



From A to B, Asap!

Congress wants to increase the C-17 fleet to 222

The logistic demands of operations in Afghanistan and Iraq initially concentrated attention on shortfalls in strategic airlift, a problem that several Euro-Nato nations are to solve in the short-term by leasing assets from the former Soviet Union. As operations in south-west Asia have changed to counter-insurgency, or perhaps civil war, the emphasis has switched to intra-theatre airlift, stressing the need for heavy-lift helicopters and reviving an old US inter-service demarcation dispute.

Roy Braybrook

Dominating the lightweight end of the transport range, the Eads-Casa C-212 first flew in 1971, but it has been progressively improved, resulting in a combined military and civil total of over 460 units for 42 countries. The current 8.1-tonne C-212-400 began flight trials in 1997, and has a virtual monopoly of its market sector.

In comparison, the 9.5-tonne Antonov An-38-100 has yet to prove itself, having first flown in 1994, and with only a handful so far in service. Although similar in capacity to the C-212, the An-38 is clearly designed for short field performance and hot/high operations. Both employ Honeywell TPE331 turboprops, but the Ukrainian aircraft has 1312 kW units, while the Spanish aircraft has engines of only 820 kW.

The 8.1-tonne Eads-Casa C-212 is the smaller brother of the 16.5-tonne CN-235-300 and its 23.2-tonne C-295 derivative. The gap between the C-212 and the CN-235 provides scope for the 12.5-tonne Sukhoi Su-80, which first flew in 2001, powered by General Electric CT7 engines. The Su-80 employs a twin-boom configuration with a high-set horizontal tail to facilitate rear loading.

In 2003 the 20-tonne Ilyushin Il-112VT was chosen to be the Russian Air

Force's next lightweight tactical transport, to replace the 21-tonne Antonov An-24 and 24-tonne An-26. The Il-112VT has Klimov TV7 engines and a conventional military transport layout (i.e., high-wing, fuselage-mounted undercarriage and rear-loading ramp). The Russian Defence Ministry expects to buy 100 to 120 over the next five years, and the Il-112 will also be built in civil form.

The Il-112 will be broadly competitive with the 19.15-tonne Antonov An-140, which first flew in 1997, powered by two Klimov TV3 engines. In 1998 a licence was granted to Iranian Aviation (Hesa) to assemble kits produced at Kharkov (Khapo) in the Ukraine, the end product being the IrAn-140. Hesa is reportedly

working with Antonov on the IrAn-140T with a rear loading ramp. Russia's Federal Security Service is discussing placing an order for some form of An-140 with Aviacor, which produces the commercial version in Samara.

The CN-235, powered by two General Electric CT7 turboprops, was initially developed by Casa in co-operation with the state-owned IPTN, now Indonesian Aerospace (IAe), which earlier built the C-212 under licence. Eads-Casa and IAe have sold a total of around 250 CN-235s, but now market different versions.

The near-term future of the Indonesian company is largely dependent on urgently securing new military orders for the CN-235. Its best prospects appear to be Libya, which reportedly needs eight transports, and South Korea, which already operates a mix of Casa- and IAe-built CN-235s.

The Eads-Casa C-295 is a long-body CN-235 derivative with Pratt & Whitney Canada PW127 turboprops and a Thales Topdeck avionics system. The first new-build C-295 had its maiden flight in 1998,



Demonstrating its capability in a low-altitude parachute extraction mission, the Eads-Casa C-295, first flown in 1998, is truly a modern aircraft. It is a stretched derivative of the CN-235 and is adopted by Brazil, Jordan, Poland and Spain. (Eads-Casa).



Developed by Airtech, a joint venture between Spain and Indonesia, the CN-235 is exemplified by this Eads-Casa-built aircraft of the Spanish Air Force 35th Transport Wing. (Armada/RB).

and the aircraft is now in service with the air forces of Jordan (two), Poland (eight) and Spain (nine). It has also been ordered by Brazil (twelve units) and allegedly chosen by Venezuela (ten plus two for maritime patrol).

The CN-235 and C-295 now compete with the larger (31.8-tonne) and more expensive Alenia Aerospazio C-27J Spartan, which was developed from the G.222 by introducing the Rolls-Royce AE2100 engines, Dowty R391 propellers and cockpit avionics from the four-engined C-130J Hercules.

The first flight of a new-build C-27J took place in 2000. Twelve aircraft are now being produced for the Italian Air Force with head-up displays as per those of the service's Lockheed Martin C-130Js, a defensive aids suite and an in-flight refuelling probe. Deliveries will begin in late 2005. Greece has ordered twelve C-27Js (of which four will have the probe), with an option on three more. Bulgaria has selected the C-27J to replace the Antonov An-26, and the contract for a batch of eight is under negotiation.

The principal battleground between Eads-Casa and Alenia is currently provided by the US Army, which wants a Future Cargo Aircraft (FCA) to replace its fleet of around 43 C-23 Shorts Sherpas, and possibly its 113 Beech C-12 Hurons (Super King Airs) and eleven

Fairchild C-26 Metros. Most of these aircraft are with National Guard or Army Reserve units. The US Army has so far been authorised to buy 33 FCAs, and the US Air Force has evidently decided not to oppose this initial purchase, on the



The Alenia Aeronautica C-27J is competing with the CN-235 and C-295 in the US Army's Future Cargo Aircraft (FCA) programme. An initial batch of 33 aircraft is planned. (Alenia).

understanding that these aircraft will come under the operational control of the Joint Forces Air Component (Jfac) commander, traditionally a US Air Force officer. Whether this amicable arrangement will extend to further FCA buys

(including special-mission aircraft and an 'AC-' gunship version) remains to be seen. Army budget plans refer to a unit price of \$ 33.8 million and a "procurement objective of 123 aircraft, with a requirement for 145".

The US Army issued its FCA request for information (RFI) in May 2005, and the request for proposals is due in the autumn. Type selection is possible in FY2007, when it is planned that three will be ordered, the rate rising steadily to eleven in FY2010. The FCA will perform all the usual tactical airlift roles, including airdrop. It is required to be able to take off in 610 metres, a demand that is believed to reflect future humanitarian operations in Africa. Radius is specified as 1100 km and ferry range as 3900 km.

There is no home-grown solution for FCA, and foreign contractors are required to nominate a US company as prime. In the case of Eads-Casa North America (promoting both the CN-235 and C-295), the partner is Raytheon Space and Airborne Systems, while for Alenia North America the partner is L-3 Integrated Systems. This C-27J team is designated Glob-

al Military Aircraft Systems, and includes Honeywell, Lockheed Martin and Rolls-Royce. The two teams organised demonstration tours of US Army bases in May 2005 using all three types.

Boeing also responded to the RFI, reportedly acting as prime for either a Chinese or Ukrainian product. The most likely contender appears to be a Westernised version of the Xian Aircraft (Xac) Y-7H-500, with P&WC PW127 engines, Hamilton Sundstrand propellers and Collins avionics, as used in the MA60 version of the Y-7. This would be broadly equivalent to the 24-tonne Antonov An-26 (the Xac Y-7 having been based on the civil An-24), and thus in the same class as the CN-235-300.

It may be noted that Boeing has a long-standing relationship with Xac, who supplies aluminium and titanium forgings, floor beams for B747s and the vertical tails for over 1000 B737s. Xac also has ambitions to develop a four-engined transport between the C-130 and C-17.



In the mid-1970s the US Air Force planned to replace the C-130 with a jet-powered short-take-off and landing transport. This Boeing YC-14 investigated 'upper surface blowing' to vector thrust. (Boeing).



The Antonov An-72/74 appears to have followed the Boeing YC-14 in the use of 'upper surface blowing'. The high engine mounting also reduces foreign object ingestion. (Armada/RB).

The less likely alternative would be for Boeing to propose a Westernised Antonov An-32, which would require some development work. The 27-tonne An-32 (distinguished from the An-24/26 series by its high-set engines) was originally designed to meet an Indian Air Force requirement to suit hot/high operations in the Himalayas, hence the use of 3863 kW Ivchenko AI-20D-5 engines. The An-32 first flew in 1976, and deliveries of 118 to India began in 1984. India is planning various improvements, notably to increase airframe life, double the engine time between overhauls (TBO) to 4000 hrs and extend engine life to 20,000 hrs. It is also intended to reduce cockpit noise, add fuel tanks to increase range, modernise the avionics and increase take-off weight to 28.5 tonnes.

Perhaps more relevant to the FCA programme was the fact that, in trying to win the Polish Air Force order, PZL-Mielec and Antonov jointly proposed an An-32M with Pratt & Whitney Canada PW150A engines, Dowty propellers and Western avionics to the customer's choice, all for a unit price of only \$ 15 million.

Twin Turbofans

The advent of high-bypass turbofans in the 1960s sparked some interest in developing a tactical transport that would sacrifice the ultimate in airfield performance

in favour of a faster cruise. In 1970 Kawasaki (KHI) flew the 45-tonne C-1, powered by Pratt & Whitney JT8Ds, and deliveries began in 1974. The C-1 was not produced in large numbers but its configuration set the general pattern for future twin-turbofan tactical transports.

Two alternative configurations were tried in the 1970s under the US Air Force

for take-off and landing, exhausted directly at slotted flaps, thus generating high lift coefficients. The rival Boeing YC-14 had two engines mounted on top of the wing, exhausting through flattened jetpipes, so that the gases adhered to the upper surface of the flaps (Coanda Effect), thus vectoring the thrust. The YC-14 first flew in 1976.

Although neither of these US Stol turbofan projects had any direct consequence in terms of C-130 replacement, the YC-14 may have inspired the Antonov An-72, which first flew in 1977, powered by two high-set Ivchenko D-36 turbofans. This was followed in 1989 by the An-74, which was initially developed for Arctic operations and then became the basis for further development. Interestingly, the next major change came with the An-74TK-300 of 2001, which lowered the engines to a conventional position under the wings, presumably sacrificing short take-off performance for superior cruise aerodynamics and better engine accessibility.

A very similar project to the Kawasaki C-1 was the 47.3-tonne Ilyushin Il-214V, which is believed to form the basis for the Indo-Russian Tactical Transport Aircraft (TTA). A commercial agreement was signed in 1999 between Hin-



Pictured recently «somewhere over Iraq», this Hercules comes from the US Air Force C-130J Formal Training Unit at Little Rock Air Force Base, Arkansas. (Lockheed Martin).

AMST (Advanced Medium Stol Transport) programme, which was aimed at investigating ways to replace the C-130. The McDonnell Douglas YC-15 employed four underwing engines that,

dustan Aeronautics (Hal), Ilyushin and NPK Irkut. The current situation appears to be that the results of a joint feasibility study have been presented to the two governments, and that a first flight is planned to take place six years from the hoped-for go-ahead. According to Irkut, the Indian Air Force plans to purchase 45 TTAs, and the 'Russian market' (suggesting both military and civil users) will demand almost 100.

The C-1 configuration is naturally retained for its replacement, the C-X, of which prime contractor KHI is set to make at least 44. The company was selected in 2001. It has since built a full-scale mock-up and is working on structural test airframes. In April 2005 KHI was contracted to build two C-X flight test aircraft. The first is due to fly in mid-FY2007, for delivery to the Japan Defense Agency in March 2008. The C-X is to be powered by two General Electric CF6-80C2 turbofans as used on Japan's four Boeing E-767s, four KC-767s and two



Had it arrived a decade earlier, the Antonov An-70 might well have become the mainstay of Soviet tactical transport operations. In the event, its future may depend on China. (Armada/RB).



The Airbus Military A400M has gone through a small number of design changes that include the repositioning of the refuelling probe to the port side, and the 'handing' of the propellers. (Airbus Military).

B747-400s. The first of a batch of 100 engines for the C-X is due for delivery in 2006. Service entry is scheduled for 2011, by which time Japan may have relaxed its ban on arms exports. KHI is also prime contractor for the maritime patrol P-X, with which the C-X is required to have some commonality, although the P-X is a four-engined, low-wing project.

Much further up the weight scale, the same basic configuration is used for the 110-tonne Tupolev Tu-330VT project, which is conceptually a tactical transport derivative of the civil Tu-214, using the same cockpit, wings and Perm PS-90AT turbofans. If Russia terminates its support for the Antonov An-70 (discussed later) any available funding will presumably switch to the Tu-330VT.

Quad-Props

The Lockheed Martin C-130 Hercules remains the middleweight workhorse for many air forces, with over 1600 still in service in 67 countries. In 2001 Boeing was selected by the US Air Force to carry out the C-130 Avionics Modernisation Program (AMP), which was launched with a

\$ 1.8 billion contract for the development and demonstration phase running to FY2008. However, in May 2005 the service announced its intention to re-compete the implementation of the programme from FY2009 onwards. It was originally



The Ilyushin Il-76MF combines re-engining, as in the case of the civil Il-76TD-90VD with Perm PS-90A turbofans, and fuselage plugs, giving a 6.6-metre stretch. (Armada/RB).

planned to fly the first C-130 AMP in early 2006 and apply the upgrade to 519 C-130E/Hs, but the number available may be reduced by wing fatigue problems.

The 70.3-tonne C-130J Hercules is a major private venture development by Lockheed Martin, introducing Rolls-Royce AE2100 engines, six-blade Dowty propellers and a modernised flight deck. Having left development to the contractor, the US services came late to the C-130J programme. Although it first flew in 1996, the C-130J did not enter the US Air Force inventory until February 1999, and it was only in December 2004 that the service finally introduced the type in Iraq.

Orders for the C-130J currently stand at 180 units, including 117 for the US services. The US Air Force is so far slated to have 62 combat delivery aircraft (eleven C-130Js and 51 stretched CC-130Js) and 16 special missions aircraft (ten WC-130J Weatherbirds and six EC-130J Commando Solos). The US Marine Corps has ordered 33 KC-130J tankers, and the US Coast Guard is to have six HC-130Js. Australia has ordered twelve, Denmark four, Italy 22, and the UK 25.

Secretary of Defense Donald Rumsfeld announced in late 2004 that C-130J procurement would be terminated. That decision, part of a series of economy measures, was evidently based on an esti-

mate that cancellation charges would amount to only \$ 493 million. It subsequently became clear that cancellation of the C-130J would dramatically increase the overheads charged on Lockheed Martin's production of the F/A-22 and modernisation of the C-5, effectively doubling the original estimate. Faced with the revised figures Rumsfeld cancelled the cancellation. However, it is still possible that US procurement will be stopped prior to completion of the current programme, depending on the results of the Pentagon's Mobility Capabilities Study.

The hassles experienced by Lockheed Martin over the C-130J pale in comparison with those of Antonov over the 132-tonne An-70, which first flew in 1994. In propulsion terms, the An-70 is potentially the most advanced transport aircraft currently in flight test, having four Ivchenko D-27 propfans turning Aerosila/Stupino SV-27 multi-blade propellers. However, the An-70 may well go down in history as a casualty of the dissolution of the Soviet Union. Despite Russian assurances in February 2004 of continuing sup-



This US Air Force Boeing C-17 Globemaster III from Charleston Air Force Base is pictured on a taxiway at Bagram Air Base in Afghanistan. (US Air Force).



This Bell/Boeing MV-22, assigned to VMX-2 operational test and evaluation squadron, was photographed as it was landing on the amphibious assault ship USS Nassau, LHA-4. (US Navy).

port for a trials programme that was due to run to the end of 2005, the chances are that the An-70 will join the long list of basically sound projects that simply missed their windows of opportunity. In fairness to Russia, it must be acknowledged that development of the propulsion system of the An-70 was not straightforward, and that transport aircraft seldom have top budgetary priority.

The final nail in the An-70 coffin may have been the Euro-Nato decision in May 2003 to proceed with the 130-tonne Airbus Military A400M (seen in a mock-up picture on the cover of this supplement), on the basis of a contract for 180 aircraft for seven nations. Powered by Europrop International TP400-D6 engines, the first of six developmental A400Ms is scheduled to fly in January 2008, paving the way for the start of deliveries to France and Turkey in November 2009. Britain and Germany will receive their first aircraft in 2010, to be followed by Belgium, Luxembourg and Spain.

Airbus Military has invited other countries to join the A400M programme, and in December 2005 the South African government accepted, committing to purchase between eight and 14 aircraft for delivery between 2010 and 2014. Eight aircraft would cost € 837 million. Denel and Aerosud are negotiating with Airbus Military for the guaranteed design and manufacturing work packages that will cover the next 17 years. They will later be able to bid for maintenance and upgrade work. Malaysia and Australia may join the programme, although work sharing is reportedly finalised. So far, the typical

yardstick for the size of an aero-transportable armoured vehicle has been the Hercules. The A400M could well bend the rule upwards.

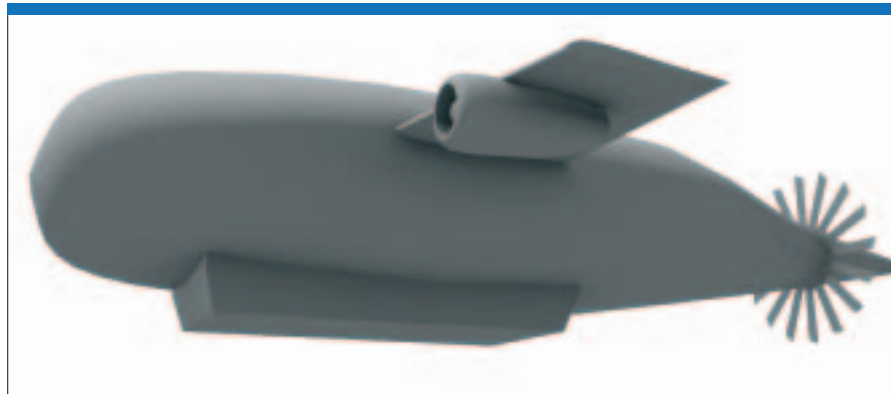
Quad-Jets

Another programme that is finally going ahead is the re-engined Ilyushin Il-76, although in this case a commercial operator is leading the way. Flight tests of a new-build Il-76TD-90VD with modernised avionics and Perm PS-90A turbofans in place of Rybinsk D-30KPs (which do not meet Stage Three noise regulations) were to begin in June 2005.

The first two aircraft, produced by Tapo in Tashkent, have been funded by Volga-Dnepr Airlines, which own the proprietary rights. Thus encouraged, the Russian Air Force has contracted Vaso in

Voronezh to re-engine three Il-76MDs with PS-90As. The service is also reported to have ordered two further prototypes of the stretched, 210-tonne Il-76MF (also with PS-90As), the first having flown in 1995. When funds are available, 120 Il-76MFs are required by Russia. Saturn is meanwhile developing a D-30KP Burlak upgrade, aimed at satisfying the new noise requirements.

The 265-tonne Boeing C-17 Globemaster III (seen in our title picture in nine-ship formation performing an air-drop exercise – courtesy of the US Air Force) has been one of the big success stories in military air transportation. Congress is now pressing the US Air Force to start negotiating for 42 more, to follow the present 180-unit programme (which will provide a final delivery in 2008). The service has ordered long-lead



Darpa's Walrus is designed to augment its buoyancy with aerodynamic lift and vectored thrust. The aim of the project is to be able to transport a brigade anywhere in the world within a week. (Darpa).



The US Army's workhorse in intra-theatre operations is the Boeing CH-47 Chinook, shown here landing at the Afghan Army training base at Policharki. (US Army).

items for seven additional C-17s in FY2006 but refuses to commit itself to the 222-aircraft total. The US Air Force is reportedly considering selling some early production C-17s to commercial operators, to add to the Civil Reserve Air Fleet and provide money to purchase additional improved aircraft, which will carry 37,900-kg more fuel. The only C-17 export customer to date is Britain, with four on lease. These, together with a fifth (and possibly four more), are expected to be purchased when the lease expires in 2008. At the 2005 Paris Air Show Boeing revealed that it is studying a 'C-17 Plus' with more powerful Pratt & Whitney F117s, and modifications to the undercarriage and flaps, to allow it to take off and land in less than 610 metres

In US Air Force service the C-17 complements the 380-tonne Lockheed Martin C-5 Galaxy. The service plans to have that company apply its Avionics Modernisation Program (AMP) to 60 C-5As, 50 C-5Bs and two C-5Cs. One C-5A and two C-5Bs will then be fitted with General Electric CF6-80C2L1F turbofans and receive 70 improvements to specific aircraft systems, these made under the Systems Definition and Demonstration phase of the Reliability Enhancement and Reengining Program (Rerp). The first such aircraft, redesignated C-5M Super Galaxy, is due to fly in the fourth quarter of 2005.

Whether the Rerp will be applied to further C-5s depends on the measured improvements, and on the Pentagon's Mobility Capabilities Study. This is expected to show a need for the US Air Force Mobility Command to be able to generate almost 60 million short-ton miles (85 million tonne-km) per day, around one-third more than is currently possible.

In moving heavy equipment to the Afghanistan and Iraq theatres, several countries have chartered 392-tonne Antonov An-124s from Antonov and Volga-Dnepr Airlines. Fifteen Nato nations plus Finland (to be joined later by Bulgaria and Romania) will, from the end of 2005, benefit from a secured-access scheme under which two An-124-100s will always be available within 72 hours and four more within six days. Details are scarce, but Volga-Dnepr (which has ten) appears to be the major contractor. The airline is also seeking support to restart production at Aviastar in Russia.

Vertical Risers

The extra power required for vertical take-off penalises disposable load, it is, therefore, arguably appropriate to begin this review somewhere higher up the gross weight scale than for fixed-wing aircraft – at 20 tonnes.

The 21.5-tonne Bell/Boeing V-22 Osprey is the world's first production tilt-rotor aircraft, and is currently in operational evaluation prior to a full-rate production decision in November 2005. Procurement plans cover 458 units, including 360 MV-22 assault transports for the US Marine Corps.

Under recently revised US Army plans, 397 Boeing CH-47D Chinooks are to be upgraded to 24.5-tonne CH-47F Improved Cargo Helicopter standard, with new digital cockpits and uprated Honeywell T55-GA-714A engines. The US Army will also buy 55 new-build CH-47Fs, and its Special Operations Command is to have 61 CH-47Es upgraded to CH-47Gs. Beyond this, the Army is looking at a Joint Heavy Lift (JHL) project, one which could carry a Future

Combat Systems (FCS) vehicle weighing up to 25 tonnes.

The US Marine Corps plans to have its 31.6-tonne Sikorsky CH-53E superseded by a Heavy Lift Replacement (HLR) or a CH-53X, with a gross weight in the 40-tonne region and a 13-tonne payload. In late 2004 the US Marine Corps awarded a \$ 103 million contract to Sikorsky to launch development. Service entry is scheduled for around 2015, and it is hoped that Germany will adopt the HLR as a replacement for the ageing CH-53G. However, the German Army will be under pressure from Eurocopter to order its projected Heavy Transport Helicopter.

Congress would prefer to combine US Army's JHL and the Marine Corps' HLR developments, but they are clearly very different in size, and probably a decade apart.

This survey would be incomplete without mention of the Darpa 'Walrus' Global Reach Air Vehicle project, to develop a massive 'hybrid aircraft' that generates lift through a combination of buoyancy, aerodynamics and vectored-thrust. Darpa is studying performance in a rolling vertical take-off of around 450 metres, a short take-off in less than 1400 metres and a conventional take-off in 3000 metres.

Following a smaller scale advanced technology demonstration air vehicle, similar to the C-130 Hercules in payload-range performance, the full-scale Walrus will carry a 500-tonne payload over inter-continental distances, covering 22,000 km in less than seven days. The primary mission is to deploy the personnel and equipment of the US Army's future Unit of Action (UA), ready to fight within six hours of disembarkation. The first FCS-equipped UA, consisting of three Combined Arms Battalions, is due to be fielded in 2014.



The heaviest Western helicopter currently in service, the Sikorsky CH-53E Super Stallion, is pictured during deck landing qualifications on the USS Essex, LHD-2. (US Navy)



Wagon Train

The GPV A1+ is under evaluation by the US Army

An excerpt from the USNI-published book, *On Point – The United States Army in Operation Iraqi Freedom*, explains, «Fuel, water, and food are the greatest burdens for logisticians to bear. To meet the 2 million gallons of fuel per day required – from tanks to aircraft – the Third Army had worked for two years to develop the infrastructure that a potential war with Iraq would require».

Ian Kemp

The logistics effort in support of the US-led Operation Iraqi Freedom was truly impressive. During the 500 km advance to Baghdad the US Army's V Corps alone consumed 14,659,260 meals ready-to-eat, 2,831,000 collectively prepared meals, 26,613,396 bottles of water, 54 million gallons of fuel and 5156 tonnes of ammunition. A small quantity of these stores was carried on combat vehicles as they began their advance into Iraq. A fleet of logistics vehicles that would have been the envy of World War II commanders carried the vast majority.

Throughout the Cold War, logistics planning for Nato armies relied heavily upon building forward bases and host nation support. Logistics practice during field training exercises focussed primarily on the real requirements of keeping units supplied with fuel, food and water. The movement of ammunition, spare parts, replacement vehicles, reinforcements and a host of other vital logistics functions necessary for actual operations were usually simulated on a small scale and occasionally ignored all together. The self-defence of logistics units was another area that was usually 'underplayed'.

Since the end of the Cold War the emphasis has shifted to expeditionary logistics to mount and sustain peace support operations in such diverse locations as former Yugoslavia, Somalia and East Timor, and to support combat operations in Afghanistan and Iraq. An early lesson of asymmetric warfare soon became apparent and was summarised in a 2004 article in the US Army's *Armor* magazine, «The enemy will very rarely decide

to attack our heavily armored vehicles, instead they focus on the armored force's Achilles' heel – its support assets. As a result, new tactics, techniques and procedures must be exercised to combat the threat against soft-skinned vehicles.» The need for military forces to copy the US Marine Corps' mantra that 'every marine is first a rifleman' has never been more apparent. In response to this threat the US Army has made a pledge that «all wheeled vehicles will be armoured before crossing the berm» and all will be fitted with machine guns for self defence. For a service that has a requirement for more than 83,000 2.5 to five-tonne medium tactical vehicles, this is an expensive challenge. However, it is a necessity that any army with a claim to an expeditionary capability cannot afford to ignore.

Although civilian contractors are increasingly relied upon to supply established peace support operations, the UK Ministry of Defence report on Operations

in Iraq – Lessons for the Future notes, «Experience in this operation demonstrated that the MoD cannot necessarily rely on contractor support in regions where the threat level is high».

The US market, indeed the global market, for military logistics vehicles is dominated by two American companies – Stewart & Stevenson and Oshkosh.

The US Army's Family of Medium Tactical Vehicles includes a series in 15 different configurations. Stewart & Stevenson has produced over 29,000 FMTV vehicles since the series entered service in 1991. In April 2003 the company was awarded the current multi-year production contract that covers 7063 trucks and 3826 trailers for delivery from Fiscal Year 2004 through 2008 with options to order up to an additional 12,000 trucks and trailers over the five-year contract period. In June 2005 Stewart & Stevenson received three contract modifications totalling \$ 483 million for 3016 vehicles in addition to 2770 units already ordered in the third contract year. Deliveries under this order will continue until September 2008. To meet the increased demand the company is currently expanding its production facility in Sealy, Texas.

The FMTV range consists of two primary versions: the 2.5-tonne 4 × 4 Light Medium Tactical Vehicle (LMTV) and the five-tonne 6 × 6 Medium Tactical Vehicle (MTV). The two versions share 85 per cent commonality between components. The LMTV is produced in van and cargo variants while the MTV line includes cargo, tractor, expansible van, dump, wrecker, long wheelbase cargo and materiel-handling equipment variants. The design, with a tilt cab over the engine, means that the vehicles are typically one metre shorter than the vehicles they replaced. All FMTV variants can be carried by a C-130 Hercules and the cargo variants can be slung beneath a CH-47 Chinook helicopter. The FMTV trailers have the same payload capacity as their prime movers, thus a five-tonne cargo truck can tow a five-tonne trailer.

The newest variant is the 8.8-tonne Load-Handling System (FMTV-LHS) that mounts a container-handling system capable of loading a standard six-metre ISO container on both the truck and its



A convoy of military and civilian trucks delivering stores to a forward operating base in Iraq. Civilian contractors are especially vulnerable to attacks by insurgents. (US Marine Corps)



Stewart & Stevenson has produced more than 29,000 examples of the Family of Medium Tactical Vehicle for the US Army with thousands of vehicles still on order. A five-tonne FMTV cargo truck can tow a five-tonne trailer. (Stewart & Stevenson)

associated trailer. The five-tonne FMTV serves as the chassis for the Lockheed Martin High Mobility Artillery Rocket System (Himars), for which the US Army and US Marine Corps are expected to order 900 launchers.

The Sealy factory is also manufacturing the Low Signature Armored Cab (Lsac) for use on FMTVs. By December 2004 the army had ordered 1743 Lsac kits worth \$ 155,000,000.

In April 2005 Stewart & Stevenson acquired the outstanding shares of Automotive Technik (ATL), the British-based manufacturer of the Pinzgauer light utility vehicle, for £ 25 million. ATL has received two major defence orders since it took over production of the Austrian Pinzgauer family of 4 × 4 and 6 × 6 cross-country vehicles in 2000. The Ministry of Defence ordered 360 Pinzgauer 716 MK hardtop models to meet the British Army's Truck Utility Medium Heavy Duty (Fitted-For-Radio) requirement. They will join more than 1000 Pinzgauers already in British service. Deliveries began in mid-2004 and will be completed by the end of 2005. ATL was awarded contracts in 2004 to supply 321 Pinzgauers for the New Zealand Army's Light Operational Vehicle project. In early 2004 ATL unveiled an armoured Pinzgauer based on the 718 series 6 × 6 chassis and it has added the Pinzgauer X-M (X-treme Mobility) model.

Oshkosh produces a range of logistics vehicles for the US Army, including the M1075 Palletized Load System (PLS) truck and M1076 PLS trailer, the eleven-tonne 8 × 8 Heavy Expanded Mobility Tactical Truck (Hemtt) series which includes the M977 cargo truck, the M978 2,500-gallon fuel tanker, the M983 tractor, M984A1 wrecker and M985 cargo truck with materiel-handling crane and the M1120 load-handling system. Also included are the Heavy Equipment Transporter System (Hets) – a Hemtt variant – and the M1977 Common Bridge Transporter.

Since March 2001 these have been combined, along with associated mod-

ernisation projects, under a single production contract designated the Family of Heavy Tactical Vehicles.

With more than 15,000 vehicles fielded the Hemtt is described as the workhorse of the army's combat divisions and production is planned to continue until FY2011. The army is nearing completion of an upgrade programme to bring early vehicles to the current production standard and convert some variants to address shortfalls in specific areas. The Hemtt recapitalisation project, which is scheduled to run until FY2016, will insert modern commercial technology into the fleet in order to reduce operational and support costs and increase readiness.

Oshkosh unveiled the Hemtt A3 at the AUSA Winter Exposition in Fort Lauderdale, Florida in mid-February 2005. The third-generation design features numerous advanced technologies, such as hybrid-electric drive, an enhanced load handling system and independent suspension to improve performance. The Hemtt A3 is the first production-ready tactical defence vehicle to feature a

diesel-electric drive system known as ProPulse that, according to Oshkosh, increases fuel economy by at least 20 per cent. It also allows the vehicle to export up to 200 kilowatts of AC power, helping reduce the army's requirements for separate generators to power command posts, hospitals, workshops and other installations. An integral armoured cab can be field installed in less than eight hours.

The load handling system enables the Hemtt A3 to unload cargo from a C-130 without the need for other additional equipment. «This capability will produce efficiencies in the supply chain never before experienced in a joint operating environment. Air Force cargo planes will be able to deliver supplies directly to army transport units in remote locations,» said John Stoddart, Oshkosh's executive vice president and president, defense business. The A3 is 1360 kg lighter than its predecessor, enabling it to be carried inside a C-130 with a partial payload; a first for the Hemtt line.

The Hemtt A3 is undergoing an 18-month performance and reliability evaluation supervised by the army's Heavy Tactical Vehicle Program Office.

The Heavy Equipment Transporter System, comprising the M1070 tractor and the M1000 semi-trailer, was designed to carry the M1 Abrams main battle tank which, in its latest configuration, weighs almost 70 tonnes. Of the approximately 2200 in service in 2004 about 1000 were deployed to the Gulf region to support operations in Iraq. The army has a total requirement for 2412 units. Unlike previous Hets the M1070 carries both the tank and its crew.

This year Oshkosh will complete delivery of 6931 6 × 6 Marine Tactical Vehicle Replacement (MTVR) trucks ordered by the US Marine Corps in December 1998. The MTVR has been used extensively by the marines in Afghanistan and Iraq. With a payload of seven tonnes off-road and 15 tonnes on-road, and greater cross-country performance the MTVR represents a significant increase in capability over the five-tonne



The US Marine Corps has bolstered its cargo lift capability by replacing more than 8000 of its five-tonne M809/M939 medium tactical trucks (right) with the Oshkosh Marine Tactical Vehicle Replacement (MTVR) that is capable of carrying a seven-tonne load cross country and twelve tonnes on roads. Oshkosh has recently begun delivering MTVR wrecker and dump trucks. (US Marine Corps)



Oshkosh Marine Tactical Vehicle Replacement trucks fitted with armour protection kits are being used on convoy protection and patrol missions in Afghanistan and Iraq. (US Department of Defense)

M809/M939 medium tactical truck that it replaces. The specified MTRV mission profile is 70 per cent off road and 30 per cent on-road compared to 30 off-road and 70 per cent on-road for its predecessor. Under a \$ 185.9 million contract modification awarded in February 2004 Oshkosh is producing 274 MTRV wreckers and 426 MTRV dump trucks. Deliveries of these new models began in May 2004. The MTRV wrecker is the first Oshkosh military truck to be equipped with the company's Command Zone electronics system, designed to simplify operation and maintenance.

Oshkosh is competing with American Truck Company (ATC) for the US Marine Corps' Logistics Vehicle System Replacement (LVSr) project to supply up to 1588 vehicles as partial replacement for the Marine Corps' fleet of about 4000 Mk 48 series heavy logistics vehicles built by Oshkosh in the early 1980s. These have an off-road payload of 16.5 tonnes and an on road payload of 22.5 tonnes. Each company received a contract in March 2004 to deliver three prototype cargo vehicles by March 2005 for a 19,312-km durability and performance test followed by operational assessment. The anticipat-

ed variants will include cargo, fifth wheel and wrecker vehicles.

ATC was formed in 2001 by Czech truck manufacturer Tatra, its American owner, Terex, and Special Task Vehicles USA to market Tatra vehicles to military and commercial customers. It received a \$ 54 million foreign military sales contract from the US Army's Tank Armaments and Automotive Command to supply the Israel Defence Force with 302 Medium Tactical Trucks and associated logistics support. The contract includes options for an additional 243 trucks worth more than \$ 40 million. Selection for the LVSr contract would be a significant breakthrough for ATC. Tatra has suffered since the loss of its former military market in the Soviet Union. The Czech government has stated its intention to order 552 Tatra R.210.12 W 6 x 6 medium trucks in September and to follow this with a later order for 421 vehicles to carry special payloads.

The Freightliner Group, a division of DaimlerChrysler and North America's largest manufacturer of tractor trucks, produces the US Army's M915-series Line Haul Tractor. These trucks equip active and reserve component trans-

portation units that move bulk supplies and fuel on highways and secondary roads from ocean ports to division support areas. The series consists of the M915, M915A1, M915A2, M915A3 and M915A4 vehicles; the latter three models are based on Freightliner's commercial FLD120 tractors. The tractors are used primarily to haul the 22.5-ton M871 flatbed semi-trailer, 34-tonne M872 flatbed semi-trailer and the 28,400-litre M1062 tanker.

The M915 and M915A1 were delivered from 1978 to 1982 and supplemented from 1989 by the M915A2 tractor and the M916A1 6 x 6 light equipment transporter. In 1998 Freightliner incorporated modern technologies, including the Detroit Diesel Series 60 engine and its own TufTrac maintenance-free suspension system for enhanced off-road mobility, to produce the M915A3. The company also began producing 'glider kits' to upgrade the fleet of 1857 M915s to the M915A4 configuration to keep them in service for another 20 years. The M915A4 incorporates many of the modern M915A3 design features but costs about 35 per cent less than a new vehicle. The service's 2200 M915A1s are also likely to be upgraded in the future.

Last year the Tacomb bought an 8 x 8 Medium Tactical Vehicle (MTV) A1+ from General Purpose Vehicles for evaluation. This truck can carry a 16-tonne payload on roads and a twelve-tonne payload cross-country. The large flatbed area is able to carry three standard Nato pallets. The vehicle can be carried inside a C-130 aircraft after only five minutes of preparation. The MTV A1+ is fitted with an armoured cab with ballistic windows and individual seats designed to provide protection against mines and improvised explosive devices. The truck can be fitted with a machine gun on the cab – a nuclear, biological and chemical defence system is an option. As a private venture Freightliner has developed the modular General Purpose Vehicle family that it describes as a «national security and defense vehicle». These 4 x 4, 6 x 6, 8 x 8 and 10 x 10 armoured vehicles share about 95 per cent of the components used in the MTV A1+. The company has also developed a



A US Marine Corps Logistics Vehicle System drives past bottled water and rations stockpiled in one of the many logistics storage lots at Camp Taqaddum, Iraq. (US Marine Corps)



The £ one billion British order is the first for MAN's new HX range of tactical trucks launched in 2003. This includes 4 × 4 (left), 6 × 6 and 8 × 8 (right) vehicles in a variety of configurations. (MAN)

suspension and steering retrofit modification kit for the FMTV that provides increased wheel travel, improved ride quality, greater side slope navigability and electronic ride height control. For evaluation purposes the kit has been tested on the five-tonne cargo variant.

Every American truck maker is hoping for a share of the army's Future Tactical Truck Systems (FTTS) project that is intended to provide a complete family of logistics vehicles to support the Future Combat System, which is planned to enter service about 2014. There will be two versions of the FTTS: the FTTS-Maneuver Sustainment Vehicle (FTTS-MSV) will replace the LMTV, MTV, Hemtt, and PLS trucks. The second is to be the FTTS-Utility Vehicle (FTTS-UV), which is intended to replace the High Mobility Multipurpose Wheeled Vehicle. The FTTS-MS cargo variant is visualised as an 8 × 8 vehicle with a ten-tonne payload. Early plans call for each brigade-size unit of action to be equipped with 150 FTTS-UV and 204 FTTS-MSV.

The FTTS Advanced Concept Technology Demonstration programme, now underway, will assess key technologies such as Hybrid Electric Drive, advanced diesel engines and new systems. The army is seeking significant improvements in the four key areas of: fuel efficiency, mobility, cargo handling and electronic systems. The Iraqi experience over the past two years has increased the importance of crew survivability features within the specifications. The army wants to double the average operational range of logistics vehicles from the current 500 km to 1000 km per vehicle with no increase in fuel consumption. As 70 per cent of the logistics burden on military operations is fuel this would represent a significant economy. The FTTS will be carried by C-130 and must have the ability to load and offload cargo from the aircraft. Situational awareness will both enhance crew protection and also ensure that logistic units are fully integrated into network-centric operations.

In mid-2004 Lockheed Martin launched itself into the \$ 1 billion-a-year American military truck market when it signed an agreement with HMT Vehicles of Britain. This covers the marketing of HMT's range

of 4 × 4 and 6 × 6 High Mobility Transporter (HMT) vehicles in North America and countries covered by the US FMS programme. "This type of vehicle fulfils an urgent need by the US military's rapid reaction forces for a highly mobile, tactical vehicle system that meets the expeditionary requirements of the modern battlefield," said Frank Meyer, Lockheed Martin Systems Integration Owego president. Lockheed Martin had earlier selected the HMT 6 × 6 model as the platform for the British Army's Soothsayer electronic warfare system. The 6 × 4 model was chosen by Insys as the platform for the Lightweight Mobile Artillery Weapon System (Rocket) that is now being developed for the British Army. For the US market the vehicles will be designated the LM 4 × 4 and the LM 6 × 6. Built by Supacat, HMT Vehicles' sister company, the HMT 4 × 4 can carry a typical payload of 3.5 tonnes while the 6 × 6 can carry a 5.5-tonne payload. The HMT 4 × 4 is small enough to be carried internally by a CH-47 Chinook. An 8 × 6/8 × 8 model is under development.

Germany's MAN scored a major coup in October 2004 when it was selected by the British Defence Procurement Agency to supply the next generation Support Vehicle to the British armed forces in preference to bids from DaimlerChrysler, Stewart & Stevenson and

Oshkosh. The £ 1 billion contract covers 4851 cargo trucks, 314 recovery vehicles and 69 recovery trailers and, if options are exercised, the contract could increase to 7200 units. The in service date for the cargo vehicles is June 2007 and February 2008 for the recovery vehicles. Deliveries will run until 2015.

Within the British Defence Procurement Agency the General Support Vehicles Integrated Project Team is responsible for the acquisition and management of vehicles, with a payload of four tonnes and above, across the services; thus ensuring maximum commonality. After determining that procurement would not be possible through a Private Finance Initiative the DPA launched the SV tender in November 2001.

The British order is the first for MAN's new HX range of tactical trucks launched in 2003. The medium mobility vehicles, based on MAN's HX-series, include 4 × 4 six-tonne, the 6 × 6 nine-tonne and 8 × 8 15-tonne cargo vehicles and a 6 × 6 tanker. The improved medium mobility 6 × 6 cargo truck and tanker are based on MAN's SX44 high mobility chassis. The SX-range is derived from the Kat 1 trucks, of which MAN supplied 8168 examples to the Bundeswehr from 1976 to 1982. The improved Kat 1A1 was launched in 1993 and followed by the 1A1.1 in 1997. The UK order will add to the more than 12,000 Kat 1/SX series trucks sold to more than 60 customers. The contract also covers two 8 × 8 – an 18-tonne and a 36-tonne – recovery vehicles. Both HX and SX series vehicles can be carried by C-130 aircraft. Krauss-Maffei Wegmann has developed an appliqué armour kit for the Kat 1/SX series and mine protection kits have been fitted to German Army vehicles operating in Kosovo and other potentially dangerous theatres.

Oshkosh was confident of winning the British contract as it has recently received two significant orders from the Ministry of Defence. Under the Wheeled Tanker programme Oshkosh is supplying 57 Close Support Tankers-Water with an 18,000-litre capacity, 82 Tactical Aircraft Refuellers (15,000 litres) and 218 Close Sup-



The MAN SX 32.460 8 × 8 logistic truck is fitted with a landmine and ballistic protection package designed by Krauss-Maffei Wegmann. The two manufacturers claim the system offers a level of protection not exceeded by any other logistics vehicle. Pre-series vehicles began field trials with German peacekeepers in Kosovo in 2004. (KMW)



Having won the contracts to supply the British Ministry of Defence with 92 Heavy Equipment Transporters seen here and 348 Wheeled Tankers Oshkosh believed that it was in a strong position to win the UK's Support Vehicle competition. Its hopes were not realised. (Oshkosh)

port Tankers (20,000 litres). These are towed by a tractor truck of the MTRV type that formed the basis of the company's unsuccessful bid for the UK's SV competition. The first tankers were delivered from Oshkosh's new manufacturing facility in Llantrisant, Wales earlier this year. Oshkosh is responsible for maintaining and supporting the vehicles through their 15-year service life including training, spare parts supply, major maintenance work and supply of manuals.

Oshkosh has delivered 92 1070F 8 x 8 Heavy Equipment Transporters coupled to a King GTS 100 seven-axle semi-trailer to Britain since 2003. The vehicles, developed from the US Army's Hets, are actually owned, operated and maintained by the Fasttrax consortium under a PFI, whereby drivers are required to be members of the reserve forces. Due to the increasing incidents of insurgent attacks on logistics convoys machine gun mounts have recently been fitted on Hets and other British logistics vehicles in Iraq.

Renault Trucks Defense publicly launched its Sherpa 5 6 x 6 tactical truck series at Eurosatory 2004. The design builds on the Renault experience in refurbishing and upgrading more than 5600 Berliet GBC 8KT 6 x 6 trucks (designated RGBC 180 after refurbishment) for the French Army and producing about 2700 TRM 6 x 6 tactical trucks. The standard Sherpa 5 cargo configuration can carry a five-tonne payload and tow a load of four tonnes cross-country or eight tonnes on roads. Enclosed or soft-top cabs are available; the later model can be carried by a C-160 Transall and C-130 aircraft. An armoured cabin protection kit is also available. Giat is the launch customer for the Sherpa 5, with 76 vehicles on order. Indeed production models of the Caesar 155 mm self-propelled howitzer will now be based on the Sherpa as the German Mercedes-Benz Unimog 6 x 6 truck chassis that carried the five prototypes is no longer produced. The Sherpa 10, 15 and 20 are based on its Renault's Kerax range of heavy-duty commercial trucks that it began building in 1997. The French Army has bought more than 250 militarised Kerax trucks in five configurations, including some 4 x 4, 6 x 6 and 8 x 8 models.

In recent years Mercedes-Benz has launched its S2000 series of tactical vehicles. The first 4 x 4 prototype was shown in 2000 and was followed by a 6 x 6 model in 2003 and an 8 x 8 prototype in 2004. Automotive components are found from the company's commercial truck range while a modular three-seat military cab was designed by Mayflower Vehicle Systems in Britain. A seven-millimetre steel floor protects against anti-personnel landmines and an appliqué armour kit can be fitted to improve mine protection and provide ballistic protection. The two- and three-axle vehicles can be carried by a C-130. The company's Actros and Atego military truck ranges, based on the commercial vehicles of the same names, have been sold to customers around the globe. Parent company DaimlerChrysler is the world's largest manufacturer of trucks with production facilities in 37 countries. The two-axle Atego range carries payloads of three to five tonnes while the larger Actros is produced in two-, three- and four-axle configurations. Mercedes-Benz also produces the Unimog U3000, U4000 and U5000 range of high mobility 4 x 4 tactical trucks.

Finland's Sisu Auto has recently supplied 110 Sisu 480-series 6 x 4 tractor

trucks to the French Army. Under a 1997 collaboration agreement with Renault the two companies manufacture components for each other's trucks and Renault markets the Sisu range in Europe. The Finnish Defence Force is the company's major military customer and operates 220 E11T-6 6 x 6 high mobility tactical trucks delivered between 1998 and 2002 and 27 E11T-8 8 x 8 trucks fitted with a load handling system. The 6 x 6 vehicle has a cross-country payload of 15.5 tonnes while the 8 x 8 vehicle can carry 19.7 tonnes. The vehicle cabs can either be fitted with an appliqué armour package or a fully armoured cab can be installed.

There are two major manufacturers of military trucks in Sweden. Although its largest defence customer is the Swedish armed forces, Scania has achieved significant export success with its 4-Series vehicles in recent years. These include its largest export order in 2003 with a contract to Dutch subsidiary, Beers Bedrijfsauto, to supply 533 P124CB 8 x 8 trucks to the Royal Netherlands Army. The trucks will be equipped with a cargo handling system and the contract includes 257 cab ballistic protection sets. Scania France has supplied 300 6 x 6 fuel tankers and twelve heavy equipment transporters to the French armed forces. Scania has also sold 131 trucks to Finland over the past six years with an option to buy a further 40 vehicles per year in 2005 and 2006. Sweden's armed forces are also the largest customer for Volvo Truck's FM12 range that is available in two-, three- and four-axle configurations.

In January 2004 Iveco Defence Vehicles received a € 70 million contract to supply 400 M250-series 6 x 6 medium trucks (M25040WM) to the Belgian Army with an option for a further 379 vehicles. The cabins in all of the vehicles will have land mine protection installed and the contract also covers 350 add-on armour kits for protection against small



Renault Trucks Defense launched its Sherpa range of tactical trucks at Eurosatory 2004. Giat has ordered 76 Sherpa 5 6 x 6 chassis to carry the Caesar 155 mm self-propelled howitzers now on order from the French Army. (Renault)



Sweden's Scania is currently building 533 logistics vehicles for the Royal Netherlands Army in its largest defence export order to date. Ballistic protection sets will be supplied for 257 vehicles. (Scania)

eral Dynamics – Land Systems Australia, MAN Nutzfahrzeuge, Mack Truck Australia, Scania Australia, Stewart & Stevenson, Tenix Defence and Terex. ADI has since teamed with Oshkosh and ATL to compete for Land 121.

Land 121 is a rolling project to replace five major vehicle types and 40 different variants in three mobility categories. The current strategy is to upgrade the current fleets with new technology and limited procurement to fill existing shortfalls in critical capabilities. These fleets will then eventually be replaced by planned phased procurements, rather than as separate projects.

Brisbane-based MAN Automotive Imports received a A\$ 16 million contract to supply of 14 tank transporters as part

arms fire. Deliveries will run from 2005 until 2008. Iveco is already delivering 150 Eurotrakker MP410E44H 8 x 8 flatbed trucks, equipped with the Tam flatbed system, ordered in 2003.

Hungarian truck builder Rába, with its German partners DaimlerChrysler and MAN, was selected in 2003 to supply up to 8000 logistics vehicles over a 15-year period to Hungary's armed forces. The five major types include DaimlerChrysler G-Wagen utility vehicles, Mercedes-Benz Unimogs, Rába five-to-eight tonne H-14s, Rába three-axle 10- to 18-tonne H18s and MAN 18-tonne trucks and trailers. In the first stage of the project Rába delivered 90 H-14 4 x 4 trucks in 2004.

Australia's armed forces are amongst the most capable in the Asia-Pacific region and a number of projects are underway to enhance their expeditionary capabilities. The Australian Army's Project Land 121, expected to be worth A\$ 3



A convoy of French Army vehicles forms up after disembarking in the Côte d'Ivoire. Renault Trucks Defense is producing the refurbished GBC 180 (centre right) and the TRM tactical trucks (centre left). (French ECPA)

billion, is intended to modernise and replace the service's fleet of 7700 wheeled vehicles, 3100 trailers, and 750 motorcycles and all terrain vehicles. Nine companies were shortlisted in March 2005, ADI, DaimlerChrysler Australia-Pacific, Gen-

of the Australian Army's project to acquire 59 refurbished M1A1 tanks. The prime movers will come from the parent company's German production line while local firm Drake Trailers will manufacture 14 heavy-duty trailers.



Shipping New Challenges

The Mounts Bay just prior to launch

Some interesting news items have appeared recently which illustrate the fundamental changes that have emerged in how both amphibious warfare and naval strategic transport operations are now being perceived.

E. R. Hooton

One of the first related to the € 210 million order placed by the Portuguese Defence Ministry

with Howaldtswerke-Deutsche Werft (HDW) to meet the former's Navio Polivalente Logistico (NPL) requirement. The second was the outline response to the United States Navy's requirements for its sea-basing policy, while activity in both

shipyards and defence ministries point to further changes.

The NPL is a combined multipurpose logistical ship that is capable of strategic projection operations. It was widely believed at the time that HDW would offer the Royal Schelde Enforcer design to meet this role but, in fact, a German-Netherlands agreement had lapsed and HDW will now be offering its own Multi-Role Dock design.

This reflects the growing view that in strategic operation the prospects of a frontal amphibious assault against heavily fortified coasts, similar to those made during the Second World War (or even at Inchon in 1950), have gone. Coastal defences do exist, and with surface-to-surface missile support they can ensure that any amphibious force must stand off a considerable distance from the coast.

Naval assaults are now increasingly based on the initial insertion of troops by rotary wing aircraft or air cushion vehicles (hovercraft) also known as Landing Craft, Air Cushion (Lcac). These can then weaken or neutralise the defences allowing the heavy support, reserve and logistics forces to be delivered by sea across the beaches. Consequently, there is less



The new French BPC Mistral is the basis of a design being offered to a number of countries. (DCN International)

demand in navies for Landing Ship Tank (LST)-type vessels which run themselves aground and allow men and material to reach the beach via bow doors.

Instead, ships need to have large spaces to carry both men and material, ramps allowing the rapid movement of vehicles and material between decks, side doors for rapid loading and unloading at docksides and accommodation for medium size nine tonnes or more) rotary-wing aircraft. For amphibious assault roles a landing platform dock (LPD) is used with a long aircraft deck offering between four and nine landing spots for rotary-wing aircraft and a 'wet' deck in the stern to allow for the loading of landing craft and/or air cushion vehicles with support forces and the initial logistical requirements.

Many of these vessels externally resemble aircraft carriers including the US Navy's Wasp (LHD 1) and the Tarawa (LHA 1) classes, the British Albion, the Italian San Giorgio classes and the Japanese Oosumis. Similar ships are being built by other European naval powers for strategic protection including France's *Bâtiment de Projection et de Commandement* (BPC) and Spain's *Buque de Proyección Estratégica* (BPE).

The first of the two 21,500-tonne Mistral class BPCs built by DCN Brest joined the fleet in June and will become operational next year. The two will replace two conventional class Landing Ships Dock (LSD) and have flight-deck spots for six heavy (16-tonne) helicopters. They can carry 450 troops or 60 armoured vehicles or 230 soft-skinned vehicles in an 1800-m² helicopter/vehicle hanger and a 1000-m² vehicle hanger that can also accept an alternative 1000-tonne load. The wet decks will accommodate four utility landing craft (LCU) or two Lcacs.

Steel for the 27,082-tonne BPE was cut in June at Navantia's Ferrol-Fene yard. She will have six medium (nine to ten tonne) helicopters but will also be able to embark Short Take-Off and Vertical Landing (Stovl) aircraft, for which a

ski-jump ramp is provided, bringing the total air group to 22 aircraft.

There will be a single 2000-m² vehicle deck beneath the aircraft hanger deck and, as with the BPCs, this will be extremely flexible. In the amphibious assault role the BPE will take 19 main battle tanks, 88 vehicles and 900 troops, some accommodated in the 1000-m² aircraft hanger, which would also help accommodate 46 main battle tanks, 10 medium helicopters and some 80 vehicles in the joint projection role.

Both BPC and BPE feature diesel-electric propulsion pods and are also fitted for a disaster relief role. Both types are designed to act as command & control centres for joint task forces and this equipment, plus the space for a fully equipped hospital, makes them ideal for disaster relief, a fact demonstrated not only by US fleet carriers in the recent tsunami catastrophe but also by Thailand's carrier HTMS *Chakri Naruebet*.

The disaster relief role might help provide funding for the Italian Navy's plans for a ship that would be of similar length to the French ships but have only four spots for medium helicopters. This programme is not in the budget and even the overall layout has not been decided. One

option features two flight decks fore and aft of the superstructure while another would have a superstructure well forward, like an LSD, and the aircraft deck astern. Both conventional and podded propulsion are being considered, but it is agreed the ship would carry 750 troops with equipment on two vehicle decks accessed through two stern and one side ramp.

A decision on the layout was scheduled for July 2005 but priority is being assigned to the 26,660-tonne *Conte de Cavour*, which is scheduled to be commissioned in 2007. This ship is officially an aircraft carrier but has most of the characteristics of an LPD, including a wet deck, and will accommodate up to 450 troops and vehicles including 24 main battle tanks on a separate vehicle deck. Senior Italian officers have indicated that the proposed new vessel, described as an LHD, might actually be closer to the *Conte de Cavour* than the *San Giorgios*.

Both DCN (through Armaris) and Navantia are beginning to market their designs along the Pacific Rim. They are already competing for the Royal Australian Navy's Joint Project 2048 requirement to replace an LST and two converted LSTs. The new ship is to carry up to 900 troops. Canberra is seeking a vessel of between 25,000 and 27,000 tonnes displacement – indeed Armaris has offered a 213-metre-long version of the Mistral. A decision on the preferred ship design is anticipated in October and the new ship, together with new LCUs, will join the fleet in 2010.

South Korea is developing its own LPD design, LPX, which was launched in March and is being built by Hanjin Heavy Industries. This will be a 19,000-tonne ship capable of carrying up to 700 troops, ten tanks and two Lcacs. She is to be commissioned in June 2007, by which time it is anticipated a second-of-class will be on the stocks.

The US Navy has brought forward one year its replacement amphibious assault ship or LHA (R), with formal authorisation to be made in FY 2007. The Flight 0 ship will be the USS *Makin Island* (LHD 8), the last of the 40,000-tonne Wasp class, which was laid down in February 2004 and will be launched by Northrop Grumman Ship Systems in January.



This view of the Mistral clearly shows the wet deck entrance. (DCN International)



An artist's impression of Spain's BPE with the aircraft carrier Principe de Asturias showing the power projection capabilities of even medium-size nations. (Navantia)

The *San Antonio* lay out – a flight deck aft over a wet deck – is used by many amphibious warfare vessels. It was incorporated in the Rotterdam class designed by Royal Schelde and produced in a joint programme with Bazan (now Navantia), whose versions were named the Galicia class although the designs were amended to meet national requirements.

HrMS *Rotterdam* has diesel-electric propulsion and is a 12,750-tonne diesel-electric ship capable of carrying some 600 troops and 170 armoured vehicles. It has a two-spot flight deck for medium helicopters and the wet deck takes four LCUs. She was commissioned at the same time as the *Galicia*, the first of two 13,815-tonne diesel-powered ships that carry between 400 and 500 troops and up to 130 armoured vehicles. Her sister ship, the

The *Makin Island* will replace the oil-fuelled, steam propulsion system of her sisters with a pair of GE LM 2500 gas turbines, her electrical distribution system will be redesigned, there will be an advanced machinery control system and a new command and control system. The wet deck will be eliminated and there will be improved aircraft handling facilities, all of which will increase the displacement to 41,772 tonnes.

A more conventional LPD design entering US Navy service is the USS *San Antonio* (LPD 17), which was anticipated as being the first of a dozen of such ships to replace four classes of vessel. However, the numbers are likely to be reduced due to design changes pushing up the costs.

The new 25,300-tonne diesel-powered LPDs are designed to carry up to 700 troops and provide 2300 m² of deck space for vehicles. There is a flight deck aft that can operate four medium or two heavy helicopters or a couple of Ospreys while the wet deck can operate two Lcacs. The fifth of class, USS *New York* (LPD 21), has a bow which incorporates steel from the wrecked World Trade Center.

Meanwhile, the US Navy's existing fleet of 72 Lcacs is being upgraded, the GE TF40B gas turbines are being replaced by the TF50B and new skirts and electronics are being added. The Lcacs can carry 60 tonnes and plans exist for an Lcac (X), capable of carrying twice that load, but no decisions have been made on the requirement.



The future for smaller navies might be the Multi-Role Vessel (MRV), which is being acquired for New Zealand. This is an artist's impression of these vessels that will be able to transport up to 150 troops. (Tenix)

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An artist's impression of Navantia's BPE. Work has just started on this ship, which is also being offered for Australia's Joint Project 2048 requirement. (Navantia)

Castilla, has improved command and control facilities with separate operations centres for an amphibious group and a combat group.

Royal Schelde revised the Rotterdam design to produce the Enforcer class with the first, HrMS *Johan de Witt*, being laid down earlier this year. She replaces the conventional shafts of her sister with podded propulsors and will be longer, with a displacement of 16,680 tonnes. The Enforcer design can combine amphibious operations with underway replenishment, a trend which is reflected in the HDW MRSV which, in turn, incorporates roll-on, roll-off (ro-ro) architecture.

The basic design of the *Rotterdam* appealed to the United Kingdom and was selected for the Bay class being built by Swan Hunter (Tyneside) and BAE Systems Govan to replace the 5674-tonne LST-like Sir Bevidere class landing ships logistic. All four of the 16,160-tonne Bay class have now been launched and they



An artist's illustration of the HDW MRD 10000 which is believed to have been offered to meet the NPL requirement. (Howaldtswerke-Deutsche Werft).



HDW is also offering the slightly smaller MRV 7500. An artist's impression of the vessel is shown. (HDW)

are designed to carry some 360 troops and 36 main battle tanks. Their role is to transport men and material and they will carry medium helicopters and some small landing craft.

Several navies are seeking multi-role vessels of the Enforcer type. Canada in particular has a requirement for three 28,000 Joint Support Ships (JSS) to replace underway replenishment ships from 2011 onwards.

The JSS will also be underway replenishment ships but will have sealift and shore support functions, the latter including command and control facilities. The flexible cargo system, based on a container handling system's ramps and cranes, will be able to move 30-tonne loads from ship to shore via landing craft although there is unlikely to be a wet deck. Both the Netherlands and Norway have a requirement for similar ships and there is a possibility of some form of joint project, while Portugal is proceeding with its own NPL programme.

A potential contender is HDW's 10,000-tonne Multi-Role Dock design. This is intended to be a 153.5 metre long

vessel with a wet deck capable of operating an Lcac, accommodation for 450 troops, 300 lane metres of space for vehicles and 700 m² of cargo space. It will have a replenishment-at-sea facility on the starboard side for underway replenishment of both solids and liquids. The company is also offering a slightly smaller, 7500-tonne Multi-Role Vessel.

An alternative approach is the Danish Aabsalon class Flexible Support Ship (FSS). These 6300-tonne diesel-powered ships have recently been commissioned and are designed to assist expeditionary force operations combining the warship, command and control and shore support roles.

They are well armed with medium calibre guns, surface-to-surface and surface-to-air missiles but they also possess a 900-m² multi-purpose deck accessed from the

rear. This can accept 200 troops with their equipment, a containerised command centre or a containerised hospital, while fast insertion or long-range insertion craft can be operated from it with a crane system. A flight deck can accommodate two medium helicopters from these extremely versatile vessels.

New Zealand is adopting a similar concept with the Multi-Role Vessel (MRV), an 8870-tonne ship that will have a wide range of roles, including the transport of up to 150 troops with light armour. It is based upon a commercial ro-ro design and will be built by a Dutch yard under contract to Tenix Defence. Eire is also considering building an FSS/MRV-type ship but the status of the programme is currently unclear.

Other navies are looking at a more modest strategic sealift capability. Poland, for example, is considering a 9100-tonne vessel designated UTL, which would be capable of carrying 3100 tonnes of cargo up to 10,000 nautical miles (18,500 kilometres). The concept of a strategic sealift vessel is also being considered by the United States to meet its



The latest addition to US Navy amphibious warfare forces is the USS San Antonio (LPD 17). (Northrop Grumman Ship Systems)

Maritime Pre-positioning Force (MPF) requirements.

During the US Navy League's Sea Air Space Exposition this year, replacements for the existing Strategic Sealift Force's Bob Hope, Shugart and Gordon class LMSRs (Large, Medium-Speed, ro-ro) and Algol (T-AKR 287) class fast sealift ships were proposed separately by Gen-

eral Dynamics and Northrop Grumman Ship Systems.

General Dynamics would replace the Algol class with a Joint Strike Ship (JSS) to move large numbers of personnel and some of their vehicles. The JSS would be a 34,000-tonne trimaran capable of carrying 2500 troops and up to eleven heavy helicopters.

It would link up at sea with a 61,000-tonne LMSR replacement Joint Positioning Ship carrying up to 200 containers and with spots for four heavy helicopters. The 'connectors' would be based upon the company's Littoral Combat Ship (LCS) design and could each carry a company-sized force.

Northrop Grumman is proposing a concept based on existing designs to reduce costs, but would incorporate the latest technology including the electric propulsion system planned for DD (X). A Wasp-based LHA could be produced in aviation-dedicated and cargo-dedicated versions augmented by one of three San Antonio class ships providing cargo, command & control or medical support while the Bob Hope class would be offered in versions with either greater cargo capacity or improved aviation facilities, including a flight deck.

With the increasing focus upon asym-metrics, the technology of modern combat is being forced to adapt. It is clear that the future will see much more flexible platforms that can be used for a wide range of operations – everything from conventional warfare to emergency aid – while also supporting 'operations-short-of-war'. □



Helicopter carriers such as the HMS Ocean are the spearhead of modern amphibious operations. She can carry 830 troops and deliver them deep inside hostile territory through a dozen medium size helicopters while vehicles and supplies can be brought in by landing craft. (BAE Systems)

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