

Replacing the Caribou: mission impossible?



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The Caribou provides the ADF's battlefield airlift, carrying 3-ton loads into the smallest and most difficult airfields, linking the gap between helicopters and larger airlifters. (Photo: Department of Defence)

For 20 years the ADF has pursued a replacement for one of its most versatile aircraft, the DeHaviland DHC-4 'Caribou' Short Takeoff and Landing (STOL) aircraft. After countless evaluations, proposals and wish lists the reality is the Caribou will have to soldier on for some time to come – because there's no replacement on the horizon.

While the Caribou is in increasing demand for Army support, especially for tasks into rough airfields and drop zones, funding for a replacement aircraft has not matched the operational requirement. The most recent replacement project AIR 5190 sought to replace the Caribou with a 10-ton load carrying airlifter but the project was abandoned due to lack of priority. Now the ADF is trying again. The shrinking Caribou fleet seems destined to serve another decade with limited upgrades such as the Night Vision Goggle (NVG) upgrade, better avionics and perhaps an engine upgrade.



During Australian deployments to Timor Leste, the Solomon Islands and Papua New Guinea Caribous fly in and out of the most inaccessible terrain in the world. (Department of Defence)

Cairbou's Unique Capability

Acquired in the mid-1960s the aircraft were, at first, part of the RAAF's support for the Australian Army's conversion to the tropical warfare establishment. The Caribou was originally designed for a US Army requirement to provide intra-theatre lift, basically to move cargo loads from army base to army base – and particularly in the South East Asia theatre. This capability was in high demand for carrying high priority loads over distances and at speeds that the early generations of helicopters couldn't match – and the airborne option avoided 'tangles' with insurgents that could be encountered during road movements in low intensity conflicts.

The Caribou's load carrying capacity is more than 3,100 kg, over a range of 2,000 km, at a cruising speed of 280 kph. Typical payloads include two Landrover 4WDs, 32 equipped troops or 22 stretchers with medical attendants.

The Caribou isn't just a light transport aircraft shifting loads from airfield to airfield. It has a range of unique capabilities in the Australian Defence Force that make upgrading its niche capability extremely difficult. The Caribou has a proven STOL capability, albeit with light loads compared with other airlifters, but it can sustain operations from improvised airfields in remote areas. It has proved to be a valuable tactical airlift asset in Defence exercises and for operations in areas such as Papua New Guinea, Bougainville and the Solomon Islands.

While the Caribou is somewhat unfairly considered to be a maintenance 'hog', it is nevertheless labour intensive. The Caribou is not a 'plug and play' aircraft, with line replacement of modular components an option. In the Caribou, maintainers need to find the fault and repair it the old-fashioned way: pulling components apart and replacing or fixing the broken part. While this adds to in-service cost in terms of manpower it has the advantage

The Caribou is the only ADF aircraft fitted for the Low Altitude Parachute Extraction System (LAPES). (Department of Defence)



that the aircraft can operate in the field for extended periods of time – and this is important in remote locations where resupply is not always a good option. Onboard each Caribou is a Flight Engineer who can effectively maintain the aircraft in the field without a large logistic train, as would be the case with more modern, so called cheaper-to-maintain aircraft.

Some of the latest airlifter designs such as the Airbus Military A400M are designed for substantial periods of operation without access to high-level maintenance support, and it has the added advantage of digital design, whereas the other Caribou replacement contenders date their designs back to the 1970s and 80s.

Another advantage of the venerable Caribou is its economical fuel burn, running on AVGAS not Jet Fuel, and it needs far less fuel than the modern 10-ton class airlifters. This means it's not just cheap to fly but also easier to maintain in remote areas. AVGAS is the principal fuel of general aviation, and the Caribou can virtually 'live off the land' from civilian resources. The Pratt & Whitney R2000 radial engines are more tolerant of not-so-perfect fuel stocks, and AVGAS can be moved and stored in drums, unlike Jet Fuel. These unique capabilities contribute to the Caribou's ideal suitability in the 'battlefield airlifter' role.

For all its advantages the Caribou has one huge disadvantage – and that is its deployment range capability. Imagine the problem in deploying Caribous to the Persian Gulf: it would take 'forever' to get there, transiting at less than half the cruising speed of a C-130J and virtually having to island-hop its way to the Gulf.

Like all machines, the Caribou can't run forever and needs replacing if the ADF is to retain its tactical airlift and STOL capability. As there is no new aircraft that matches the Caribou the decision to replace it will be decided on which of its capabilities are most important to the ADF.



Caribou's forte is in remote area operations.

Battlefield Airlift

The Defence Capability Plan 2004 aims to replace the Caribou by 2010 under project AIR 8000, Phase 2 'Battlefield Airlifter'. The capability statement calls for an inter-theatre and intra-theatre transport, light fixed wing platform to be integrated with rotary and medium fixed wing platforms that would usually operate below an altitude of 10,000 feet.

The project is still in the early days of establishing both the RAAF and the Army requirements. There are two key and divergent taskings: the 'milk-run' requirement for regular operations in and out of places hard to get to, and the more intense forward support of troops with urgently needed resupply. The Caribou ably handles both tasks, and with the increasingly mechanised and mobile Hard-Net Army the requirement for more consumables in the form of fuel and ammunition will continue. In Operation Iraqi Freedom the US Army's thrust towards Baghdad was held up due to lack of supplies; however, the US Marine Corps (USMC) passage on the right flank encountered no delay, supported by C-130 Hercules landing on local roads flying in load after load of fuel direct to the forward echelons. This rapid resupply is what the Army needs from the RAAF's Air Lift Group.

For such a difficult capability replacement there are a range of options, some innovative and some unexpected.



The A400M is a potential RAAF C130 replacement offering both tactical and strategic lift. If acquired, a 10-ton class airlifter will be needed to replace the Caribou. (Photo: Airbus Military)



The C-27J 'Spartan' lost out in the last attempted acquisition project to replace the Caribou, now with its price slashed and more export orders it has a better chance. (Photo: Alenia Aeronautica)

C-295 vs C-27J

Under the ill-fated AIR 5190 Phase 2 two prospective tactical airlifters were short-listed: the Lockheed Martin Alenia Tactical Transport Systems' (LMATTS) C-27J 'Spartan' and the Spanish CASA (now EADS CASA) C-295M. Between 12 and 18 aircraft were to have been purchased for more than \$500 million. The C-295M was recommended because it was cheaper but the project didn't receive Ministerial endorsement and was cancelled in mid-2000. The C-295M and C-27J can each carry loads of up to 10 tons but both lack the STOL capability of the Caribou. In light of the difficulties the C-27J has had in competing with the cheaper C-295M, LMATTS has reportedly lowered the 'sticker' price from roughly US\$25 million to US\$22 million, roughly equivalent to the C-295M.

Both aircraft have evolved more austere designs and now rival the C-130 in flight performance but neither offers significantly better STOL and field deployability than does the C-130. In effect, they are twin engine C-130s that are correspondingly cheaper to operate in fuel and maintenance costs but offering lower cargo carrying and range performance. Rather than purchasing this class of aircraft it may be more economical for the RAAF to acquire more C-130s and take advantage of consolidating the Air Lift Group fleet with one

airframe type. The RAAF has recently considered purchasing EADS A400M 37-ton airlifters to replace the C-130 fleet. These aircraft are highly capable and are formidable tactical airlifters. If these aircraft, with their four 10,000shp engines and high consumption, are ordered then complementing them with a smaller 10-ton class airlifter begins to make more sense.



The C-295M is the primary alternative to the C-27J in the 10-ton class. It evolved from the CN-235 design jointly developed by Spain and Indonesia. (Photo: EADS)

The Spirit of Australia



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Defence Services



The An-74T-200 offers improved performance, especially STOL, over turboprop powered 10-ton airlifters. With political change in the Ukraine and its low sticker price the An-74 could be an attractive replacement for the Caribou. (Photo: Antonov)

Ukrainian Solution

While the C-295M and C-27J lack the Caribou's STOL and rough and ready nature, one modern airlifter does have these attributes, and that is the ex-Soviet now Ukrainian Antonov An-74T-200. The original An-72 was developed to meet a Soviet Air Force and KGB Border Guard requirement while the An-74 evolved from the An-72 for Arctic scientific missions, proofed for operations from -65°C to +45°C. Characterised by its high mounted engines the An-72/74 is the world's only turbo-fan powered STOL tactical transport aircraft. The high mounted engines reduce the incidence of Foreign Object Damage (FOD) ingestion and have the added advantage of increasing air flow across the titanium wing panels to boost lift at low speeds.

Since the break-up of the Soviet Union, Antonov have kept the An-74 in production, customised as an effective airlifter into hard to get to places, such as the hot, arid mountains of Central Asia. The An-74 can carry a 10-ton load 1,450km or 3.05 tons 4,370km and has demonstrated a take-off distance of only 350m with 3.5 tons of cargo. While it has impressive performance statistics and comes cheap (US\$10-12 million) its heritage begs the question as to whether the ADF has inclination and political will to purchase an ex-Soviet product? Antonov aircraft provide heavy-lift support to ADF through regular wet-leases of the An-124 transport aircraft for loads beyond the capacity of the C-130J – such as intercontinental transporting of CH-47 Chinook helicopters to the Persian Gulf – but is such an east European purchase achievable?

With an Australian business partner offering through-life support and with western engines and a glass cockpit the An-74 could be a serious contender if and when the project gains momentum. Replacing the Lotarev D-36 engines with a western 60kN class turboprop such as the Rolls-Royce Deutschland BR710 or General Electric CF-34-8 could potentially boost the performance of the An-74. The An-74 comfortably outperforms the other 10-ton class airlifters and would be able to sustain the current Caribou STOL commitments to the highlands of Papua New Guinea, and other places.



After long, troubled and expensive development the MV-22 Osprey is entering US service. It provides amazing performance, combining flight characteristics of helicopters and conventional winged aircraft but at a cost and with unanswered safety concerns.

Tilt Rotor?

A relatively higher cost and potentially riskier solution to replacing the Caribou could be to go with the Bell/Boeing MV-22A Osprey tilt-rotor airlifter. This revolutionary aircraft combines the Vertical Take-Off and Landing (VTOL) and the hovering capability of a helicopter with conventional fixed wing cruising flight. The MV-22A can provide VTOL with a payload of 2,700kg out to a range of 800km or 3,700kg to 400km. The MV-22A's ability to combine the flexibility of a helicopter with the speed and range of a fixed wing aircraft makes it an attractive option but, unfortunately, there are aerodynamic limitations in the design. When in rapid descent the tilt rotors can create the 'vortex-ring effect' during which the inner portion of the blades airflow is upwards rather than downwards. This can lead to catastrophic loss of control, often fatally when at lower altitudes. The solution to this problem is to limit the aircraft's flight profile through the avionics system. Engineers also propose adding more blades to each rotor, but the design is currently frozen, with the three-blade design enabling folding for shipboard storage. The ADF has had some bad experiences in acquiring unproven capability – evidenced by the F-111 acquisition and Collins-class combat system – so it seems unlikely that they would be willing to take a leap of faith on a new aerodynamic concept that is yet to be proven in service.

Lighter Than Air

One of the most interesting potential solutions to the battlefield airlifter question is the British Advanced Technologies Group SkyCat Lighter Than Air (LTA) vehicle. The SkyCat is a scaled series of air vehicles that combine aerodynamic lifting bodies with lift from inert Helium. LTA aircraft are able to carry heavier loads more efficiently than conventional aircraft and helicopters but at lower maximum speeds. The SkyCat design removes one of the perennial problems associated with LTA craft: how to keep it on the ground. By replacing the conventional undercarriage with a hovercraft system, fans that would normally fill the air cushion chamber of a hovercraft can also be operated in reverse, effectively sucking the SkyCat onto the surface. The SkyCat can land in very short distances on any type of reasonably flat surface including water. SkyCat can also land and takeoff vertically, with load penalties, or hover and lower cargo by winch. The SkyCat-20 is the smallest of the family but is still able to carry 20-ton loads up to 2,250km at a cruising speed of 130kph. While much slower than other air vehicles the SkyCat can take loads from point to point without assistance from intermediaries, saving overall transport time. The low fuel use and high cargo carrying ability makes LTAs more cost effective than helicopters and fixed wing aircraft.

On the downside, LTA air vehicles are much larger than winged aircraft and are thus bigger and slower targets; however, they are far more resilient to damage than any other air vehicle. The SkyCat system is able to absorb hits from mortar bombs



Using in-flight refuelling of helicopters is an alternative way of filling the battlefield airlift capability rather than acquiring a new aircraft type. (USAF Photo)

without dangerously degrading lift. The fact that their large size is effectively mostly gasbags makes them almost invulnerable to anti-air fire.

The first SkyCat-20 is on schedule for completion in the second quarter of 2007 and certification is expected within six months. The SkyCat will then tour the world to display its capability in early 2008. SkyCat offers a range of attractive capabilities in the battlefield airlifter role and while apparently a radical new aircraft LTAs have been in operation longer than fixed wing aircraft. Also, the larger size SkyCats could be exactly what the RAAF needs if the ADF is serious about providing strategic and operational air mobility to the Army. The SkyCat-200 could carry three M1A1 tanks or six or more of the new LAND 400 AFVs. This would enable the RAAF to move a meaningful Hard-Net Army force by air rather than the current, mostly token level available by C-130. Getting in early on the SkyCat-20 could be vital for the RAAF to work up to an LTA-based airlift force.



SkyCat 20 LTA can carry more loads to and from any point regardless of airfield infrastructure. (Photo: Advanced Technology Group)

Networked Solution

The solution to replacing the ADF's divergent needs for battlefield airlift may be to evolve the RAAF's and Army's airlift assets into a fully integrated force. The original Caribou aircraft was designed to fill the gap between the early generations of helicopters and the C-130 class of airlifter, but this gap no longer exists. The differences in load, range and speed between new helicopters such as the MRH-90 and the Caribou is quite small; in fact, they are almost identical, except for range. While range and fuel sustainability is a consideration, utilising in-flight refuelling across the helicopter fleet could mitigate the problem. By introducing in-flight refuelling receptacles to the helicopter fleet and a tanker capability to the C-130s the two aircraft types could complement each other to create an integrated fleet. Helicopter in-flight refuelling is usually conducted beneath an altitude of 5,000 feet and at speeds of 200kph (110-KTAS), which is very different to fast-jet refuelling conducted at altitudes of 6 to 7.5km (20,000 to 25,000 feet) and speeds of 540kph (290-KTAS). The current ADF in-service Boeing 707 and future EADS CASA A330 MRTT aircraft would not have the capability to refuel helicopters. However, C-130s could be converted into a tanker role, and the A400M would need just the add-on refuelling hose pods to become a very capable helicopter and fast-jet tanker.

By introducing in-flight refuelling receptacles to the ADF helicopter fleet along with a tanker capability to the C-130/A400M the two aircraft types could complement each other in a networked fleet. The money saved by not acquiring a new aircraft type, about \$1 billion, could be used to fit the in-flight refuelling capability and acquire more C-130/A400Ms and MRH-90s. In-flight refuelling of helicopters is quite common in US service especially amongst the USMC and Special Operations Command. Tanker equipped US C-130s are often used to provide in-flight refuelling one mission then cargo lift the next or in special ops, combining the two roles. Not only would this meet the ADF's battlefield airlift requirement but would also boost capability in other areas - in particular enabling a tanker surge to support long range strike aircraft.

Conclusion

The US Army has launched the Future Cargo Aircraft (FCA) requirement for about 128 10-ton airlifters. The C-27J and C-295M are already jostling for position in this very important project. The USAF is reportedly unhappy that it has lost ground in tactical airlift and has launched its own project for a similar capability. It could present a viable, and affordable option for the ADF just to piggyback on the larger American program or re-run AIR 5190 to replace the Caribou, but in so doing the ADF would lose a vital element of airlift capability (STOL), especially in hard-to-get-into areas of operation. On the other hand, the Australian Army needs larger cargo loads to sustain the increasingly mechanised Hard-Net Army than the STOL Caribou or even a re-engined, re-built Caribou. Simply replacing the aircraft one-for-one may not solve the problem. First comes the need then the capability but for the ADF there are quite a few capability options to meet this need; choosing the right one is of course the hard part.

