Bridging remains a core mobility skill, primarily because bridges are easy targets and most commercial and military vehicles are not amphibious.

COMBAT ENGINEERING
COLD WAR TECHNOLOGY CONTINUES

Adam Baddeley

Engineers mould human and physical geography to meet their needs. Combat engineering does so at the forward edge of the battle, requiring that the tools used are protected against enemy fire and have the required mobility to keep up with manoeuvre forces they are tasked with supporting.

In earlier conflicts, knowledge of the likely terrain was highly detailed and well established, as was the case in Cold War West Germany. Engineering tasks could be planned and trained for with a high degree of precision, with foreknowledge of specific offensive and defensive choreography aided by Western Europe's excellent transport infrastructure. Today's combat engineering tasks are the polar opposite; typically set in the developing world, with little or no infrastructure, as witnessed by missions in Afghanistan and a range of peacekeeping missions.

Whilst the environment within which they operate has changed radically, the combat engineering tasks have not and mobility, counter-mobility and survival remain their core repertoire. The subtasks contained within these fields however remain wide in scope; 'mobility' covers reconnaissance, road clearance, obstacle removal, filling ditches and clearing lanes across minefields; while 'counter-mobility' covers the blocking of roads, laying minefields, demolition and the digging of anti-tank ditches and obstacles. The survival element of these tasks includes camouflage and deception, identifying minefields, neutralising explosive traps (IED), NBC decontamination, preparing protected positions, fire fighting and construction works.

Several engineering vehicle types have emerged. The two main ones are the self explanatory class of Armoured Vehicle-Launched Bridge (AVLB) and the Armoured Engineer Vehicle (AEV). All welded hulls are common to both with the AEV typically equipped with a hydraulically operated dozer blade to clear battlefield obstacles and a hydraulically operated crane with an extendable jib swapping between either gripper claws or a digging bucket. In addition, these specialist vehicles are aided by more general tracked vehicles but are also required to keep pace with armoured battle groups which in UK parlance are referred to as Manoeuvre Support Vehicles.

DENSER THAN EVER

The proportion of engineering vehicles to MBTs is high. The UK's orders for its Titan and Trojan fleet orders have remained steady at 66 vehicles with 288 Challenger II now deployed. This represents around 23 percent of the total MBTs in service. The same trend is evident elsewhere. In Malaysia there has been a contract to acquire a 48 strong regiment of PT-91M MBTs, a development of the T-72M1 by Zaklady Mechaniczne Bumar-Labedy. In addition however, several engineering vehicles were acquired consisiting of, five PMC AVLBs, three MID-M engineer vehicles and six WZT-4 Armoured Recovery Vehicles. Malaysia's 'engineering buy' represents nearly 30 percent of the total MBT acquisition.

New requirements to operate in an urban environment are seeing engineer capabilities spread across the AFV fleet. Armours use in urban terrain, once an almost absolute prohibition has now proved highly successful. Engineering capabilities consequently are needed more than ever by armoured forces. The challenges presented in this environment include the need to clear booby traps, barriers and blockades and other major challenges to mobility. A thrown track in a narrow street, for example, would effectively block the route until another vehicle can be utilised to clear the blockage.

There are currently three major development programmes in this field; the Leopard II MBT PSO and the Nexter Leclerc Action en Zone URban (AZUR) - neither of which has been fielded - and the US Tank Urban Survival Kit TUSK a modular solution for the M1A1 Abrams. The primary characteristic of these vehicles are improved armour protection, all round surveillance and close-in defensive firepower as well as the increased use of the plough, and in the case of the Leopard II PSO, the addition of a dedicated capability.

NEW OR OLD CHASSIS

A major issue for engineering vehicles is should they share a common chassis with the MBTs they accompany or rely on earlier generation platforms.

The UK has firmly sided with the common fleet approach sourcing its new Engineering Tank System from its Challenger II fleet. These comprise 33 Trojan 'breacher' vehicles, the latter equipped with Pearson Engineering dozer and excavation equipment and the Titan AVLB which replace elderly solutions based on the Chieftain, two generations behind the CH2. The 255m contract with BAE Systems was inked in 2001.

The US however has not followed this route. The Army opted to cancel development of the Abrams based AVLB and AEV; General Dynamics' Land Systems Wolverine Heavy Assault Bridge and the then United Defense's Grizzly Combat Mobility Vehicle. The latter would have replaced the M728 an M60 based AEV equipped with turret and 165mm main gun. The M728 has now been retired leaving no dedicated AEV in the inventory.

Where it has renewed its broader combat engineering capability, the Army has not however sought a newer chassis type. For example, the US has not sought to base its new M88A2 Hercules (Heavy Equipment Recovery Combat Utility Lift and Evacuation System) on the Abrams chassis and

Rheinmetall's Kodiak AEV is based on the Leopard 2 chassis, and thus giving it clear potential for any existing Leopard users. (PHOTO: Rheinmetall)

has instead opted for an upgraded engineering of the M60 Patton, now even phased out of the Army Reserve. The M88A2 replaces the earlier M88A1, which could only recover vehicles up to 56 tonnes and which required two Hercules to pull a single Abrams. The M88A2, better protected and with boosted performance in a wide range of criteria, can do this alone with a pull of 70 tons. In contrast, however the Trojan/Titan are built on a Challenger 2 chassis and the former can tow over 100 tons.

The US is certainly not alone. While adopting the Ariete as its standard MBT, Italy has continued with its current Leopard 1 based engineering suite, manufactured locally by Oto Breda. Spain operates the M47 as the basis for its AVLB and operates 38 M60 based AEVs designated the CZ-10/25E Alacran. In the early 2000s, Nexter developed the Leclerc Main Engineer Vehicle or Engin Principal de Genie. However the system had no export or domestic successes and the Armee de Terre opted instead for the retention of the AMX-30 EBG (Engin Blinde du Genie), which is now being updated. Germany is maintaining its Leopard 1 fleet based AEVs in service for the foreseeable future.

Russia has sought to maintain a roughly parallel link between MBTs and its AEV fleet. The T-55 base IMR-1 is being replaced by the T-72 based IMR-2, while the IMR-3 also being developed, based on the more recent T-90. A dedicated mine clearance vehicle, the fully amphibious BMR-3M, based on the T-90, is also in domestic service and is designed to protect the three man crew against a TNT blast of up to 8.4Kg. Despite these advances however, the earlier T-55 based M1977 is still in widespread service.

Joining the UK in its common chassis are countries that include Switzerland. Switzerland has ordered 12 "Geniepanzer" based on surplus Pz87 (Leopard 2) under a deal worth CHF 95 million. RUAG Land Systems and Rheinmetall AG will provide 12 carrier vehicles, plus 12 AEV modules and 6 mine-clearing modules for delivery in 2010-2011. Also known as the Kodiak, the AEV can pull up to 62 tons.

The Titan AVLB seen launching a bridge during trials

GENERAL PURPOSE ENGINEERING

Outside MBT based solutions is the CEV class of vehicle. A lighter weight general support solution, this class of vehicle typically equipped with a front bucket, excavator arm and winch.

The latest such offering is the BAE Systems Terrier, known as a Manoeuvre Support Vehicle (MSVs) in UK service. A total of 65 vehicles have been ordered to replace the FV180 Combat Engineer Tractors, which are over 30 years old. The first trials of the 31.5tonne vehicles are due this year to pave the way for entry into service in 2009. The one-man M9 Armoured Combat Earthmover, which is in US usage, offers a combat dozer capability with the addition of a 11,000kg winch. Over 900 vehicles have been built, with some already in service with South Korea and Taiwan.

Providing a wheeled solution to these roles and work in a more benign environment is JCB. The company's 523M Loadall is designed to British Army specifications to provide a dedicated telescopic handler capable of travelling as part of a high-speed convoy at road speeds of up to 85kmh with good cross-country abilities. In the US the company is the sole supplier of the High Speed Engineer Excavator (HMEE) to the US Army. The vehicle can be used for back-filling mortar or IED damaged surfaces, constructing anti-tank ditches and a range of demolition, quarrying or levelling duties where speed is of the essence. All this is coupled with low maintenance costs relative to tracked solutions.

BUILDING BRIDGES

While Germany is lagging behind in replacing its Leopard 1 AEV fleet, in the field of AVLBs things are quite different, with the replacement of the Leopard 1 based PSB-1 Biber AVLB well underway. Germany adopting the Leopard 2 as the basis for the MLC 70 Mobile Bridges Panzerschnellbrucke 2 which carries three bridging sections, deployable in eight minutes. A total of 35 platforms have been ordered, while a further 14 ordered by the Netherlands, where it will be known as the Bruglegger MLC 70.

The UK's Titan fleet will use the No.10 and 12 bridges, both capable of supporting 70 tonnes and of crossing gaps of 24.5 and 12 metres respectively. Part of the BR90 family of bridges, the scissor system has also been married to a Hyundai K1 MBT

chassis for South Korean service

Switzerland's RUAG Land Systems have also won a contract from Patria to build a Leopard2 based bridge layer using a MAN bridging system.

German MAN Mobile Bridges Leguan AVLBs have been demonstrated on a range of platforms including an 8x8 truck, M47, M80, Leopard 1 and M1A1. It offers MLC 70 support over a 26-metre bridge and can be launched in under 5 minutes. Leguan bridges are in service with South Africa, Singapore, Venezuela, Germany, Spain and Belgium.

France is moving away from its tracked AMX-30PP AVLBs capable of supporting MLC50 bridges. The PTA Modular Assault Bridges (MAB), to be delivered between 2007-11 by domestic firm CNIM, are based on a 10x10 NBC protected vehicle capable of carrying MLC 70 bridges up to 26m in reach. Italy has looked at replacing its Biber AVLBs using this solution.

MINE CLEARANCE

AEVs are commonly seen using their mine plough, signature-duplicator and lane-marking units to provide cleared routes through AT minefields, eliminating or at least mitigating this threat and limitation on battlefield mobility.

Several countries are developing and fielding wheeled mine clearance systems for more rapid mobility. Denmark's Hydrema MCV-2 mine clearing vehicle uses an articulated 4x4, 10m long chassis with a rear mounted flail. It is designed to clear mines on metalled surfaces at speeds of 13Kmh and over rough terrain at speeds of 1.4Kmh with a path 3.5m wide. The Hydrema vehicle can be readied for C130 deployment in five minutes. The system has two engines and either one can be used to power the vehicle if the other is disabled. Norway has acquired 16 units and Denmark 9, with the US Army obtaining a single unit.

The Nexter Demeter system creates a magnetic field in front of the vehicle, triggering magnetic influence mines before reaching them. Weighing 180Kg, the Demeter is fitted as an integral part of mine ploughs to provide extra protection for de-mining vehicles. The range of the Demeter is said to be up to 6.6m in front of the system and 5m to the side. Nexter have also combined electromagnetic duplicators, a mine plough and line charges to create the K2D system. Other systems in this area include Israeli firm RAMTA's Anti-Magnetic Mine Actuating Devices (AMMAD). The system can reach 3-5 metres in front of the MBT or other AFV using a 20A/24V power supply and weighs 113kg. It is in service with Israel, the US, Italy and Sweden. Russia uses the EMT-7. Pearson Engineering also offer a 24/28 VDC Magnetic Signature Duplicator solution in this area, which weighs in at 180Kg.

Immediately behind the front

The militarised JCB 4cx backhoe loader, which in conjunction with the US Army, JCB has developed a high-speed backhoe called a High Speed Engineer Excavator (HMEE). (PHOTO: A. Baddeley)

line, militaries are developing the means to rapidly clear large areas using dedicated vehicles. Germany has developed a number of specialist vehicles in this role. The Minebreaker 2000/2 demining vehicle, in service with German and South Korean forces, has seen service in support of ISAF since 2002 in Afghanistan. Based on the Leopard 1 chassis, the crew compartment has been reinforced against kinetic and shock pressure. The vehicle has a large hydraulically powered tilling drum which uses its tungsten carbide 'teeth' to destroy all types of mine as well as trigger anti-personal trip wires, which are commonally used against dismounted demining teams. Developed by FlensburnerFahrzeugbauGesellschaft, the Minebreaker is also being offered with the T-72, M48 and M60 chassis. The German Army has also adopted the two-man Keiler using the M48A2 chassis with much improved power and transmission systems. The vehicle uses a 24-hammer flail to clear a 2.5m path and has an electronic survey system to accommodate different terrain level when moving cross-country. Rheinmetall have also developed the Rhino system, which is similar to Keiler.

Add on ploughs allow a variety of platforms to contribute to demining. RAMTA, part of Israel Aircraft Industries, offer a number of solutions in this area, including its Track Width Mine Plough and Scatterable mine clearing devices for below and above ground solutions. The KMT-8 mine plough, developed in the FSU, cuts two 60cm wide tracks at speeds of up to 15Kmh - although it takes 1.5 hours to deploy - and is designed to fit all T-series MBTs.

A major player in the field is the UK's Pearson Engineering, with products such as the Pearson Lightweight Mine Roller for AFVs. Weighing 1000kg, the widely used Miner Plough product line and the recent Rapid Ordnance Removal System which clears a 3.15m lane of surface munitions, is in service with the US Army. The company's Surface Mine Plough originally designed for the British Army, clears up to a 4.58m width lane. While typically seen on IFVs this lightweight solution has also been tested on a 4x4 truck.. Rheinmetall's AMIR Mine cleaning surface plough creates a 4.7m safe lane.

Trojan seen employing its plough attachment

Blasting an explosive path through a minefield remains a key requirement to ensure unimpeded manoeuvre across the battlefield. The US is replacing the elderly M58/M59 Mine Clearing Line Charge (MCLIC), which entered service in 1986, with the Mongoose Explosive Standoff Mine Clearer for Stryker equipped units. BAE Systems Mongoose is a towed system and offers a cleared path of 80x3.4m, eliminating over 90 percent of mines. US M60 AVLB have the option of replacing the bridge equipment with an M58 and the Marines M59 can be fielded from an AAV-7, enabling it to be fired while under armour.

Mine laying is still a core competency for combat engineers, although these days somewhat limited to anti-tank operations. Systems developed by a number of manufacturers, largely from the Cold War era, remain in service and there has been little investment in new technology. Nexter's Minotaur System solution can deploy a 2.4km long barrier in under 5 minutes and has been fitted to a range of tracked IFVs and trucks. The US M139 Volcano System remains in service with an adapted version known as the Vehicle Launched Smart Mine System (VLSMS), in operation with the Royal Engineers. Germany operates the Scorpion, based on the M548 chassis.

MEDIUM WEIGHT

The increased emphasis on more rapidly deployable forces and the move to medium and lightweight forces means the accompanying combat engineer equipment has to drop down in weight too.

For the UK the CET has always been medium weight, although it was envisaged to work with heavy armour. Its replacement, Terrier, however is already being eyed for FRES; once a common family of vehicles but fragmenting into a number of different and in some cases off-the-shelf platforms. The Terrier, weighing in at 31.5 tonnes, is well within the upper limit of the revised

The need to clear barricades has increased in significance during recent urban operations. Here Trojan demonstrates that capability.

FRES weight requirement and is being considered in studies to provide the three FRES variants in both today's tracked and 6x6 wheeled options, with a potentially stretched chassis. Three engineer variants are being explored under the FRES initial Assessment Phase; the AVLB with a MLC 50, an AET - potentially a minimally modified Terrier - and an AEV or in UK parlance AVRE.

The US Stryker programme represents the vanguard of next generation light forces. The M1132 Stryker Engineer Support Vehicle (ESV) focuses on mine detection, neutralisation and lane marking systems. The ESV is equipped with either the Pearson Engineering's Light Weight Mine Roller or Surface Mine Plough and the Nexter Demeter electronic mine neutralisation system. The US has opted to move away from the Stryker chassis vehicle in the Stryker bridging role, and instead go for an Oshkosh HEMMT M1977 8x8 truck combined with a General Dynamics Rapidly Emplaced Bridge Systems (REBS). This is an MLC 30 bridge capable of reaching 13.8m and deployed in ten minutes, with the bridge system weighing 9.5tons. The deployed bridge itself weighs 4.8t, allowing REBS to also be deployed by CH-47. A total of 18 systems were ordered in July 2001 with options for 32 more. Other vehicles are also contained in the engineer company with the BCT responsible for 80 percent of the brigades engineering needs. These include the Small Emplacement Excavator (SEE) equipped with backhoe, a bucket loader and somewhat ironically the lightweight but solid rubber tracked Caterpillar Inc Deployable Universal Combat Earthmovers (DEUCE), which can only move at road speeds of 30mph. The DEUCE will also equip light divisions and the 18th Airborne Corps.

General Dynamics already have medium weight options from their European holdings. The 4KH 7FA - AVE engineer vehicle and a similarly modified ASCOD IFV are in Spanish and Austrian service with dozer blade and hydraulic arm. RUAG Lands Systems has provided uparmouring, mine plough and magnetic signature duplicators within a 14.5tonne chassis as an adaptation of the M113A2.

Medium, or at the very least non-MBT weight have historically been fielded in areas of poor infrastructure. India is a long time operator of the BAE Systems lightweight and amphibious CET and has independently developed the Sarath engineering vehicle based on the Russian BMP-2 infantry-fighting vehicle. In the AVLB role, Singapore Technologies Kinetics has shoehorned a 22m two-part bridge onto a Bionix vehicle, which is in service with the Singapore Armed Forces.

CONCLUSION

From heavy to light forces combat engineering is becoming an increasingly prominent and proportionately more significant capability. It is as relevant in war fighting as it is in peacekeeping, in a theatre now characterised by poor on non-existent infrastructure.