coast [about 294 miles], 30 hours.

Tusa's calculation was without taking into other considerations that delay or complicate humanitarian aid deliveries: occupying and securing port, rail, and air facilities or traversing routes held or contested by regular or paramilitary units belonging to or allied with the warring factions. The occupation of and standoff at Pristina Airport, the only airport in Kosovo, by Russian troops illustrated this problem; until recently, the UNHCR has had to exclusively rely on road-bound aid convoys; in Bosnia, this method accounted for nearly 75 percent of all aid deliveries. Attempts by to secure land routes can quickly bog down a relief effort, even with the assistance of armed peacekeepers. In 1993, UNPROFOR undertook Operation *Lifeline* to secure a proposed convoy route from the UNHCR warehouse in Metkovic on the coast through to the Muslim-controlled interior. Refusing to grant a safe conduct pass, the paramilitary Croatian Defense Council (HVO) blew up two bridges along the route near the city of Mostar. Twenty-four after UNPROFOR engineers repaired the span of one of the bridges, the HVO again sank it. See Francis Tusa, Haunted by Past Retreats, *Armed Forces Journal International*, October 1995, p. 27. General Accounting Office, *Humanitarian Intervention: Effectiveness of U.N. Operations in Bosnia*, GAO/NSIAD-94-156BR, (Washington D.C.: GAO, April 1994), pp. 18, 26.

[2]The glider traces its origins to Greek fable of Daedalus and his son Icarus. According to legend, King Minos imprisoned father and son in a labyrinth on the isle of Crete. Having secretly fashioned wings made out feathers and wax Daedalus and Icarus escaped their imprisonment by gliding over the prison wall. Captivated by the experience of flight, Icarus ignored his father's advice to soar low over the water until they reached safety in Sicily. Instead, Icarus flew higher until the temperature of the Sun melted his wings, and plunged into the sea and drowned. Attempting to turn myth in reality, successive generations of proverbial Daedaluses determined to fly instead went to their deaths. Several centuries passed before Leonardo Da Vinci's detailed anatomical studies of humans and birds confirmed the futility of man's earlier attempts to fly *vis-a-vis* arm-powered wing-flapping mechanisms. Compensating for the inadequacies attributed to the human physique, Da Vinci conceived of a flying wing incorporating a system of cables and pulleys to harness the kinetic energy derived from briskly moving the arms and legs; modern-day hang gliders are nothing more than derivatives of these sketches. Gerald M. Devlin, *Silent Wings*, (New York: St. Martin's Press, 1985), pp. 1-2.

[3]German inventor Otto Lilienthal turned Da Vinci's theory into reality four centuries later as he flew a single-wing glider off a Berlin hillside in 1891. A mechanical engineer by trade, Lilienthal had earlier published *Bird Flight as the Basis of Aviation*, a culmination of 10 years of research which essentially upheld Da Vinci's findings. Over the next several years, Lilienthal carried out 2,000 glides in a visionquest, that ultimately cost him his life, to duplicate the dexterity of a bird; constant refinements in design gradually extended flight time, distance, and altitude. Further experimentation discovered that an individual could effect turning maneuvers using the prevailing winds as propulsion if one shifted their weight in the direction they wished to travel. Ibid., p. 4

[4]Ibid. p. 16.

[5]Specifications required the glider must land a combat-ready formation or cargo on short, uncultivated fields no longer than 75 yards, and unit cost must not exceed 7,500 Reich Marks; the equivalent of manufacturing 10 parachutes. Milton Dank, *The Glider Gang*, (New York: J.B. Lippincott Company, 1977), p. 22.

[6]This force numbering less than a hundred captured a force ten times it size within a period of three hours; estimates for taking the fortress by a ground assault predicted a six-month siege costing 6,000 casualties before capitulation.

[7]By 1946, the U.S. Army disbanded eight of 11 glider infantry regiments, a separate glider infantry battalion, and seven of 11 glider field artillery battalions. The U.S. War Assets Administration declared gliders' surplus and the public immediately purchased all excess stocks for $75 each, (original unit cost: $15-25,000) not

for the aircraft itself but for the lumber content in its five shipping crates — enough to build a small ranch-style house. In post-war Great Britain, the Glider Pilot Regiment, after returning from occupation duty in Palestine, saw its strength decrease to only a headquarters and training squadron plus two tactical squadrons. By 1950, a single squadron remained, and the Royal Air Force (RAF) discontinued new intakes of pilots; a year later it abandoned the program and reassigned crews to powered aviation units. Not until 1957 did the British Army officially disband the regiment. Devlin, op. cit., pp. 374-375. Shelby L. Stanton, *World War II Order of Battle*, (New York: Galahad Books, 1991), various pages.

[8]High-velocity drops means what it says. U.S. Army regulations for this method specify building for each bundle a CDS designed to survive a high-speed impact. One configuration for packing foodstuffs suggests using some lightweight foods to cushion other heavier foods. For example, six layers of MREs or HDRs are placed on the bottom followed by one layer of canned meat, and then one layer of biscuits placed on top. All eight layers are packed on a shipping pallet (with a base consisting of a three-quarter to one-inch board of plywood wrapped in five layers of energy-absorbing material (cardboard honeycomb)) and held together by plastic wrap. It is then placed in a cargo bag rigged with a stabilizing parachute. Trimming the edges of parachute canopies can reduce drag at high-altitudes and permit cargo pallets to float directly downward. Using this method in Bosnia permitted an average of 85 percent of the bundles to land within a mile of the target, yet civilians still faced the danger of ambush and injury as they made their way to the drop zone (DZ).

A free drop is a descriptive term, and a makeshift alternative, for showering single packets of foodstuffs upon population centers without the use of parachutes or energy-absorbing materials. It entails placing 40 individual boxes of MREs or HDRs in a large cardboard box pre-cut at stress points (to weaken its load bearing capacity) and held together by webbing. As the box exits the cargo bay in flight a static line attached to the lengths of the webbing elongates and the ties break as the box hits the stream of air driven aft by the propellers causing it to break apart and scatter the contents to the ground. There are drawbacks despite being inexpensive: free drops can deliver only 480 foodstuffs in each CDS compared to 768 for a high-velocity drop. Furthermore, this method could spark a riot in the streets as people fight for every individual packet that lands or if residents claim ownership for all packets that fall on their property, especially if that property covers several acres, as is the case in many rural farms. Also, a percentage may never reach the intended recipients if soil (sand and dirt) and dense terrain features (mountains and forests) camouflage a packet the size of an eight-and-a-half by eleven piece of paper made of dark brown (MREs) or tan/yellow (HDRs) plastic wrapping. See Captain Brian L. Williams, CW3 Ken K. Studer, and CW2 Nancy E. Studer "Operation *Provide Promise*: The Airdrop Phase," *Quartermaster Professional Bulletin*, Autumn 1993.

[9]Captain Stephen R. Davis, "Emerging Technology in Airdrop Operations," Quartermaster Professional Bulletin, Autumn 1997. Obtained electronically from http://www.lee.army.mil/quartermaster.

[10]Another alternative, the low-altitude parachute extraction system is no better as it subjects delicate equipment and supplies to damage or destruction from the suction produced when pulled out of a cargo aircraft moving hundreds of miles per hour. Furthermore, this hazardous maneuver puts a multi-million dollar aircraft in danger of crashing if not properly executed in a non-permissive environment.

[11]The recent emergency airdrop of anti-cancer drugs to a scientist temporarily stranded at the Amundsen-Scott South Pole Station would have been an ideal setting for using cargo gliders in a life-threatening situation.

[12]James E. Mrazek, *The Glider War*, (London: Robert Hale & Company, 1973), p. 231.

[13] *Debriefing Conference —Operation Neptune*, August 1944, p. 9. Obtained electronically from the U.S. Army Military History Institute Digital Library at http://carlisle-www.army.mil/cgi-bin/usamhi/DL/showdoc.pl?docnum=32.

[14]Military gliders had a 1:10 glide ratio compared to 1:22 for its civilian counterpart during the Second World War; in free flight, this meant that for every 10 feet the glider flew forward its altitude decreased by a foot. James E. Mrazek, *Fighting Gliders of World War II*, (London: Robert Hale & Company, 1977), p. 24.

[15]The Luftwaffe's first (and only) experiment of this tactic in combat occurred on the Russian Front in 1943 when a dive-glider assault on the besieged citadel of Velikye Luki safely delivered seven anti-tank guns inside its perimeter. *Airborne Operations - A German Appraisal*, Pub 104-13, (Washington D.C: Center for Military History, 1989), p. 53.

[16]Glider serial post-landing tables from the after-action report for the 82nd Airborne Division during Operation *Market-Garden* — the airborne invasion of Holland — noted the following landing statistics: *Gliders*: 155 used, 98 intact, 31 damaged, 11 destroyed, and 15 missing; *Personnel*: 1,153 okay, one killed, 12 wounded, and 75 missing; *Jeeps*: 27 serviceable, 15 unserviceable; *Trailers*: 17 serviceable, 7 unserviceable; *Artillery pieces*:

13 serviceable, four unserviceable. Mrazek, *The Glider War*, op. cit., pp. 293-294. Appendix: Table B, C, D, and E.

[17]Ibid., pp. 159-160.

[18]Of all the locations, Burma is perhaps the best example for illustrating the flexibility of the glider in a role commensurate with the requirements of Complex Emergencies. Under Operation *Thursday*, carried out in 1944, gliders assigned to the 1st Air Commando Group landed engineers and almost 67,000 pounds of construction equipment 165 miles behind Japanese lines at night. Within 24 hours, the engineers began erecting a forward airfield in the jungle with a 5,000-foot runway and medevaced the wounded to India by aerial retrieval. One least known, but noteworthy accomplishment from this forgotten theater, that echoes with overtones for contemporary application involved the ferrying of 2,216 pack mules and horses by glider; records indicate most were docile passengers, very few had to be shot by handlers in flight — a safety precaution in case any tried to kick the fuselage apart. In similar fashion, farm animals can be landed to repopulate flocks decimated by those characteristics associated with a Complex Emergency: weather, famine, plague, and war.

There is one ignominious stain upon its service record for an event in July 1944 reminiscent of ethnic cleansing. Located at the foothills of the French Alps, the village of Vassieux served as an important hub for clandestine airdrops to the Resistance on the plateau of Vercors in southern France. A preemptive glider raid by Waffen-SS troops used scorched earth tactics to raze the village and wipe out its civilian inhabitants. Successive landings nearby did the same to other communities in an effort to neutralize Resistance groups, and their civilian base of support, poised to ambush the German 19th Army in the event of an Allied airborne and amphibious landing along the French Riviera. Mrazek, *The Glider War*, op. cit., pp. 110-28. Devlin, op.cit., pp. 141, 386. James Lucas, *The Last Year of the German Army*, (London: Arms and Armor Press, 1994), pp. 150-154. Mrazek, *The Glider War*, op.cit., p. 268. Terrain and climate data from the *Central Intelligence Agency World Factbook 1991-1992*, (Washington D.C.: Brassey's, 1993), various pages.

[19]*Airborne Operations - A German Appraisal*, op.cit., p. 12.

[20]Mrazek, *Fighting Gliders of World War II*, op.cit., various pages.

[21]This test-bed design intended for landing in a Tehran soccer stadium made use of a modified C-130 Hercules transport aircraft incorporating anti-submarine and air-to-air missile rocket motors positioned around the cockpit and under the wings to halt the aircraft. Nick Cook, "How 'Credible Sport' made SuperStol a reality," *Jane's Defense Weekly*, 9 March 1997, p. 18. *Airborne Operations - A German Appraisal*, op. cit., p 53.

[22]Devlin, op. cit., pp. 125-126.

[23]Ibid., p. 116.

[24]"Precision landing by GPS set for take-off," *Jane's Defense Weekly*, 12 June 1996, p. 41.

[25]Kenneth Gatland, *Space Technology*, (New York: Harmony Books, 1981), p. 278.

[26]Cook, op. cit., p. 21.

[27]Soviet experiments in the early 1930s perfected the concept of the "glider train," for which it set a record by towing four gliders in a sausage-link configuration. Mrazek, *The Glider War*, op.cit., pp. 231-234.

[28]Gatland, op.cit., p. 278.

[29]The were plans for a larger version of the ME-321 with a 60- to 70-ton cargo capacity but these never got off the drawing board. Aircraft data from Tom Clancy, *Airborne — A Guided Tour of an Airborne Task Force*, (New York: Berkley Books, 1997), p. 161. Mrazek, *The Glider War*, op.cit., p. 36.

[30]Another enhancement that can financially pay off for the UNHCR as well as NGOs is to do what the British Glider Pilot Regiment did when it lacked adequate support personnel to assemble gliders: cross-train the pilots as mechanics. Ibid., p. 85.

[31]For the hangars to accommodate the quantities of gliders envisioned in this scheme, space-saving technology such as folding components would have to be incorporated into the fuselage.

[32]Between one-sixth to one-third of the total stockpile — 6-12,000 tons — the equivalent of 250 to 500 fully loaded ME-321s — would be pre-stocked and ready for instantaneous deployment. The food calculation is based on U.S. military figures for MREs/HDRs prepositioned in the Balkans prior to the Albanian diaspora from Kosovo. Figures obtained electronically at http://www.fas.org/man/dod-101/ops/sustain_hope.htm

[33]Operation *Turkey Buzzard* conducted during the Second World War already validated the feasibility of an intercontinental or intra-theater glider airbridge depicted in the scenario above. Conceived by the RAF Air Transport Command in 1943 the plan entailed towing a manned glider loaded with vaccines destined for Russia, and, aircraft, radio, and engine parts from Canada to England, a distance of some 3,500-miles. The success of this five-leg, 28-hour experimental flight turned the theory of a transatlantic glider "train" service into reality as a tactical and strategic alternative to moving men and material by naval convoys. With the success of *Turkey*

Buzzard the RAF went on to tow 30 Horsa gliders from England to Tunisia a record-setting distance of 2,400 miles with just one stopover. Dick Illingworth, "The Angle of the Dangle," *Airforce*, January 1996, pp. 14-15. Mrazek, *The Glider War*, op.cit., pp. 267-268.

[34]A 1994 *Newsweek* article recounted an interesting anecdote of an overland journey by the Danes to reinforce a U.N. enclave in Bosnia in October 1993:

> 11 Leopard battle tanks...set off from Denmark...to the besieged town of Tuzla where a Nordic U.N. battalion was trying to secure the airport; Serbian leaders had given their OK. But once the 45-ton tanks crossed over into the former Yugoslavia, the Serbs reneged and demanded *$1 million* for road repairs and customs fees. "And we were stupid enough to pay," says a Norwegian logistical officer involved in the tank deployment. Instead of heading to Bosnia, the tanks were forced to a U.N. supply depot outside Belgrade. There they stayed for 97 days, hostage to the Serbian bureaucracy. Finally, the blue helmets gave up and proceeded on what is being called "The Long March" — a retreat by train out of Serbia through Hungary, Austria, and Italy. From there a cargo ship hired by the British took the tanks down the Croatian coast to Split.
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> See Tom Post, et.al., "Blues for the Blue Helmets," *Newsweek*, 7 February 1994, p. 22.

[35]Operation *Repulse* organized in the midst of the 1944 German winter Ardennes offensive due to a lack of parachute containers and para-packing units in the European Theater of Operations, ferried by glider a replacement field hospital accompanied by four surgeons to the American 101st Airborne Division encircled at Bastogne. The initial serial of 11 gliders landed inconspicuously and unscathed within this tight defensive pocket; subsequent waves had to evade flak from anti-aircraft artillery. Although least known of the contributions towards ending the siege, *Repulse* resupplied the 101st with 106,291 pounds of cargo at a decisive point in time when surrender was the only other alternative. The Germans mounted similar relief efforts on the Russian Front. At the siege of Kholm in January 1942, cargo gliders landed on the frontlines to deliver ammunition and equipment to its 3,500 defenders; as the pocket shrank, village streets literally turned into LZs. Moreover, as German control of the Russian and Balkan Fronts receded during late 1943 through 1944, gliders helped evacuated men and material from the Crimea, Sardinia, Corsica, Rhodes, Crete, and Greece. Mrazek, *The Glider War*, op.cit., pp. 224-229, 261.

[36]An earlier U.N. supervised withdrawal from Srebrenica in April 1993 turned tragic when deficient planning failed to provide adequate logistics for the withdrawal of several hundred DPs. Consequently, the evacuation degenerated into a melee as DPs rushed for the minimal allotments of space available in the convoy, crushing to death some of their fellow citizens. Major Brian R. Layer, *Some Principles of Convoy Operations in Operations Other Than War*, First Term AY-93-94, (Fort Leavenworth, Kansas: School of Advanced Military Studies-United States Army Command and General Staff College, 17 December 1993), p. 11.

[37]Lieutenant-Colonel John Sray, USA to Steven A. Torrisi, 7 February 1996. Correspondence in the possession of the author.

[38]Operation *Bunghole* proved in 1944 such clandestine operations feasible when gliders were the first Allied aircraft to land on Yugoslav soil since the 1941 invasion and accomplished what propeller-driven aircraft failed to do: deposit the Soviet Military Mission seconded to Tito in German-occupied territory. The rendezvous point for this was a snow-blanketed valley located 100 miles inland at the foothills of the Dinaric Alps between Sarajevo and Zagreb. Hazardous meteorological conditions plagued the insertion force of three gliders as it approached the Dalmatian coast at an altitude of 8,000 feet. Geographic landmarks and partisan signal fires though, recognized upon tow release some five miles from the objective, permitted the pilots to plot their landing trajectory and pin-point the location of the target area, located 4,000 feet above sea level. The presence of three feet of soft snow at that altitude enabled the gliders to rapidly decelerate on an LZ reported to be only 20 feet in length. Operation *Freshman*, attempted in Norway in 1942 involved landing commandos to attack the Norsk Hydro Plant in southern Norway to terminate its production of heavy-water, a necessary component in atomic weapons research. Heavy snowstorms, an inoperable navigation beacon, mistaken LZs, and ice on the wings was responsible for wrecking the sabotage force of two gliders. On orders from Hitler the SS summarily executed the survivors. Though ending in tragedy, it lends credence to the fact there is also a role for the glider, a peaceful one, with inspectors from the International Atomic Energy Commission. Mrazek, *The Glider War*, op.cit., p. 271.

[39]Mussolini's 1943 rescue, Operation *Oak*, from the Campo Imperatore Hotel atop the summit of the Gran Sasso located in the Abbruzzi Mountains of central Italy is a textbook example of the versatility of a glider. Otto

Skorzeny, Hitler's unconventional warfare expert, undertook the assignment of freeing the fascist dictator from house arrest. Ruling a frontal assault out of the question since a cable car controlled access from the valley below to the crest and the altitude precluded a parachute drop Skorzeny opted for a glider assault. Despite four out of 12 glider tow lines prematurely releasing en route and Skorzeny altering the choice of the LZ on approach when the flat alpine meadow turned out to be a ski run, his commandos landed 15 to 20 yards from the resort's entrance. The entire rescue took less than four minutes and resistance was non-existent from the 250 surprised Italian Carabineri (police) billeted in the hotel. James Lucas, *Kommando-German Special Forces of World War II*, (New York: St. Martin's Press, 1985), pp. 99-100.

[40]In terms of the caliber of troops involved and the meticulous detail in its planning, Operation *Knights Move*, the 1944 Nazi plan for snatching Tito from his mountain stronghold in western Bosnia-Herzegovina was as one appraisal phrased it, a surgical strike of "superior grade." Intending to quietly swoop down on the mouth of Tito's cave headquarters in the Drvar Valley two companies of Waffen-SS glider infantry instead found themselves in the middle of ambush sprung upon landing. Historical accounts attest the Luftwaffe is to blame for this compromise in operational security. Earlier, the Luftwaffe advertised the impending assault by dropping two companies of parachutists to seize and cordon off a nearby village to thwart partisan interference with the gliders scheduled to arrive in the second wave. This tactical error in judgment permitted the mobile partisans to preempt the glider landings with delaying tactics as Tito escaped unmolested. Ibid., pp. 103-26.

[41]SFOR Joint Press Conference Transcript — Sarajevo, 11 July 1997, (Belgium: North Atlantic Treaty Organization). Obtained electronically from http://www.nato.int.

[42]Operation *Eagle Claw*, (1980-Iran) — The disaster at Desert One that killed eight U.S. servicemen did not have to happen had SOFs staged a series of glider landings at a remote location on the Turkish-Iranian border and then set out to infiltrate Tehran undetected to secure the release of the American hostages. Furthermore, instead of parachuting in a Ranger company to seize and hold the Manzarieh Airfield (35 miles south of Tehran) for the fly-out as the plan envisioned, SOFs could then have moved the freed hostages to a second staging area to join up with another cache of gliders co-located earlier by a different team and exfiltrate the area by aerial retrieval. Operation *Just Cause*, (1989-Panama) — Apprehending indicted drug smuggler and dictator Manuel Noreiga quickly with gliders from the roof of his stronghold — the Commadencia — may have eliminated the need for a full-scale invasion and occupation of the Panama isthmus and a subsequent man-hunt ending in an 11-day standoff at the Papal Nunciature. Operation *Restore Hope*, (1992-Somalia) — Army Rangers could have quietly and quickly snatched General Mohammed Farrah Aideed from his Mogadishu fiefdom by a deliberate crash-landing in his compound and not fallen prey to an ambush that left 18 dead, 84 wounded, and downed two helicopters.

[43]Remarks attributed to a Colonel Joshua Dalbey, Chief of Staff, USA Airborne Command, Devlin, op.cit., p. xiii.

[44]In the United States, studies are currently underway regarding the potential of giant transatlantic airships, similar to those of the 1930s, to serve as heavy transports for tanks, armored vehicles, and artillery. Nick cook, "Giant airships: shifting the load of the future," *Jane's Defense Weekly*, 28 October 1995, p. 4.

Main Contents Page

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