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Tail to teeth: unmanned haulers ease the soldier's lot on the battlefield

Unmanned resupply systems are becoming more sophistcated as the need to remove the debilitating effects of battlefield burdens increases Rupert Pengelley and Huw Williams consider the latest developments

For major armed forces, manned helicopters and high-mobility logistics vehicles have been the *sine qua non* of forward-area resupply since the 1960s. Despite the speed and payload benefits these offer over other forms of portage, in the close-combat logistic support role they may not be apt in every circumstance, be that on the grounds of cost, availability, terrain accessibility, discretion or vulnerability.

On today's asymmetric battlefield insurgents are still inclined to use time-honoured non-mechanised, non-human logistic aids such as mule trains, accepting their unpredictability and the fact that these have a large logistical footprint of their own. Major armies on the other hand seem rather less willing to turn back the clock, preferring instead to investigate inanimate solutions, ironically among which are to be found million-dollar mechanical approximations of their mammalian counterparts.

Such unmanned resupply systems might once simply have been dismissed as fanciful 'gee-whizz' technology looking for a home. However, capitalising on commercial developments, there has in recent decades been a progressive adoption of robotic technologies throughout the defence sphere and unmanned mechanical systems are correspondingly being viewed as a potential means of reducing military manpower requirements and saving lives in the logistics realm just as in any other.

Initially this emerging interest was driven at command level, principally by force-protection and manpower-savings considerations. Now, however, the cause is also being taken up at user level where there is direct experience of the scale and debilitating effects of the battlefield burdens that have routinely to be carried by the dismounted soldier in theatres such as Afghanistan. If the soldier's battlefield performance is not to be undermined, either as a result of injury arising from excessive weight burdens or of the casting aside of a needed combat capability, some form of mechanical assistance would seem unavoidable.

Terrestrial unmanned systems such as the US Multifunction Utility/Logistics and Equipment (or MULE) vehicle could, as a minimum, reduce the cost in lives when maintaining supply lines in disputed territory. The extra 'musclepower' they provide could also boost the planned firepower and sustainability of dismounted infantry squads in forward areas. To these may be added pilotless powered aerial delivery systems, most likely in the form of unmanned helicopters such as the US Marine Corps' future Cargo UAS (unmanned aerial system) project, or vertically launched 'missiles in a box' of the ilk of the US Army's NLOS-T (Non-Line of Sight-Transport), which potentially offer other ways of circumventing ambushes and roadside bombs by exploiting 'the third dimension.'

With enduring manpower constraints and border patrol requirements, the Israel Defence Force (IDF) has been among the first to adopt an autonomous unmanned patrol platform in the form of the Guardium unmanned ground vehicle (UGV). This has been developed by G-NIUS, a joint venture between Elbit and Israel Aerospace Industries (IAI). The range of roles cited for Guardium include patrol, route-proving, convoy security, reconnaissance and surveillance, and combat logistic support. In its baseline configuration it is built upon a TomCar 4x4 all-terrain vehicle with a length of 2.95 m, a height of 2.2 m, a width of 1.8 m and a payload of 300 kg. Maximum speed in semi-autonomous mode is 50 km/h.

In September 2009 G-NIUS unveiled Guardium-LS, a stretched version optimised for logistics, based on the TM57 chassis and similar to one adopted by the British Army as the basis of a manned company-level logistic support platform known as Springer. Guardium-LS is 3.42 m long and has a payload (including towed load) increased to 1.2 tonnes. It can be operated manned or unmanned, having the same systems suite as its patrol-version predecessor, including an Elbit/Elisra EJAB bomb jammer; an IAI Tamam Mini-POP electro-optical (EO) sensor ball incorporating a thermal imager, charge-coupled device (CCD) daylight camera, and eye-safe laser rangefinder; a GPS navigation system; light detection and ranging (LIDAR) systems for obstacle avoidance; and stereoscopic cameras. It also has 'follow' sensors that enable it automatically to follow human guides or other vehicles in a chain.

Close-combat support

Another potential aid to close-combat logistic support from the G-NIUS stable is AvantGuard, now also in service with the IDF. Exploiting Guardium control technology, it instead uses the smaller Dumur Tactical Amphibious Ground Support (TAGS) platform derived from the Canadian company's Wolverine tracked vehicle. With four wheelstations either side and powered by a 100 hp Kubota V3800DI-T four-cylinder diesel, it has a maximum speed of 19 km/h and can be operated either in a semi-autonomous mode or controlled from a portable control station. It weighs 1,746 kg and has a payload of 1,088 kg which can be applied to casualty evacuation (CASEVAC) or logistics roles.

A new entrant to the field is the Rex 'field porter', which IAI's Lahav Division unveiled in October 2009. This is based on a small robotic platform that autonomously accompanies units of between three and 10 soldiers and is capable of carrying 200 kg of equipment and supplies for up to three days without refuelling. According to the company "the robotic vehicle follows the lead soldier from a given distance, utilising technology developed and patented by IAI. Using simple commands, including 'stop', 'fetch' and 'heel', the lead soldier controls the robot without being distracted from the mission at hand. Controlling the robot in this way allows for intuitive interaction and rapid integration of the product on the field within a short time frame." Measuring 50x80x200 cm, Rex has a maximum speed of 12 km/h, a turning circle of 2 m and a maximum 30-degree gradient climb capability.

The canine analogies reach an altogether different plane with the BigDog quadruped vehicle developed by Boston Dynamics in the United States. Sponsored by the Defense Advanced Research Projects Agency (DARPA) with additional funding from the US Marine Corps (USMC) and US Army, BigDog is a robot weighing about 109 kg, which is 1 m tall, 1.1 m long and 0.3 m wide. It has been evaluated at Fort Benning in prototype form as an aid to a foot patrol, carrying an 81 mm mortar tube with its baseplate and tripod. A typical all-terrain load for the current prototype is 50 kg (up or down a 60-degree slope), but a maximum of 154 kg has been demonstrated on flat terrain.

BigDog's locomotion modes include a crawl at 0.2 m/s, a 5.6 km/h trot, a 7 km/h running trot, or a 'bounding' gait which in the laboratory has enabled it to exceed 11 km/h. Its prime mover is a 15 hp water-cooled two-stroke engine that powers a hydraulic oil pump driving four actuators in each of its legs. BigDog incorporates around 50 sensors, including inertial sensors to measure attitude and accelerations, plus joint sensors to measure motion and force of the actuators in the legs, which are controlled by an on-board computer.

The latter also handles internet protocol (IP) radio communications with the remote operator who gives BigDog the requisite steering and speed directions for the unfolding mission, plus stop/start, squat, walk, trot or jog instructions. The stereo vision system, developed by the Jet Propulsion Laboratory, comprises a pair of stereo cameras, a computer and vision software. It is used to determine the shape of the ground immediately in front of the robot and to sense a clear path. A LIDAR is also fitted to enable BigDog automatically to follow a human guide.

Cross-country hike

At an early stage BigDog showed that it could undertake a 10 km cross-country hike lasting 2.5 hours, but Boston Dynamics is now pushing the design boundaries in order for it to be able to cross even rougher terrain, to be self-righting if toppled, to lower its noise signature and to lessen its operator dependence. The currently expressed goal for DARPA's Legged Squad Support System (LS3) programme, under which it funds BigDog, is to carry 400 lb (181 kg) for 24 hours.

The somewhat more conventional R-Gator resupply vehicle, developed by John Deere in partnership with iRobot, can be operated in manned or unmanned mode. Powered by a 25 hp three-cylinder diesel, the six-wheel R-Gator has a 20-litre fuel capacity sufficient for a range of 500 km. It drives through a continuously variable transmission, giving a maximum speed of 56 km/h in manual mode and 0-8 km/h in tele-operated or autonomous modes.

Measuring 3.08x1.65x2.13 m, it has a curb weight of 861 kg, a payload volume of 0.4 m3 and a capacity of 453 kg (towing capacity 680 kg). The R-Gator's standard video system includes front and rear fixed (drive) colour TV cameras with 92.5-degree fields of view, and a stabilised pan-and-tilt colour zoom (25x optical/12x digital) camera that features a 440-degree traverse and 240-degree elevation range, autofocus and 0.2 Lux F 2.0 light sensitivity. The latter can optionally be replaced by a day/night EO/infrared (IR) zoom camera.

R-Gator's baseline communications fit (with 900 MHz, 2.4 GHz or 4.9 GHz frequency options) has a minimum control range of 300 m, linking to the operator's Windows-based laptop or wearable control unit. The GPS-based NavCom Technology vehicle location system can be combined with an inertial system for increased position accuracy. It is fitted with one rear-looking and two forward-looking LIDAR sensors able to detect obstacles up to 20 m away in both tele-operation and autonomous mode.

Lockheed Martin Missiles and Fire Control System's efforts in the field are headed by its Multifunction Utility/Logistics and Equipment (MULE) vehicle. This is one of the centrepieces of the UGV systems family originally conceived as part of the US Army's cancelled Future Combat Systems (FCS) programme, but now subsumed within the successor Brigade Combat Team (BCT) Modernisation programme.

It is still to be produced in three versions: the ARV-A-L (Armed Robotic Vehicle - Assault Light) equipped with EO/IR sensors and a laser rangefinder/designator to target the enemy; MULE-CM (Countermine) fitted with GSTAMIDS (Ground Stand-off Mine Detection System) to enable it to detect and neutralise anti-tank mines and mark cleared lanes, as well as perform limited detection of improvised explosive devices (IEDs) and other unexploded-ordnance disposal tasks; and MULE-T (Transport), able to carry 862 kg (or two squads' worth) of equipment. All three have the same General Dynamics Robotics Systems autonomous navigation system (ANS) intended to enable them to conduct semi-autonomous navigation and negotiate obstacles or gaps.

MULE is specifically intended to operate in support of mounted heavy forces on or approaching their objectives and has a commensurate rate of advance (maximum road speed 65 km/h). In principle there would be two MULEs per platoon, but it is likely these will be administered centrally at battalion level and issued in the numbers and types required for specific missions.

MULE has a 2.26 tonne gross weight and a base frame supported on six independently sprung, articulating road wheels each fitted with BAE Systems in-hub electric motors. Its diesel-electric propulsion system is powered by a 135 hp Thielert diesel engine. Tests to date have been carried out using MULE EEUs (engineering evaluation units), but 20 prototype systems, including six MULE-Ts, seven ARV-A-Ls and seven CMs, have been funded under the DoD's Fiscal Year 2010 budget, and these should be delivered in late 2011 to early 2012. These will differ from the EEUs by having electro-mechanical systems in place of hydraulic and airless tyres.

Squad support vehicle

In parallel, Lockheed Martin has been pursuing its Squad Mission Support System (SMSS), which it has been funding as an independent research and development project to meet a perceived need for a squad-size vehicle to provide manned and unmanned transport and logistics support for light and early-entry forces. Weighing 1.8 tonnes, this 6x6 platform has a range of 500 km on roads and 320 km off road. The vehicle can be operated either by a driver on board, be tele-operated ('supervised autonomy'), or function in full autonomous mode. It is credited with a payload in excess of 454 kg, a vertical step capability of 588 mm and a gap-crossing capability of 0.7 m. It has a range fully loaded of 160 km on road and 80 km off road.

One of its features is a charger that is powered by the diesel engine that can be used to top up the batteries of the squad members' personal radios. SMSS can also function as a mother ship for small unmanned ground vehicles (SUGVs) as well as carrying two stretchers for CASEVAC purposes. A winch fitted with front and rear attachment points is carried for self-recovery.

Block 0 SMSS prototypes were most recently subjected to tests at the US Army Infantry Center, Fort Benning, in August 2009, and the company is on the point of rolling out the first two of three Block I models. These have hardpoints for underslung loading beneath the UH-60L helicopter, enhanced sound signature and reliability, plus a repackaged sensor suite giving improved autonomy. A capability development document (CDD) is currently being staffed by the US Army and it is anticipated that two SMSSs will be deployed to Afghanistan for a follow-on operational trial in mid-2010. If its benefits are thus upheld, an order for further units could be placed in response to an urgent need statement raised by a combatant commander.

Significantly, at the 2009 AUSA exhibition in Washington, Lockheed Martin exhibited the SMSS in conjunction with its Human Universal Load Carrying System (HULC). This has a powered exoskeleton, which, among its other roles, is seen as a useful adjunct to SMSS as a means of outloading its stores over 'the final mile': the point at which the terrain becomes insurmountable to a vehicular platform. Weighing 13.6 kg, HULC provides the wearer with load-carrying assistance sufficient to offset weights as high as 91 kg.

A pragmatic approach to UGV technology exploitation has been adopted by Oshkosh Defense for the DARPA-funded TerraMax project. This combines remote-control or autonomous operating capabilities with a standard military logistics vehicle, prospectively reducing the number of personnel needed to mount routine combat logistic patrols in contemporary combat zones.

Within the TerraMax team Oshkosh is responsible for hardware integration, modelling and simulation, drive-by-wire, waypoint following and overall design direction. Teledyne Scientific Company provides high-performance algorithms supporting mission and path planning and high-level vehicle management, while the University of Parma is developing the Multi-Directional Vehicle Vision System (MDVVS). Ibeo Automobile Sensor is providing a customised LIDAR system utilising Ibeo's Alasca XT sensors and Auburn University is integrating the GPS/IMU package and assisting with vehicle control.

The TerraMax vehicle - a 4x4 version of Oshkosh's MTVR (Medium Tactical Vehicle Replacement) military truck fitted with TAK-4 independent suspension - is 6.9 m long, 2.49 m wide, 2 m high and weighs 11,000 kg with a 5-tonne payload capacity. It is powered by a 425 hp Caterpillar C-12I 11.9 litre six-cylinder inline turbocharged, four-stroke diesel engine that gives it a maximum speed of 105 km/h. The autonomous vehicle control system, developed in kit form, includes a vision system with cameras; a LIDAR system; GPS/IMU navigation system; an Oshkosh Command Zone computer-controlled, multiplexed electronics system; navigation computers to handle the sensor fusion, world map management, real-time path planning and high-level control; and CANBus-controlled brakes, steering, engine and transmission.

Pathfinder for convoys

Having participated in various DARPA-sponsored robotic vehicle competitions, including Urban Challenge staged in November 2007, Oshkosh signed a Co-operative Research and Development Agreement (CRADA) with the US Army's Tank and Automotive Research, Development and Engineering Center (TARDEC) in early 2009 to adapt TerraMax technology to convoy applications. Under the three-year CRADA, a Convoy Active Safety Technology (CAST) surrogate system is being installed aboard the TerraMax vehicle. This is intended to enable it to act as a pathfinder for convoys, communicating route information to unmanned follower vehicles while operating safely among people, animals and other vehicles. Subsequently in March 2009 Oshkosh announced it was also to work with the US Naval Surface Warfare Center to evaluate the use of TerraMax as a Roboticised-MTVR (R-MTVR) in various mission-specific scenarios.

A more recent entrant to the field is Vecna Robotics with its Porter UGV. This is portrayed as a gapfiller between personal load-bearing equipment systems and standard military transport solutions, catering for 90-272 kg load-carrying requirements. The base 4x4 vehicle is 1.21 m long, 0.76 m wide and 0.71 m high, and weighs 90 kg.

It can be configured to carry different payloads at a maximum speed in excess of 16 km/h, maximum range being 50 km depending on terrain and the configuration of its lithium polymer battery. The latter is field rechargeable with optional solar or generator charge units. Maximum control range is a function of the communications line of sight (up to 32 km).

Porter, which currently exists as an early-stage research and development prototype, is being offered with a semi-autonomous control package that features attitude control for load balancing plus 'follow-me' and convoy modes, or an autonomous control package incorporating GPS navigation, path planning and terrain mapping capabilities. Several Porters could be used in an autonomous convoy or perform co-operative perimeter surveillance, among other tasks.

The USMC Cargo Unmanned Aerial System (UAS) programme exemplifies the capabilities being sought for a new generation of unmanned aerial delivery platforms. The USMC Warfighting Laboratory (MCWL) issued a solicitation in April 2009 for a contractor to demonstrate by February 2010 or sooner a cargo UAS capable of operating in deployed remote locations.

Captain Amanda Mowry, Project Officer, Air Combat Element, Technology Division and a subject matter expert at the MCWL tells *Jane's* that the requirements for the Cargo UAS were largely driven by operational experience from Afghanistan. The MCWL worked with the Marine Corps Combat Development Center and other USMC elements to determine what poundage of supplies company-sized units in Afghanistan might use in a day, and arrived at a figure of 10,000- 20,000 lb of cargo. "As [for] the distance, a 150 n miles round trip, [this] was based on what we were seeing FOB [forward operating base]-wise, from the main operating bases to the FOBs, but obviously those change," she said.

The capabilities outlined by the MCWL for the demonstration are accordingly focused on the ability to deliver a minimum of 10,000 lb of cargo within a 24 hour period with an objective target of 20,000 lb, over a 150 n miles round trip distance. The smallest element in a cargo package must be equivalent to at least a standard wood pallet (48x40x67 in) weighing at least 750 lb with an objective weight of 1,000 lb. It must be able to deploy from a FOB or unimproved road, autonomously beyond line of sight (BLOS) as well as be remotely controlled at its terminal BLOS location; the cargo must be delivered to an accuracy of at least 10 m.

The performance parameters laid down for the platform are the ability to travel with a full load at 70 kt (130 km/h) and hover in ground effect/hover out of ground effect at 12,000 ft density altitude (DA) but fly at 15,000 ft DA with a full cargo load. The UAS must also be able to integrate with existing airspace control agencies at deployed locations and the command-and-control (C2) radio frequencies must be compatible with deployed location requirements.

In August 2009 the MCWL announced that it had selected two bids to compete for the Cargo UAS contract: Lockheed Martin/Kaman's K-MAX system and Boeing's A160T Hummingbird. It ruled out Northrop Grumman's MQ-8B Fire Scout.

Lockheed Martin and Kaman formed Team K-MAX in March 2007; the pairing saw Lockheed Martin's UAS C2 system integrated with Kaman's commercially successful K-MAX medium-lift helicopter, which is widely used in the construction and logging industries.

The K-MAX design features two counter-rotating intermeshing rotors that obviate the need for a tail rotor and increase the lift density in a compact footprint; Kaman says that this allows all of the 1,800 shp produced by the Honeywell T53-17 gas turbine engine to be directed to the main rotors, improving lift performance. When carrying its maximum load of 3,109 kg K-MAX can travel at 80 kt with a range of 214 n miles; unladen this improves to 100 kt and 267 n miles. As it is essentially a modified manned platform, the K-MAX can be piloted if necessary as the on-board flight controls have been retained.

Jeff Bantle, Lockheed Martin's vice president of rotary wing programmes, told *Jane's* that the team has been focused on meeting the USMC's requirements rather than exploring other avenues for the development of the platform. He explained that the team has worked to modify the aircraft and added a number of systems, including line-of-sight (LOS) and BLOS communications systems, a tactical common datalink, a redundant flight control system and redundant INS/GPS.

Aerial cargoes

The USMC's requirement to carry at least a standard pallet-sized load largely ruled out internal load-carrying solutions, and any cargo would thus need to be carried under the platform, Captain Mowry explained. "It wasn't necessarily a sling-load criteria, we had a dimension criteria of a pallet size... it just seemed that was how industry or the companies were going to carry that type of load - they couldn't carry that size in a pod."

The K-MAX team point to the proven capabilities of its platform as a major selling point, in particular its ability to carry a significant underslung load. Terry Fogarty, director of K-MAX programmes at Kaman, highlighted one of the platform's key design features: "On the basic K-MAX aircraft there's a trolley that allows the load to traverse laterally along the airframe, [keeping] the load directly under the rotor shaft, directly in the centre of gravity. ... That's a very big stability capability for the basic aircraft, [making] it a lot easier for the autopilot system to be able to control the load. There are sensors connected from the load to the autopilot, which help in the stabilisation. As an example, during some of our testing we have manually excited the load in a hover to ensure that the autopilot system will bring it back within three or four swings."

Bantle added: "I think people undersell that [sling-load configuration]. That's not a simple thing. You can't just take any aircraft that's done other missions and attach a sling load and move that around, especially when you get to the altitudes that they want to fly at in Afghanistan, where there are all sorts of wind conditions etc. That's not a minor feat and we've done a lot of testing, including going up to high altitudes at Leadville and now at Yuma."

The K-MAX's load system also features a four-hook carousel that can carry in excess of 2,700 kg; each hook is activated independently, allowing loads to be delivered to four different locations.

To date the K-MAX team has only investigated using a sling-load configuration to deliver cargo as the platform has little load capacity internally. Bantle said that the company had previously tested a configuration with external fuel pods for endurance purposes and that the company is firmly behind the idea of carrying cargo in an underslung configuration. "If you have things in pods you need to land at these forward locations: it complicates flight. If you can just hover over and put down your sling load and move on, it makes for a much more efficient operation and probably a less dangerous operation."

Following discussions with the MCWL, the K-MAX team has selected a ruggedised laptop for the control of its platform. A controller uses the C2 software to upload a mission flight plan to the on-board mission management computer and at any point during the flight this can be modified. The terminal controller uses the same system to manoeuvre the aircraft at the drop site.

The K-MAX team had already undertaken a number of demonstrations for the US military prior to the USMC solicitation. In April 2008 the system was demonstrated to the US Army at Fort Eustis, Virginia, and in November of that year to the USMC at Quantico. Autonomous take-off and landing plus pick-up and delivery of a 3,000 lb sling load was demonstrated, as was the ability to re-route and detour the aircraft in mid flight to accommodate changes to a mission and counter threats. According to the team it has already met the requirements set out by the MCWL.

In July 2009 the platform was tested in the Colorado Rocky Mountains, where it carried 3,000 lb loads to 15,000 ft. Following the installation of an improved LOS datalink in October, further testing took place in November and December at Yuma, Arizona, where K-MAX operated autonomously with a number of different loads at altitudes up to 15,000 ft. Night flights and multiple BLOS cargo drops were also conducted.

Boeing's A160T (military designation YMQ-18A) Hummingbird has already demonstrated a number of the capabilities required by the MCWL. It has also set a number of records in its class of UAVs and in rotary-wing platforms as a whole - manned and unmanned - flying for almost 19 hours without refuelling and hovering at an altitude of 16,700 ft.

The Hummingbird was initially developed as an Advanced Technology Demonstration project by Frontier Systems under a contract awarded by DARPA in 1998. Boeing assumed responsibility for the platform after acquiring Frontier Systems in 2004.

Much of the capability of the platform can be attributed to the advanced design of its main rotor system. The optimum speed rotor (OSR) technology allows the speed of the composite rotor blades to be adjusted to suit flight conditions, altitude, weight, speed etc to improve the efficiency of the system, enabling the Hummingbird to fly at higher altitudes, at increased speeds - both cruise and maximum - and with extended endurance.

Speed and efficiency

The Hummingbird features a two-speed gearbox, which allows a low gear to be selected in flight and the aircraft to slow its main rotor and maintain an efficient speed.

Low disc loading is another contributing factor to the performance of the Hummingbird as this reduces the power required to hover, allowing it to operate at higher altitudes in less dense air, for greater periods, or with an increased weight (and therefore payload). The Hummingbird has less than 6 lb per square foot disc loading, whereas manned rotary-wing platforms typically have 5-10 lb per square foot.

The first systems were powered by four- and six-cylinder petrol engines and had three-bladed rotor systems. However, two crashes occurred with this rotor configuration and subsequently the design was changed to accommodate a four-bladed rotor. The current model has a Pratt & Whitney 207D turbine engine, a four-bladed main rotor and a two-bladed tail rotor. At present Boeing is looking to achieve a cruising speed of 140 kt, a top speed of 170 kt, a maximum operating altitude of 30,000 ft and an endurance of more than 20 hours at 15,000 ft with a range in excess of 2,250 n miles.

Mike Lavorando, A160T deputy programme manager, told *Jane's* : "The logistics delivery role was envisaged and planned for in the design of the baseline aircraft." The vehicle has multiple structural hard points for carrying sling loads or cargo pods. Lavorando noted that the YMQ-18A is capable of simultaneously carrying a sling load and cargo in pods mounted on stub wings, with a capacity for up to 2,500 lb of cargo.

The platform counters the swing produced by the underslung load through flight control responses.

The Hummingbird has a smoothly contoured fuselage made from lightweight carbon fibre, and a retractable undercarriage that reduces drag to improve performance. The rotor blades have been designed to provide optimal lift across a range of speeds and are made from composite materials to reduce their weight and increase stiffness.

Boeing also points to the ability of the YMQ-18A to operate in an intelligence, surveillance and reconnaissance (ISR) role alongside that of a cargo platform as an important potential benefit. The company has also developed a streamlined cargo pod that will allow the Hummingbird to travel at higher speeds, albeit with a reduced cargo capacity as it will not be able to accommodate a standard size pallet.

Cargo role for Fire Scout

Although ruled out of the MCWL Cargo UAS programme, Northrop Grumman still envisages a cargo role for its MQ-8B Fire Scout.

Earmarked as an important future asset for the US Army and US Navy (USN), Fire Scout was selected as the vertical take-off unmanned aerial vehicle (VTUAV) for the USN, as well as by the army for the latter's now-cancelled FCS programme. It has nonetheless been retained as the Brigade Combat Team Modernization programme's Class IV UAV.

Based on the Schweizer model 333 commercial helicopter, which has more than 20 million flight hours, Fire Scout has the advantage of proven flight capabilities. It features a Rolls-Royce 250-C20W turboshaft engine, which has been derated to develop 320 hp. The gearbox is rated to provide a continuous 320 hp. The typical top speed of the Fire Scout is 115 kt with a flight ceiling of 20,000 ft.

However, Fire Scout's primary role is as an ISR platform. Mike Fuqua, the lead business and strategy development manager for Fire Scout programmes, said that the logistics resupply role was not an original requirement and that it had been added by the company after recognising customer interest. John VanBrabant, Northrop Grumman's manager for business development, Maritime Fire Scout, confirmed that "there was no requirement specifically laid out by the navy for a logistics role for Fire Scout when it selected the MQ-8B as its version of Fire Scout". He said that in 2005 Northrop Grumman had already demonstrated a capability to deliver beyond line of sight.

The Fire Scout's design may have contributed to it not being selected to continue as part of the MCWL programme. The platform carries its external payload on stub wings on either side of the fuselage and, although these can each carry 200 lb, they would be unable to accommodate the pallet size required by the MCWL. To date Northrop Grumman has not demonstrated the ability to carry a cargo in a sling-load configuration. VanBrabant said that the company has demonstrated a logistics capability with cargo attached to the pylons and confirmed that it was working on the ability to use a sling-load configuration.

VanBrabant said Northrop Grumman also believes there is capacity elsewhere on the platform. "There is also internal excess, not storage space, internal cubic volume in which you could configure cargo conceivably and, if you didn't need the EO/IR payload, you could potentially configure that nosecone section for additional payload. There are places that you can put things."

While currently unable to carry the pallet-size load required by the MCWL, the fact that the Fire Scout is a relatively mature rotary-wing UAV bodes well for the development of its cargo role. Should a sling-load capability be developed, it is likely that the USN would opt for this platform as a cargo UAV as its use in an ISR role is well under way. Fire Scout platforms are on a military utility assessment deployed with the Oliver Hazard Perry-class frigate USS *McInerney* on counter narcotics operations in the Caribbean and eastern Pacific, and an operational evaluation is set for 2010.

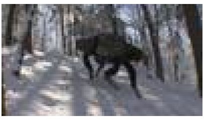
The rationale underpinning the drive for a cargo UAS capability is aptly conveyed in the sentiments expressed by VanBrabant, who believes it would reduce forces' personnel footprints on the ground. "If you think about it, if you can design an [unmanned] aircraft to take a substantial load and deliver it to a group of soldiers or marines operating remotely ... then you're reducing the risk to personnel flying aircraft and you're reducing the risk to personnel on the ground. I think in the big scheme of things when you step back and look at what helicopters do now, if we can demonstrate a capability to deliver a substantial load, the cargo UAS capability would likely move to the head of the line."

Israel is developing a wholly new concept in cargo UAVs with Urban Aeronautics' resupply and casualty-evacuation AirMule, which the company announced has successfully completed the first phase of flight testing, on 11 January 2010. The wingless aircraft demonstrated autonomous hovering at 60 cm (2 ft) just out of ground effect, with the UAV's fly-by-wire control system providing auto-stabilisation in all three rotational axes. According to the manufacturer, the AirMule's configuration of internal rotors (powered by a 730 hp Turbomeca Arriel 1 turboshaft engine) and compact design affords it access to places barred to fixed and rotary wing aircraft.

An unmanned Oshkosh MTVR TerraMax truck pictured as it negotiated a road circuit during an Urban Challenge trial followed by a chase car. Such technology could find an application in the combat logistics patrol of the future, saving lives and manpower. (Scott R Gourley)
1192954

A computer rendering of the Vecna Robotics Porter UGV, which has now reached the early prototype stage. (Vecna Robotics)
1295467

A BigDog quadruped being demonstrated at the Fort Benning infantry centre as a patrol-level porter, automatically following a designated patrol member. (Boston Dynamics)
1295472



A Boston Dynamics/DARPA BigDog quadruped UGV negotiates a snowy slope. (Boston Dynamics)
1295475

Lockheed Martin's battery powered exoskeleton enables the wearer to carry 200 lb (91 kg) loads – such as those that might be delivered by a UGV – forward to otherwise inaccessible points. Burst speed on flat ground is 16 km/h. (Lockheed Martin)
1333977

The Guardium-LS is an optionally manned logistic-support variant of the G-NIUS Guardium UGV, with which it shares common control, vision and countermeasures systems. Visible on top of the cab is a Mini-POP sensor ball, behind which is the multi-element circular antenna array of the EJAB roadside bomb jammer. (G-NIUS)
1347317

Days of Eeyore: mules of No.8 Animal Transport Company, Royal Indian Army Service Corps, pictured in the mid-1930s at a base in the North West Frontier region of what is now Pakistan. Today animal transport chiefly finds favour with insurgents, who are prepared to put up with animals' slow pace, unpredictability and significant logistical and manpower footprint in exchange for its low costs and adaptability. (RIASC)
1347527

A Lockheed Martin MULE-T experimental evaluation unit at an Army Experimental Test Force trial staged at Fort Bliss, Texas, in May 2009. MULE-T is expressly designed to be able to accompany armoured ground combat vehicles manoeuvring on their objective. (Lockheed Martin)
1347528

Lockheed Martin's SMSS on trial as a dismounted squad support system in a MOUT training village at Fort Benning in August 2009. SMSS currently has a bespoke control unit, but this is expected to be supplanted by a common controller display unit under development for both MULE and the US Army's Class I UAV. (Lockheed Martin)
1347529

The Northrop Grumman-developed MQ-8B Fire Scout UAV hovers over the flight deck of the frigate USS McInerney (FFG 8). (US Navy)
1347712

A160T Hummingbird with 1,000 lb cargo pod. (Boeing)

1363440