


Strategic Air Mobility for the ADF

by Dr Carlo Kopp



The superb Boeing C-17A is the only large airlifter now in production. Replacing the C-141, it can lift most C-5 sized payloads and has exceptional short field performance.

The War on Terror has seen for the first time in decades ADF forces deployed globally in combat operations. This is a pattern that is likely to continue long-term, reflecting a world very different from the strategic standoff of the Cold War era. ADF forces, be they Army, Navy or Air Force, could become engaged in future campaigns in the Middle East, Africa or closer to home. Concurrently, Australia is challenged by the ‘creep’ of the

Asian arms race, which is seeing the Asia-Pacific-Indian region progressively building up the largest pool of modern, evolved third-generation combat aircraft and supporting assets globally. Even though expeditionary support of the US is important globally, Australia cannot afford to shift investment away from regionally relevant combat capabilities into specialised capabilities that support these expeditionary operations.

As a former Defence Minister aptly observed in a parliamentary hearing mid-2003, Australia is the only Western nation, other than the US, facing the full spectrum of military contingencies: from high level, high tech nation-state warfare down to counter-insurgency and peace enforcement/keeping operations.

These are by any measure challenging strategic circumstances, which call for very careful planning and force structure development. To add difficulty to these circumstances, Australia is confronted with block obsolescence across a number of platforms over the coming decade, a number of which will cost many billions to replace; the F/A-18A and AP-3C being prime examples.

The issue of strategic lift for the ADF is one that will grow in importance over time, as Australia becomes increasingly a global player. Moving and supporting a combination of ground forces, naval deployments and air force contingents on a global and regional scale presents a daunting task, especially for a small Defence Force such as the ADF.

Sealift is one option but it has implicit limitations, and strengths. Sealift permits movements of the heaviest assets, especially tanks, and it permits access to archipelagic areas of operations with undeveloped infrastructure. Balanced against these considerations, sealift is inherently slow with 20 knot class speeds for conventional vessels, and 40 knot class speeds for high-speed catamarans. As distance increases, the throughput of a sealift resupply chain declines in proportion to distance. Moreover, large transport ships are high value, vulnerable targets, exposed to air, missile, torpedo and sea mine attacks.

The alternative, airlift, provides significantly faster delivery rates for personnel, palletised freight, lighter vehicles and engineering equipment. Airlift is more survivable, in large part due to the difficulties in engaging 450-knot targets. The loss of a single 100 tonne payload class heavy airlifter is much less punishing than the loss of a 20,000 tonne RORO sealifter.

However, airlift has its own constraints, especially in terms of accessing underdeveloped areas, and air delivery of personnel and equipment presents its own issues. On balance, the ADF requires robust capabilities in both sealift and airlift, as these capabilities are complementary and are not mutually exclusive.

ADF Airlift Capabilities

Australia's current airlift capabilities reflect the historical experience of the past four decades, but they are less than optimally structured for the new reality of this century. Therefore a good case can be made for a fundamental rethink of Australia's airlift force structure. In Australia, airlift is typically divided into 'strategic' and 'tactical' airlift along with 'air logistical support' (ALS). These somewhat arbitrary divisions put any kind of longer ranging inter- and intra-theatre lift into the 'strategic' category using C-130H and C-130J Hercules aircraft, while 'tactical' lift is typically ascribed to deliveries into Forward Operating Bases (FOB) and LAPES or paradrops of materiel, using the DH-4 Caribou and C-130H. Delivery of palletised freight and personnel using the Boeing 707-338C and in the future Airbus A330-200 typically falls under the ALS label.

This division is different from the US model, which divides airlift into 'inter-theatre' lift over intercontinental distances, and 'intra-theatre' lift typically within a 1,000 nautical radius, with 'tactical lift' being a special case of intra-theatre lift. Within the new strategic reality, the US model for labeling airlift operations is a far more relevant one.

Australia does not have a strong doctrinal model for global airlift operations, reflecting the reality that in the past the C-130s have been capable of covering all three categories of airlift, with the exception of light tactical lift requiring the smaller Caribou. The Americans have a far better developed doctrine, reflecting six decades of experience in performing global high volume airlift campaigns. The US model is two tiered, with large military and commercial transports providing the inter-theatre element – to carry forces and material into large in-theatre Main Operating Bases (MOB) – and smaller airlifters used to distribute these forces and material to front line FOBs.



The lowest tier of Australia's tactical and intra-theatre lift fleet is the Vietnam era DHC-4 Caribou, which remains unmatched in short and soft field performance. It should come as no surprise that a vigorous debate is now under way in the US over the absence of any new production types which fill this capability niche, forcing the use of more expensive helicopters in the role.



The new C-130J has been used primarily for intra- and inter-theatre lift roles. With additional internal volume and engine power, it has proven very effective to date.



The C-130H is Australia's primary tactical airlifter, used for a wide range of airlift roles.

The high value large aircraft and concentrations of personnel and material are kept well away from hostile attack by situating the MOBs out of the reach of opposing forces. In this fashion, only smaller airlifters such as the C-130 are exposed by flying out to FOBs.

The idea of flying larger intra-theatre lifters such as the Boeing C-17, An-124-100M or Airbus A400M into FOBs is risky. Such high value assets would be vulnerable to mortars, rockets, RPGs, large calibre sniper rifles, long range artillery and tactical ballistic missiles. A large aircraft loading or unloading at a FOB is an inviting target. If hit and disabled it could paralyse the FOB by physical obstruction, and if it burns it could shut down the FOB for hours or even days. Consider the implications of a burning C-17, An-124 or A400M loaded with 40 tonnes of munitions. Very few FOBs could resume operations quickly.

Another problem arising with FOBs is runway durability. Even if the runway surface can cope with the pressure exerted by the tyres of the larger airlifters the foundations of the runway may not. How many FOB runways could sustain repeated landings by well loaded 40 to 100 tonne payload class airlifters? Getting such an aircraft in or out of the FOB once or twice may be possible, but sustaining such traffic for days and weeks may not be possible.

The US model of two-tier airlift exists for very pragmatic reasons, and it is a model Australia should consider since it is proven and robust.

Australia's existing airlift force of C-130J, C-130H and Caribou is a well balanced intra-theatre lift force that is well suited to carrying payloads between in-theatre MOBs and FOBs. While the C-130J remains to be fully cleared for many tactical lift roles, it is a robust vehicle for MOB to FOB transport – and the C-130H covers tactical deliveries well. The Caribou remains unmatched in its soft and short field capability, but its piston powerplants present ongoing reliability and safety issues, and to retrofit turboprops would be a distinct advantage, given the longevity of the Caribou airframe and its superbly adapted aerodynamics for the role. A vigorous debate has developed in the US over precisely this airlift niche, which in the absence of suitable off-the-shelf fixed wing airframes is burning out airframe life in much more expensive to run Army CH-47 Chinooks and Marine Corps CH-53s.

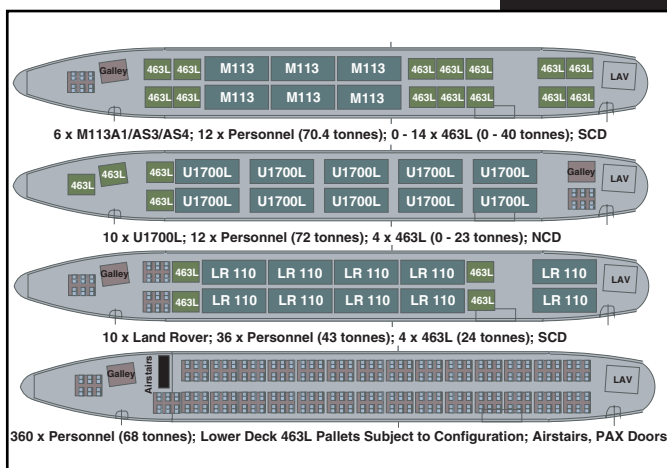
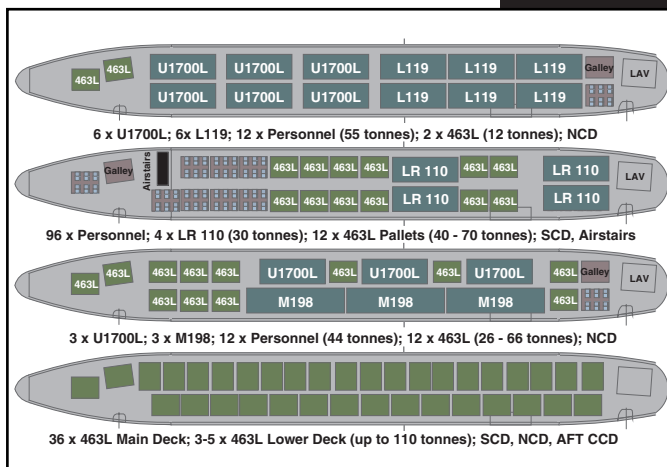
Within the new global reality Australia's airlift fleet lacks a long-range high payload backbone to sustain high volume deliveries of personnel and material beyond the near region. To date, the answer has been improvisation: lease Antonovs, hitch rides on US Air Mobility Command transports, or contract commercial carriers. Where deployments are small and there is little pressure for sustained air bridge throughput, this works. Step up the OpTempo and this model breaks down – and five A330-200 tankers with other roles to perform are not the answer.

There are compelling reasons for Australia to have its own strategic air mobility capability, so that the ADF can choose where, when and how it lifts its assets, thereby reducing dependency on foreign owned and operated airlift assets.

If we accept that Australia should invest in a fleet of high payload long-range military transports, the next questions which arise are how many, and what style of aircraft is best suited within constrained budgets.

The question of how many is an interesting one. If the ADF is to sustain a small, deployed ground force primarily by air, there are two potential throughput bottlenecks in the air bridge. The first is the rate at which materiel/personnel can be delivered from Australia to a remote MOB, the second is the rate at which the C-130s can transfer delivered materiel/personnel from the MOB to in-theatre FOBs.

We might consider a scenario in which the MOB is located 250 nautical miles from the FOBs, and twelve C-130s are available for MOB to FOB lift operations. Assuming a 20 tonne payload per sortie, a 300 KTAS cruise speed and 30 minutes to load and unload, then crew numbers and serviceability permitting each C-130 can move 20 tonnes out every three hours. Twelve C-130s permit 240 tonnes in three hours, assuming staggered FOB arrivals. If we assume 12 hours of lift operations per 24-hour cycle, this permits nearly 1,000 tonnes per day. While the C-130 is extremely versatile, this is one role in which it is exceptionally good.



How well does a 747 stack up as deployment platform for 1 Brigade and 3 Brigade? These two charts detail example deployment payloads using a 747-400 main deck and the Side and Nose Cargo Doors. The total payload weights mostly permit full fuel loads for maximum deployment range (Author).

Types for ADF Strategic Mobility

Sustaining around 1,000 tonnes of lift by air per 24 hour cycle over inter-theatre distances, greater than 2,000 nautical miles is not a task which any reasonable number of C-130s can perform. This is a task for a large 100-tonne payload turboprop transport, preferably with the range to not require aerial refuelling, and with a cruise speed in the 450 KTAS bracket.

It is worth putting this in perspective, in terms of what this volume of lift actually means. If we assume a 100-tonne payload class transport with the performance to go the distance from an Australian base to a distant MOB, then these possibilities exist for Army formations:

- * 1 Brigade - one half mechanised infantry battalion with 348 troops in six sorties, including personal weapons, 30 x M113 APC and up to 40 tonnes of stores on 463L pallets.

- * 1 Brigade - one 6-gun 155 mm M198 Battery in three sorties with 92 to 202 tonnes of stores on 463L pallets.

- * 3 Brigade - one half light infantry battalion with 348 troops in three sorties, including personal weapons, 10 x Unimog, 10 x Land Rovers and up to 50 tonnes of stores on 463L pallets.

- * 3 Brigade - one 6-gun 105 mm L119 Hamel Battery in two sorties with 42 to 82 tonnes of stores on 463L pallets.

- * Given a 100-tonne class payload per sortie, ten sorties deliver 1,000 tonnes of palletised materiel.

Reducing the size of the aircraft used means scaling up the sortie count accordingly. Opting for a turboprop airframe over a turboprop reduces the delivery rate – to account for slower cruise speeds. In the long-haul, inter-theatre lift game bigger is better, and faster is better.

The composition of the payloads carried is important. While military airlift conjures up images of tanks and armoured vehicles rolling off tailgates and roaring away down the road to do battle, this image is much more representative of Soviet Red Army propaganda footage than pragmatic reality. US airlift experience for several decades indicates that personnel and palletised freight movements usually dominate over outsized/oversized payloads which demand Roll-On Roll-Off (RORO) military airlifters. For Australia's 3 Bde and 1 Bde, both of which qualify as 'light' or 'medium' mechanised brigades by US measures, a large fraction of payloads are C-130 compatible and do not demand a large RORO airlifter to carry.

It is worth observing that the Lockheed C-5 Galaxy and the Antonov An-124 Condor are the only two military airlifters ever built to carry 100+ tonne payloads beyond 2,500 nautical mile range, with a RORO capability for outsized/oversized payloads. The Boeing 747 is the only civilian transport capable of carrying 100+ tonne payloads, with a range capability between 3,500 nautical miles (747-200/300) and 5,000 nautical miles (747-400).

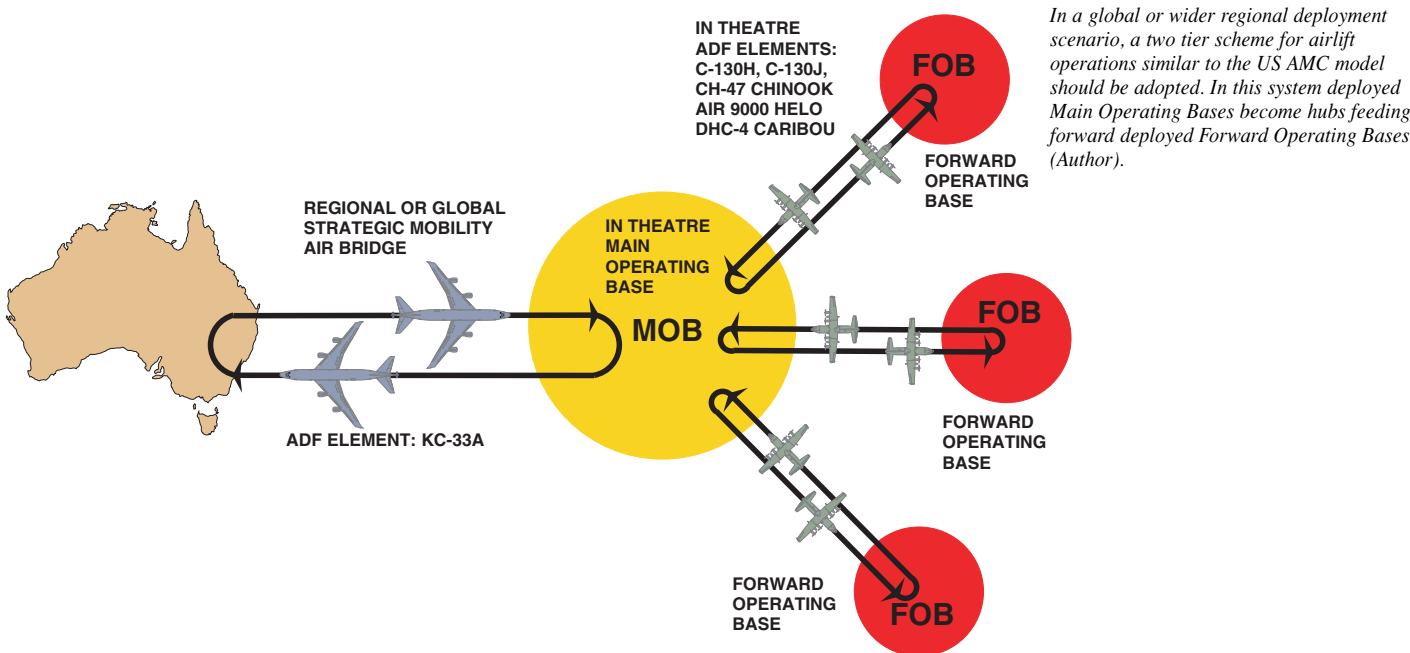
Advocates of strategic mobility often point to the Boeing C-17A Globemaster III and the planned European A400M (FLA). The C-17A is currently the only larger military RORO airlifter in production. The smaller European A400M is now in development and intended to enter service around the end of this decade. Both types deserve careful examination. Latest reports indicate another option could materialise : a new-production Antonov An-124-100M Condor, intended to be manufactured between 2006 and 2020.

Boeing's C-17A Globemaster III is both a replacement and an enhancement against the now retired C-141 Starlifter, which was the backbone of AMC for three decades.

The C-141 was limited to C-130 payload dimensions, but carried 40 tonnes of payload (cca two C-130s) to 2,500 nautical miles. The C-17A carries 76 tonnes of payload to the same radius, or 60 tonnes to 3,000 nautical miles, effectively providing twice the payload radius of the C-141. Unlike the C-141, the C-17 is built to carry outsized/oversized payloads similar to the larger C-5 Galaxy. The C-17A also has exceptional short field performance, usually described to be competitive against the C-130. To place the C-17 in perspective, it is designed to perform intra- and inter-theatre lift roles, carrying C-5 dimensioned payloads, with exceptional short field capability. As such it is the most flexible large airlifter currently in service. The US Air Force Air Mobility Command operates 76 C-17As, and the Royal Air Force four aircraft currently. The European A400M will become a serious player in the world market later this decade as it enters production. The A400M is much smaller than the C-17A and occupies a niche in between the C-17A and C-130, best qualifying as a large intra-theatre airlifter with some inter-theatre capability. For comparison the A400M's cited payload radius is 20 tonnes to 3,550 nautical miles, about 70 per cent greater than a C-130H, and cited maximum payload is 37 tonnes – almost twice that of a C-130H. Compared to the C-17A, the A400M delivers around one-third the payload to 3,500 nautical miles or lifts about 50 per cent of the maximum payload of a C-17A. Powered by four 10,000 SHP class turboprops and designed for excellent short field performance, the A400M is likely to destroy the upper band of the C-130 replacement market precisely when much of the world's C-130 fleet hits block obsolescence.

In practical terms the A400M will be a highly competitive one-for-one replacement for the C-130 series in the intra-theatre lift and tactical lift roles, but has little to offer over the C-130 in the inter-theatre or strategic lift role.





747-100SF/-200F/SF/-300SF/-400 Freighters
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 747 cargo door loading capability main deck pallets and container

<p>Either nose or side cargo door loading</p>
<p>Side cargo door loading only</p>
<p>Nose cargo door loading (-200/-400F only)</p>

∅ Volumes are based on SAB Aerospace Standard, AS 1825. TBC-MD-0075F1-30-3-PH/LM/KW
 * Maximum height varies from 78 to 86 in (198 to 218 m), depending on airplane type (e.g., 707, 727, 757, DC-8).

Commercial airlifters offer considerable flexibility in payload types. This Boeing chart shows compatible payloads for the 747 family aircraft (Boeing).



The An-124-100M series, which is an extensive upgrade of the basic An-124 design, is to be jointly produced by AviaStar and Aviant. The aircraft is to have an MTOW increased from 392 tonnes to 420t tonnes, and a maximum payload increased from 120 to 150 tonnes, with a range of 6,500 km (3,500 NMI) at 120 tonnes of payload. The 'new look' Antonov will use an avionic suite combining Honeywell, Leninetz and Aviapribor components, and a digital anti-skid brake system will be fitted. In volumetric and payload terms, the An-124-100M will be the only credible competitor to the Air Mobility Command's C-5 Galaxy fleet. The principal obstacles to RAAF operated Antonovs would be political, as such an incursion by Russian/Ukrainian industry into the almost exclusively US/EU/Israeli dominated Australian market would create significant upheavals.

The big question for Australia will be whether the C-17A can be acquired in useful numbers given the cost of new-production aircraft, but are there other alternatives? Surplus used C-5 Galaxies may become available but would require significant investment in relining wings, rewiring, retrofitting CF-6 engines to achieve commonality with the AMC fleet, along with significant overhauling to ensure the aircraft are viable to 2035 or 2040, which is in line with US plans for its C-5 fleet. With 100+ tonne class capability, a dozen used C-5s would be capable of providing the stated strategic mobility. With much younger F-111s planned to be retired around 2010 it is unlikely that even rebuilt C-5s of greater age would be of any interest.

With very limited choices in RORO capable airlifters, and noting their inflexibility through single role specialisation, the question which arises is to what extent used commercial transports can be exploited. Since the post-911 airline industry collapse, there is a surplus of used airliners either mothballed or in various leasing arrangements with owners desperate to shed them. This has been reflected in prices for many types of used airliner dropping by near to 50 per cent since 911.

The reality is that five A330-200MRTT aircraft is not enough to fill developing needs for tanker capability, and clearly will at best provide a useful supplementary airlift capability in the ALS role. From an airlift perspective the 747 family presents interesting possibilities. While the 'classic' 747-200F/-300SF provides around 110 tonnes of payload to 3,500 nautical miles, or almost twice the payload range of the C-17A, the later 747-400SF improves this by moving the same payload to 4,500 nautical miles - effectively providing 2.35 times greater payload radius performance. The 747-400 is a Galaxy or An-24 class load carrier, with better cruise speed and much larger internal fuel capacity.

Two criticisms have been directed at the idea of using the 747 as a strategic lifter. The first is payload geometry and lack of RORO capability, the second is short field performance.

The 747 evolved from a 1960s proposal for a Galaxy class military airlifter, and existing 747 fuselages will accommodate most payloads compatible with the C-130 - the Side Cargo Door (SCD) is larger than the C-130 tailgate. For Australian Army needs, the 747 can accommodate the M113, most Perentie variants, the L119 and M198 artillery pieces on pallets, and a wide range of palletised payloads. The Unimog 1700L/38 and 2450L trucks can be adapted by retrofitting the soft top cab, used for the production U1300L Unimog variant, this permitting Nose Cargo Door (NCD) access. What the 747 cannot lift are tanks, S-70/NH-90 helicopters and some trucks, usually limited by cab height. Such items need to be carried by sealift or RORO airlifters like the C-5B, C-17, An-124. What is clear is that the 747 can lift most of the equipment used by the Army.

The US Air Force have made extensive use of Civil Reserve Air Fleet and chartered commercial 747s for airlift. To use the 747 - and KC-10A/DC-10-30 - they have used mobile transloaders, their 25 klb FMC Halvorsen (NGSL) being a less capable licenced variant of the Australian Static Engineering Pty Ltd TASLU 40 klb loader. Both loaders are C-130 transportable. RORO capability is for most payloads more of a convenience than a must. Internal pallet loaders are an option for the 747, and Boeing's 1980's 'On Board Loader' design is a good example. The pragmatic bottom line is that any payload which can fit in the 747 SCD or NCD is a candidate for palletised carriage, and load/unload using a TASLU.

The previously cited 1 Bde and 3 Bde payloads were specific 747-400 payload configurations in the 100 tonne class. With 463L format palletised airline seats (designed for the KC-767A), the 747-400 can lift 360 passengers / attendants on 12 seat pallets, or 450 on 15 seat pallets. Using palletised medevac litter modules (designed for the KC-767A - 6 litters/pallet), 168 casualties plus 24 medical personnel can be lifted by a 747-400. Personnel carriage can be facilitated by retrofitting the internal E-4B/VC-25 passenger airstairs in the forward lower cargo hold.

The absence of STOL or strong short field capabilities in the 747-400 is a limitation but within the arc from India through China to South Korea, excluding US and Japanese military runways, there are no less than 55 runways rated as suitable for the 747. Within the near region there are three in Thailand, six in Malaysia, one in Brunei, two in Singapore and no less than nine in Indonesia. With US planning for a global network of 'bare bones' bases, we can expect to see the global footprint available to the 747-400 increase strongly over the next decade.

In terms of Australian basing, using the 747-400, Townsville is limited to payloads of around 70 tonnes to achieve useful unrefuelled ranges. Darwin permits full payloads of around 110 tonnes for unrefuelled operations in the nearer region. An example of deployments achievable with the 747-400 are 1 Bde (Darwin) to ~4,500 NMI with a 70 tonne payload, or ~2,300 NMI with a 110 tonne payload, and 3 Bde (Townsville) to ~2,500 NMI with a 70 tonne payload.

What the 747-400 thus provides is a fast and global C-5 Galaxy class strategic lift capability, but limited essentially to C-130 class payload sizes, and large airfields.

The big issue for the ADF in developing a capability for strategic air mobility will be funding during a period of block replacements of existing fleets. Buying a dozen of any new build large aircraft will be problematic - the AIR 5402 program absorbed around AU\$2B for a mere five new A330-200s. With recently cited unit flyaway costs around US\$200M per unit, the superb C-17A is easily within the same budgetary bracket as the A330-200 tanker, in similar numbers.

The post 911 pricing collapse in the used 747-400 market opens up possibilities. 747-400s including a full Special Freighter conversion can be sourced for around US\$50M apiece - for aircraft of this size in the younger than 15 years of age bracket these are remarkable figures. As the new 'Advanced 747' and A380 enter the market, we will see younger 747-400s continuing to appear at very affordable prices in the used aircraft market.

Unlike specialised RORO airlifters the 747-400 makes for an excellent fast heavy tanker - with twice the offload of the A330-200 - thus it is not a single purpose asset and can be swung between roles depending on demand. If the aerial refuelling receptacle used on the VC-25/E-4B is fitted, the 747-400 can be used to refuel other 747-400s performing airlift to add significant range when runway weight is limited on takeoff.

If we compare the players, in terms of raw capability, the new build Antonov An-124-100M is the top performer, followed by the C-17A, which is more flexible due to better short field performance. In terms of cost per tonne of capacity the 747-400SF is the strongest option, but with limitations in short field performance and payload sizes.

In conclusion, developing strategic circumstances make a good case for the ADF to invest in strategic air mobility, with a choice between new-buy Boeing C-17s, Antonov An-124-100Ms, Airbus A-400Ms or possibly a 747-400 transport/tanker refit.

For more detailed analyses of background issues visit:
<http://www.ausairpower.net/aar-lift.html>



Europe's new A400M FLA is in many respects a 'bigger and better' C-130, and is likely to cause devastation in the C-130 replacement market during the coming decade. Primarily an intra-theatre lifter, it provides almost double the capability of a C-130H.



The C-5 is the largest RORO airlifter in US service, set to remain in operation until the 2040 period. The most recent upgrade is likely to see CF-6 engines, widely used on the 747, replacing the legacy powerplants.