

C-130J



**HOW THE BEST
MILITARY AIRCRAFT
BECAME EVEN BETTER**

FINDINGS IN BRIEF

The C-130 Hercules is the most widely used tactical airlifter in the world. Prized for its ability to land almost anywhere, the C-130 transports troops, equipment and supplies hundreds of times each day for the Army, Air Force and Marine Corps. It also is operated by over 60 other countries, including most U.S. allies. In the five decades since it debuted, the Hercules has been adapted to a wide range of military and civil missions. Its military roles include tactical airlift, medical evacuation of wounded troops, aerial refueling of other aircraft, special operations against terrorists and insurgents, airborne fire support of ground forces, jamming of enemy communications, combat rescue and humanitarian assistance. Civil missions include weather reconnaissance, disaster relief, law enforcement, firefighting, support of scientific research and rescue of stranded mariners.

The latest variant of the C-130 is the C-130J Super Hercules. Although superficially similar to earlier versions of the plane, the “J” variant can fly farther, faster and higher with larger loads. It requires less distance to take off and land, less manpower to operate and maintain, and less fuel to accomplish missions. These improvements were achieved through the introduction of new technologies such as digital flight controls that bolster reliability and safety while reducing costs. The C-130J is used extensively in Iraq and Afghanistan, surpassing the performance of earlier variants by 200-300% in key operational measures. Although the C-130J delivers the same ruggedness and versatility seen in previous versions of the Hercules, it is essentially a new aircraft in terms of its performance and on-board features.

The C-130J is currently being produced for the U.S. Air Force, the Marine Corps and several allies. The plane will need to remain in production for many years to come, because hundreds of legacy C-130s in the U.S. fleet and overseas are approaching the end of their design lives. Some are already grounded or operating on flight restriction due to safety concerns. Failure to replace aging airframes in the domestic fleet would severely degrade the global mobility of the joint force, especially the Army. Failure to replace overseas C-130s with the latest version would diminish the capacity of the United States and its allies to cooperate in coalition warfare and humanitarian assistance. The most cost-effective way to modernize tactical airlift fleets at home and abroad is to authorize multiyear procurement of new C-130s at economical annual rates, about 16 per year for U.S. users supplemented by foreign orders.

This report was written by Dr. Loren Thompson of the Lexington Institute staff as part of the institute’s continuing inquiry into the requirements for preserving U.S. global air dominance in the years ahead.

THE BEST MILITARY AIRCRAFT EVER

The most successful aircraft in the history of military aviation isn't a supersonic fighter or a stealthy bomber. It is a propeller-driven cargo plane called the C-130 Hercules that has evolved into more variants than any other fixed-wing plane ever built. The Hercules is so successful that in 2006 it became only the second aircraft of American origin to reach the half-century milestone of continuous operation by its home service, the Air Force. The only other plane that has achieved such longevity is the B-52 bomber. But whereas the B-52 ceased production forty years ago, the Hercules looks likely to continue rolling off production lines for decades to come.

This report is about how the designers of the C-130 managed to achieve that feat, and how the newest version of the Hercules, dubbed Super Hercules, promises to extend the useful life of a famous airframe into the distant future. It is the story of a versatile, rugged, affordable plane that will ultimately surpass the record of all other aircraft in its capacity to adapt to changing circumstances. Those qualities have made the C-130 the most widely used military aircraft in the world, operated by over sixty countries, including almost every major American ally. But this is also the story of how the C-130's remarkable durability has worked against it in the corridors of power, by allowing a distracted political system to delay fleet modernization until hundreds of planes were well beyond their intended service life.

The report consists of four sections designed to illuminate both the lessons of the C-130's success and the need to improve an aging air fleet with the newest, most capable version of the Hercules:

- The first section explains how the C-130 evolved from a simple cargo plane into a multi-role airframe that could accomplish aerial refueling, search and rescue, electronic jamming of enemy communications, airborne fire support, humanitarian assistance, hurricane assessment and even delivery of the largest conventional bomb in the U.S. arsenal.
- The second section describes how the newest "J" version of the Hercules has been substantially improved to fly farther, faster and higher with bigger payloads while also enhancing the survivability and reliability of an airframe already renowned for its resilience.
- The third section underscores the urgent need to replace hundreds of aging C-130s in the joint fleet before they must be retired, and illuminates why Super Hercules is the only suitable substitute for earlier C-130s in most mission areas.
- The fourth section explores the many overseas applications of the C-130 as the tactical airlifter of choice for America's allies, and reveals how the widespread use of the same airframe in many countries contributes to military interoperability and global cooperation.

The report concludes with a summary of the lessons to be learned from the C-130 experience, and a series of findings about the appropriate path forward in exploiting the unique versatility of the newest C-130. Perhaps the most important lesson it uncovers is that skillful



The C-130 can be equipped with extensive self-protection features such as the flares being dispensed in this picture that distract heat-seeking missiles from the aircraft.

implementation of key design principles such as simplicity, durability and adaptability can make military aircraft continuously relevant to each new generation of warfighters, because there are some performance features that never lose their value, regardless of how technology, tactics and threats evolve.

AN ALL-PURPOSE AIRCRAFT

The military requirement for the first C-130s emerged during the Korean War, when it became apparent that transports left over from World War Two were not capable of satisfying emerging operational needs. The Army and Air Force sought a faster, more flexible cargo plane that could also be used for carrying troops and conducting aeromedical evacuations. They chose a Lockheed design powered by four turboprop engines that gave the aircraft jet-like capabilities when compared with the piston-powered planes already in service. The ruggedly constructed airframe would be able to carry a 20-ton load over a thousand miles, and then land on short, unimproved runways close to the fighting. The Air Force named the new aircraft Hercules, after the god in Greek mythology who was given a dozen seemingly impossible tasks to recover his honor.

That designation proved to be more prescient than anyone could have imagined, because within a few years after the first C-130As debuted in 1956, military planners began coming up with new uses for the airframe not envisioned in the original requirement. In 1958 the Marine Corps began buying a tanker version to refuel its fixed-wing aircraft and helicopters in flight. The following year the Coast Guard adapted the plane to meet its search and rescue needs. In the 1960s the C-130 was modified to serve as a special-operations aircraft and gunship in Vietnam. Dedicated variants were developed for many other military missions,

including search and rescue, electronic warfare, airborne reconnaissance and maritime patrol. Meanwhile, civil users and overseas customers discovered that the C-130 airframe was adaptable to their own needs. Eventually, over 2,000 C-130s were built in 40 different versions, and the plane remained in production continuously for six decades.

The longevity and popularity of Hercules was not due just to a good original design. Only about 200 of the initial C-130A configuration were built for the U.S. Air Force, and they were about as similar to today's C-130J as a 1956 Ford is to today's high-performance sedans. The basic C-130 airframe was continuously improved as new technologies and missions emerged, most notably with the purchase of about 400 "E" variants for the Air Force in the 1960s and 300 "H" variants in the 1970s and 1980s. However, this pattern of continuous improvement was slowed by the depressed demand for new military systems that followed the collapse of communism, so the domestic fleet aged markedly before the latest "J" version appeared in the 1990s. The performance enhancements of the C-130J are described in the next section, but before turning to Super Hercules, it is worthwhile to consider the range of missions the C-130 currently performs. No other aircraft in the history of military aviation has delivered so much functionality to so many different users.

TACTICAL AIRLIFT

The C-130 is the most widely used tactical airlifter in the world, performing hundreds of sorties daily for the United States and allied countries such as Australia, Britain, Israel and Saudi Arabia. Since its inception, the C-130 has been prized for its capacity to carry 20 tons of equipment, supplies and soldiers into the most austere landing areas, often little more than dirt strips. Alternatively, it can perform precision parachute drops of the same cargo and personnel, enabling the rapid replenishment of forward-deployed forces in areas where no landing strips are available and local terrain is too difficult for ground convoys. These same capabilities make the Hercules well suited to humanitarian relief efforts in remote areas. In the U.S. force structure, the C-130 fills the vital medium lift role between the inter-continental missions of strategic airlifters such the C-17 and the short-hop missions of helicopters such as the CH-53. For example, many U.S. troop movements within Iraq are accomplished using C-130s, with monthly passenger totals on the plane sometimes exceeding 100,000 personnel.

AERIAL REFUELING

For 50 years the U.S. Marine Corps has relied on a Hercules variant designated the KC-130 to provide aerial refueling of combat aircraft such as the F/A-18 fighter, the AV-8B jumpjet, and the CH-53E helicopter. It will continue to perform that role as the F-35B joint strike fighter and MV-22 tiltrotor enter the force, conducting rapid airborne transfer of fuel through dual drogue lines located on each outer wing. The plane is also used in a range of other Marine Corps logistics missions such as rapid replenishment of food, fuel and ammunition for forward-deployed ground forces, medical evacuations and combat troop insertion. KC-130 is the only long-range, fixed-wing assault support aircraft in the entire Marine Corps inventory, underscoring the value that the service derives from a rugged and versatile airframe.

SPECIAL OPERATIONS

The U.S. special operations community relies heavily on a fleet of modified Hercules aircraft collectively designated MC-130s to provide round-the-clock insertion and extraction of unconventional warfare units in hostile territory. Insertion is accomplished both through surrepti-

tious landings and low-altitude airdrops, often in the dead of night or during adverse weather. There are several specialized variations of the MC-130, most notably the Combat Talon I and Combat Talon II that have been equipped with in-flight refueling systems, electronic countermeasures, terrain-following and terrain-avoidance radars, and other equipment that facilitates execution of uncommonly dangerous missions. Another version of the MC-130 dubbed the Combat Shadow provides low-altitude night-time refueling of special operations helicopters in hostile airspace. The U.S. Special Operations Command has recently disclosed a requirement to replace its aging MC-130 airframes with over 70 specially modified versions of the C-130J.

AIRBORNE FIREPOWER

One specialized variant of the Hercules employed by both conventional and unconventional warfighters is the AC-130 Spectre gunship that first saw service during the Vietnam War. The latest versions of the AC-130 are equipped with side-firing 105 mm, 40 mm and 25 mm guns that can provide precise, persistent fire support to friendly ground forces. The Spectre fire control system is so accurate that the gunship has been used to attack urban targets in Panama, Somalia, Afghanistan and Iraq. Although surgical precision is necessary when employing the Spectre in close proximity to noncombatants, the aircraft can also be used to saturate large areas with gunfire when sizable enemy formations are detected. In addition to providing close air support of ground forces, the AC-130 can also be employed for interdiction of hostile aircraft and the conduct of armed reconnaissance.

ELECTRONIC WARFARE

The Hercules airframe has also been adapted to perform a range of electronic missions such as airborne command and control, jamming of hostile communications networks and broadcasting in support of psychological operations. All of the half-dozen Hercules variants designed for such purposes are designated EC-130s. For example, the EC-130H Compass Call conducts electronic jamming aimed at disrupting communications in enemy air defense and command networks, while the EC-130E Commando Solo broadcasts programming on civilian radio and television frequencies intended to demoralize opposing forces. Such “non-lethal” operations have become increasingly important to U.S. military planners as the nation has mounted limited warfare campaigns in pursuit of specific political objectives. In these campaigns it is often desirable to achieve military goals with a minimum loss of life, and denial or manipulation of the electromagnetic spectrum is one way of doing that.

COMBAT RESCUE

Yet another variant of Hercules designated the HC-130 plays a central role in the combat search and rescue operations of the Air Force’s Air Rescue Service, which supports the entire joint force. The HC-130 provides aerial refueling of helicopters that penetrate deep into hostile territory to retrieve downed pilots and other endangered warfighters. If helicopters are unlikely to arrive on the scene quickly, the HC-130 can airdrop para-rescue teams and survival equipment to the endangered personnel while awaiting rotorcraft. HC-130s often serve as the command aircraft for long-range combat rescue operations, and can conduct searches for lost personnel when air space is reasonably secure.

MARITIME PATROL

One of the earliest variants of the Hercules to evolve from the original design was the U.S. Coast Guard’s version of the HC-130. This maritime patrol variant of the airframe is the

workhorse of Coast Guard aviation, playing a major role in all five of the service's basic mission areas — maritime safety, maritime mobility, maritime security, national defense and natural resources protection. The HC-130 is used to conduct search and rescue of distressed mariners, interdiction of drug smugglers, interception of illegal migrants, environmental enforcement, and international ice patrol missions, as well as being used to move people and supplies.

Beyond these critical missions, the C-130 performs a diverse array of other functions for civil and military users alike. WC-130 weather reconnaissance aircraft fly into hurricanes to collect information about the size and intensity of storms. Other Hercules variants support space and missile operations, serve as airborne hospitals, and resupply icebound bases in polar regions. Virtually every variant of the plane has played some role in humanitarian assistance or disaster relief. The C-130 airframe has an almost boundless capacity to adapt to new demands, and that versatility is being enhanced with the introduction of the latest, most capable version of the plane — the C-130J Super Hercules.

THE LATEST HERCULES

By the time the cold war ended, the Air Force's C-130 fleet was beginning to show signs of age. The service had bought nearly 400 Vietnam-era "E" variants of the Hercules for use by the active-duty force, the Air Force Reserve and the Air National Guard. Many of these planes were approaching the end of their design lives, and could only be kept in a high state of readiness with increased inspections and maintenance. Based on a projected requirement for at least 168 new C-130s, Lockheed Martin expended its own funds to develop an improved version of the plane that became known as the C-130J Super Hercules.



The KC-130 aerial refueling tanker enables aircraft such as these two Navy fighters to refuel in flight, extending their range and flexibility in combat operations.

Although superficially similar to earlier versions of the C-130, Super Hercules is a fundamentally different plane. It can fly higher, longer and faster with more payload. It can take off and land on shorter runways. It requires less manpower to operate and maintain. It is more reliable and survivable. And it makes more efficient use of ground infrastructure. Over 150 “J” variants have been delivered to domestic and foreign customers in two configurations: a baseline variant that roughly matches the outline of earlier versions, and a stretched variant that extends the cargo compartment by 15 feet. The stretched version is expected to replace most of the aging C-130E’s in the Air Force inventory, and a brief review of its features explains why the service plans to continue production of the newest Hercules for the foreseeable future.

GREATER CAPACITY

Compared with legacy “E” and “H” variants in the Air Force inventory, Super Hercules offers major gains in virtually every measure of operational performance. Legacy planes can carry a standard 18-ton load about 1,200 miles before they need to be refueled, whereas the C-130J can carry the same load 2,000 miles. Alternatively, the stretch version of the C-130J can carry 31% more paratroopers, 33% more pallets of equipment or supplies, 39% more combat troops, and 44% more aeromedical evacuation litters. It can accommodate heavier loads with larger dimensions (such as helicopters and combat vehicles) while still taking off in shorter distances than the older planes, and then climb faster to cruising altitude once it is airborne. In addition to being able to carry larger loads further, Super Hercules can also carry them faster, because its cruising speed of 400 miles per hour is about 20% greater than that of the C-130E. The enhanced capacity of the “J” variant is especially noteworthy in the extreme heat of desert operations, where the new plane can deliver 40% better payload/range performance than earlier versions.

OPERATIONAL FLEXIBILITY

The interior of the C-130J has been completely redesigned to take advantage of new technology and assimilate lessons learned from recent military operations. Every feature of on-board operations has been simplified and, where feasible, automated. The redesign was so successful that the crew size has been cut in half, from four personnel to two (a pilot and co-pilot). Perhaps the most important facet of interior redesign, though, has been the way in which cargo space has been organized for rapid reconfigurability. By using innovations such as flip-over rollers, it is now possible to reconfigure the cargo area for different loads in about five minutes rather than the traditional twenty-five. This has big advantages in supporting forward deployed troops, because the planes can get in and out of small airstrips more quickly, affording maximum efficiency in the utilization of scarce ground infrastructure. Other improvements bolstering operational flexibility include an aerial refueling system that can offload fuel faster and an automated airdrop system that delivers parachute loads more precisely.

ENHANCED SURVIVABILITY

The same performance features that make Super Hercules more flexible and productive also make it more survivable. Greater speed, higher cruising altitude, longer range, less time on the ground and faster climb-out all reduce the plane’s vulnerability to attack. Those performance gains have been achieved while still reducing the aircraft’s noise and heat emissions. In addition, the C-130J has been equipped with an integrated defensive system that allows it to cope with threats across the electromagnetic spectrum. The system includes an advanced radar warning receiver to alert the crew when it is being tracked, similar devices to detect

approaching missiles and laser target-illuminators, and countermeasures such as flares, chaff and decoys that confuse homing warheads. When these defensive capabilities are combined with the situational awareness afforded by improved night vision and terrain avoidance systems, the options that the pilot and co-pilot have for protecting themselves from hostile action are greatly expanded.

ADVANCED TECHNOLOGY

More generally, the C-130J design includes every modern navigation aid, communications link and automation device that was feasible without compromising the affordability of the airframe. For example, the plane is equipped with redundant HF, VHF and UHF radios to assure connectivity, and also provides voice uplinks to satellites with provisions for later installation of satellite data links. It carries a sophisticated color radar for mapping weather patterns and local terrain. Flight systems have been digitized and automated to greatly reduce the workload associated with flying and landing the plane. All critical flight information is presented to the pilots on a holographic “head-up” display which is the primary flight display for the aircraft. While these upgrades are not apparent to a casual observer, they make the latest Hercules much more pilot-friendly than any other tactical airlifter in the world, enhancing safety and efficiency.



Navy students board a WC-130J Hurricane Hunter assigned to the 53rd Weather Reconnaissance Squadron at Keesler Air Force Base, Mississippi as disaster assistance teams prepare to load casualty litters during a recent exercise.

REDUCED COSTS

Although the military acquisition system often is said to be locked in a spiral of upwardly escalating costs with each new generation of combat systems, that is definitely not the case

with the C-130J. As a result of reduced crewing, better fuel efficiency, higher mission-capable rates and greater reliability, Super Hercules is generating 27% lower operating costs than legacy C-130s. Since post-production operating costs typically represent more than two-thirds of total life cycle outlays for military systems, it looks likely that the C-130J will incur significantly lower costs across its lifetime than earlier versions of the plane while offering markedly better performance. For instance, the mean time between component failures — a key measure of reliability — is 6.5 hours on C-130J and 1.7 hours on legacy planes. The mission-capable rate of new KC-130J tankers operated by the Marine Corps is about 85%, compared with 58% for legacy tankers. These differences in readiness and reliability translate into big savings across the fleet.

The cumulative result of all the aforementioned improvements is that the C-130J Super Hercules is by far the most cost-effective tactical airlifter ever operated by the U.S. military. The C-130Js employed by the Air Force and Marine Corps in Iraq and Afghanistan since 2004 have proven to be 200-300% more capable than legacy C-130s applying standard measures of merit, and in some key applications such as the use of short and/or soft runways, the gain in performance approaches 400%. In fact, the gain is so pronounced that there would be a case for replacing legacy airframes even if they were not exhibiting signs of age-related distress. However, the decay of the cold war fleet is now far advanced, and there is no real alternative to buying many more C-130Js soon.

AN AGING FLEET

There is only one drawback to the durability of the original C-130 design: it has allowed policymakers to delay modernization of the tactical airlift fleet to a point where the fleet has grown quite old. Metal fatigue, corrosion and other signs of advanced age are now commonplace across the joint inventory, forcing the services to ground or restrict the flight of some airframes. Even when aircraft remain fully airworthy, they require increasing inspections and maintenance to stay that way. Because it is Air Force policy to limit aging C-130s to training missions once they reach 38,000 flight hours and retire them at 45,000 hours, hundreds of Hercules will be exiting the fleet over the next decade. That includes a majority of the C-130s in the special operations and combat rescue fleets, most of which were produced prior to 1970.

The problem of aging C-130s has been building for many years, but is now becoming critical due to high operating tempos associated with the global war on terror and the uneven pace at which legacy planes were produced. Aside from newly delivered “J” variants, the domestic fleet consists mainly of Vietnam-era “E” variants and later “H” variants produced between the mid-1970s and mid-1990s. When the cold war ended, this fleet was in good condition because the “H” variant was in its peak years of performance while the “E” variant still had airframe life remaining. But today, 300 of the planes have passed their fortieth birthdays, and the C-130Es seldom fly above 19,000 feet — too low for optimal performance of some missions. The oldest “H” variants begin reaching critical flight-hour and safety limits in 2008, and by 2015 their age will begin detracting from operational utility in the same manner that the advanced age of “E” variants already has.

Unless timely replacement of these cold war aircraft occurs, the joint force will face a shortfall in tactical airlift capabilities before the end of the next decade. Beyond the age-related problems that planners are already projecting, a possibility of unforeseen structural fatigue

exists that could ground entire segments of the fleet. Such unanticipated problems are common in planes that have been exposed to the rigors of flight for many years, as are the rising maintenance bills that result from weakening structures and creeping parts obsolescence. The only way to preclude such problems and assure a high state of readiness in the tactical airlift fleet is to acquire replacement aircraft at a steady rate.

When thinking about air fleet modernization, it is important not to confuse the missions performed by C-130s with other airlift needs. For instance, the Army and Air Force are currently developing a small, twin-engine cargo plane called the Joint Cargo Aircraft (JCA) for use in a limited range of specialized missions. The C-130 could perform most of the missions for which the JCA is being bought, but the JCA could not perform the missions the C-130 typically executes. Not one of the fifty-odd vehicle types that the C-130 carries in support of an Army Stryker brigade or airborne brigade would fit into the much smaller JCA. Experts can debate whether such a small and specialized aircraft is really needed, but there is no question that most C-130 missions far exceed the operational capabilities of the envisioned Joint Cargo Aircraft.

At the opposite end of the capability spectrum is the much larger C-17 Globemaster III, which was designed for accomplishing intercontinental airlift. The C-17 is in all respects an impressive plane, and has been used to perform some intra-theater cargo and passenger missions in Iraq and Afghanistan. But the C-17 costs three times more than the C-130, is designed to carry three times as much cargo, and is much more expensive to operate. It cannot land at hundreds of sites where the C-130 routinely operates, and even if it could there would be little sense in using such a big airlifter for local support missions. So while the use of C-17 in some intra-theater missions is a useful innovation, it is not a suitable substitute for the C-130s in the vast majority of situations.

Some observers have proposed that rather than replacing aging C-130s with Super Hercules, the legacy planes be refurbished with new engines, electronics and structural components. In fact, the Air Force has already embarked on a limited effort to modernize the on-board electronics of aging “E” and “H” variants so they can operate successfully until replacement planes enter service. However, a more ambitious effort to replace engines and stressed structural elements such as the wingbox would cost well over \$40 million per airframe, and when completed it would yield a fleet of doubtful longevity and dependability. For less than twice the cost of fixing old planes, new C-130Js could be bought with far better performance features, multi-decade life expectancies, and superior readiness rates. Thus, from a cost-effectiveness standpoint, it appears there is no practical alternative to replacing aging C-130s with the latest variant of the plane.

THE INTERNATIONAL DIMENSION

When decisions about federal funding for the C-130 program must be made, U.S. policymakers are understandably focused on the operational needs of the joint force and various civil agencies such as NASA and the Forest Service (which uses Hercules for fighting fires). However, there is an additional dimension to the C-130 community of users that does not exist for most military aircraft — international customers. Over 60 countries operate the C-130, making it by far the most widely used tactical airlifter in the world. And like domestic users, foreign customers have found an increasingly diverse range of missions to which the plane can be applied. Four countries have already begun taking delivery of the Super Hercules, and several others are negotiating purchases.



The C-130 is often used in civil-military operations overseas, such as the Iraqi elections in which these local officials were transported to polling places around the nation.

The opportunity to purchase a rugged, versatile airframe at modest cost clearly has global appeal. C-130s typically cost less than commercial transports and can perform a much wider range of missions in more diverse settings. But beyond the intrinsic appeal of the aircraft's design, there is another virtue in having such a broad base of global customers. When different countries use the same aircraft, it facilitates interoperability and cooperative action. Because the Australian and Israeli and Japanese C-130s have the same operational characteristics as American C-130s, planners can use them interchangeably, relying on the same ground infrastructure and support systems to sustain joint efforts. Every type of multinational mission thus becomes easier, from coalition warfare to peacekeeping to humanitarian assistance.

That advantage is amplified by the fact that the biggest foreign customers of the C-130 tend to be close allies of the United States. For example, the United Kingdom's Royal Air Force operates about 50 Hercules and was an early purchaser of the "J" variant. Canada operates 30 of the planes and will soon begin taking delivery of its own "J" variants. Other members of the North Atlantic Treaty Organization operating various versions of the C-130 include Denmark, France, Greece, Italy, the Netherlands, Norway, Portugal, Spain and Turkey. Denmark and Italy have begun buying the latest version, and Norway is considering a purchase. There is even hope of selling it to Germany, despite the possibility of a competing domestic airlifter.

More generally, the inventory of C-130s owned by overseas operators tends to be concentrated in areas of greatest strategic interest to the United States. In the Middle East, the C-130 is operated by Egypt, Iraq, Israel, Jordan, Oman and Saudi Arabia, among others. In the Western Pacific it is operated by Australia, Indonesia, Japan, Malaysia, New Zealand, the Philippines, Singapore, South Korea and Thailand. In the Amazon Basin, virtually every country drained by the world's mightiest river has the Hercules in its air fleet. So the most common airlifter in most of the regions where U.S. civil and military agencies are likely to be operating in the future is a plane that American pilots know well.

The value of having an American airframe so widely distributed around the globe is measurable in both economic and operational terms. No other military aircraft has successfully penetrated the global market so thoroughly for so long. But preserving this franchise for future generations of warfighters, crime fighters, scientists and humanitarian relief workers must begin with decisions made in Washington, because it is demand from the federal government that sustains the production line for the C-130. With that in mind, it is time to identify some lessons from the success of the Hercules and draw conclusions as to the proper path forward for U.S. policymakers.

FOUR LESSONS FOR THE FUTURE

When an aircraft has performed diverse missions for dozens of countries over several decades, many lessons are learned. It is important for policymakers to understand why the C-130 has been so useful for so long, and how it manages to remain relevant in a world so different from the one in which it was first conceived. Some of the lessons from the C-130 experience may be applicable to other military programs. To the extent they are not, though, they underscore what a unique aircraft Hercules has proven to be — a global franchise worth preserving and protecting. The explanation for the C-130's continuing success seems to come down to four fundamental factors.

First of all, the versatility of the C-130 design has been crucial to its global appeal. Because it can be operated in diverse environments and adapted to diverse purposes, it is able to satisfy the mission requirements of many different users. The design of most military aircraft is so thoroughly shaped by a handful of core missions that they are poorly suited to accomplishing other tasks. In the case of the C-130, though, the tactical airlift mission has not interfered at all with its use in many other roles. In fact, the airframe has been configured so that equipment specialized for particular missions can be easily removed, facilitating the plane's migration to other missions. When this easy adaptability is combined with a capacity to operate from remote, unimproved sites as well as modern airports, it produces an airframe of nearly infinite utility.

Second, the modest cost of the C-130 airframe has been an important selling point, especially with international users. Not only does the plane cost less to buy than a jet while delivering more functionality in many settings, but its post-production support costs are remarkably low for an aircraft that often must operate under less-than-ideal circumstances. The low life-cycle cost of Hercules is traceable largely to a simple, rugged design — a virtue that has been bolstered in the latest version by greater fuel efficiency, the use of more resilient materials, and the introduction of electronic systems less prone to component failure. While the ultimate cost of a C-130 varies considerably depending on which configuration and support package a user decides to purchase, the plane's continued popularity in the global marketplace reflects the challenge other airframes face in matching the cost-effectiveness of Hercules.

Third, the improvement of C-130 technologies that occurs with the introduction of each new variant has played a critical role in keeping the airframe relevant to emerging needs. For example, the engines on the "H" variant were more powerful than the engines on the "E" variant, and the engines on the "J" variant are superior to the engines on the "H" variant. No matter how prescient the original design of the Hercules may have been, it could not have remained useful for five decades unless on-board technologies were kept current. In fact,

that process has been so thorough that today's Super Hercules is essentially a different plane from the one that debuted during the cold war. The new propulsion system, digital flight controls and other features of the C-130J make it as modern as any plane in the world today, and yet it still provides the rugged reliability that sparked enthusiasm among previous generations of pilots and maintainers.

Fourth, continuous production of the C-130 since its inception has been a major factor in sustaining the plane's utility, affordability and political support. When an aircraft production line closes, the team of specialists who understood every facet of that airframe's design and manufacture drifts away to other projects. This "critical mass" of skills and experience is almost impossible to reconstitute once lost, and even when it can be rebuilt the cost is very high. Unlike most other military planes conceived during the cold war, the Hercules today continues to benefit from a warm production line and a workforce that thoroughly understands its product. That makes every facet of manufacturing, modification and maintenance easier than it otherwise would be, and minimizes the likelihood that mistakes will be made as new variants are introduced. It also is helpful to have a stable and committed political constituency at the state level and in Congress that can guard the longstanding C-130 franchise against ill-conceived efforts to curtail federal funding. That constituency would disappear if production ceased.

All of the above lessons lead to a common conclusion about the appropriate path forward for policymakers. The federal government needs a long-term plan for the continued production of the C-130J Super Hercules. Because there is no suitable alternative for replacing hundreds of aging aircraft in the domestic fleet, because dozens of allies will require the same airframe for their own modernization needs, and because the intrinsic merits of the latest Hercules are unlikely to be matched by any other airframe for the foreseeable future, the plane needs to remain in production indefinitely. Once this reality is faced, the main question remaining is how to purchase the required planes at the most economical price. Studies indicate that a sustained annual purchase of 16 aircraft for U.S. users, supplemented by foreign orders, would offer the lowest cost consistent with military needs and budgetary constraints. Committing to a multiyear purchase of that magnitude would assure that the global Hercules franchise — a franchise built on versatility, affordability and reliability — thrives in the years ahead.

C-130 HERCULES OPERATORS

 Algeria	 Malaysia
 Argentina	 Mexico
 Australia	 Morocco
 Austria	 Netherlands
 Bangladesh	 New Zealand
 Belgium	 Niger
 Bolivia	 Nigeria
 Botswana	 Norway
 Brazil	 Oman
 Cameroon	 Pakistan
 Canada	 Peru
 Chad	 Philippines
 Chile	 Poland
 Republic of China	 Portugal
 Colombia	 Romania
 Denmark	 Saudi Arabia
 Ecuador	 Singapore
 Egypt	 South Africa
 Ethiopia	 South Korea
 France	 Spain
 Gabon	 Sri Lanka
 Greece	 Sudan
 Honduras	 Sweden
 Indonesia	 Thailand
 Iran	 Tunisia
 Iraq	 Turkey
 Israel	 United Arab Emirates
 Italy	 United Kingdom
 Japan	 United States
 Jordan	 Uruguay
 Kuwait	 Venezuela
 Liberia	 Yemen
 Libya	 Zambia



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