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Status
Production. In service with US Army.

Contractor
General Dynamics Land Systems - Canada (but see Development)

BAE Systems, US Combat Systems M9 Armored Combat Earthmover (ACE)

Development

In 1958, the US Army Mobility Equipment Research and Development Center at Fort Belvoir began work on a vehicle called the All-purpose Ballastable Crawler (ABC). This eventually became known as the Universal Engineer Tractor (UET).

The first prototypes of the Universal Engineer Tractor were built by the Caterpillar Tractor Company and the International Harvester Company. In January 1975, the Pacific Car and Foundry Company completed a further four vehicles, two of which underwent field evaluation at Fort Hood.

The result of these trials was considered satisfactory and indicated the vehicle's superiority over available equipment. TECOM testing was completed in August 1976 and type classification (Standard A) was approved in February 1977.

Trials of the M9 were subsequently carried out in both Yuma and Alaska to test modifications made as a result of previous trials and new equipment, such as a winterisation kit.

In November 1982, a revised contract worth USD29 million was awarded for the purchase of 15 equipments, of which USD19.3 million was for the vehicle and the remainder for product improvements (the original contract was to have been USD40.4 million for 36 vehicles).

All 15 vehicles were delivered by the end of 1984. Trials with this first batch of vehicles demonstrated that further improvements were required in some areas. Seven of this first batch were modified by PCF Defense Industries and were delivered to the US Army during January 1985. Tests with this batch of vehicles were carried out at Fort Hood.

During April 1986, Request For Proposals (RFP) were issued to industry and resulted in offers from ADCOR, BMY, FMC, General Motors of Canada, Ingersoll-Rand and PCF Defense Industries.

BMY was ultimately awarded a production contract on 25 July 1986. By the end of 1992 434 M9s had been built. The first production examples were delivered to the training base at Fort Leonard Wood during the fourth quarter of FY89. US Army units in Europe started to receive their vehicles during the last quarter of 1990.

During 1991, two overseas orders were placed for M9s. The first, for 18 units, was from a customer in Asia. The second order was worth USD8 million, with deliveries starting in late 1992.

In September 1993, the then United Defense (which is today BAE Systems, US Combat Systems) was awarded a USD78 million, 114 vehicle contract, consisting of 80 vehicles for the US Marine Corps and 34 vehicles for the National Guard. US Marine Corps deliveries commenced during 1995 with National Guard deliveries starting in 1996.

Production for the US Armed Forces ended in 1996, but in November 1997, a further 51 ACE vehicles were ordered for the US Army. The contract contained an option for a further 51 vehicles and was worth USD40.4 million.

The US Army placed an order for an additional 51 M9 ACE vehicles with the first of these delivered in early 1999. Production continued until late 1999. There was also an option on an additional 51 vehicles but this was not exercised. Production can start again if required. The M9 ACE has seen service with the US Armed Forces in the Gulf in 1991 and 2003.

The latest M9 ACE vehicles incorporate six new system improvements including an all-steel dozer blade furnished by the US Government, new belly plate and an improved hydraulic system.

Previous production M9 ACE vehicles were overhauled and upgraded to the latest production standard, or Product Improvement Programme (PIP), at Anniston Army Depot.

The M9 ACE has been ordered by the South Korean Armed Forces. Licence production (the final in-service total is 207) was carried out in South Korea by the now Samsung Techwin, Defense Program Division.

As of April 2012 the US Army had not announced any plans for the replacement of the M9 ACE.

Description

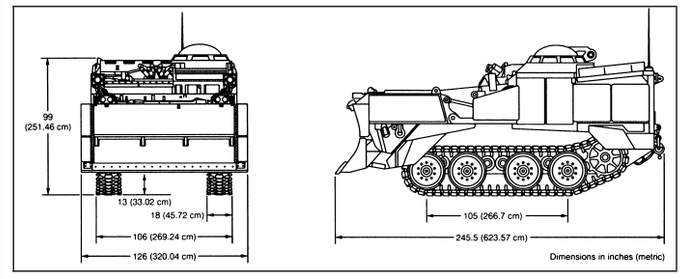
The M9 Armored Combat Earthmover (ACE) is intended to operate in forward areas and, due to its high road speed, can be located with the lead tanks in a convoy, closer to where it is needed, rather than at the back, as is the case with vehicles (such as the Caterpillar D7 medium crawler) which the M9 was intended to replace.

The M9 ACE is a general purpose engineer vehicle and can carry out tasks in three critical areas: mobility, counter-mobility and survivability.

Mobility tasks include: filling craters and ditches; assisting fighting vehicles (winching or towing); removing roadblocks, trees, rubble and other battlefield obstacles; preparing access/egress for fording sites and river crossings; preparing and maintaining combat routes; and preparing and maintaining assault airfields.

Counter-mobility tasks include: the construction of anti-armour obstacles; demolishing fords and bridge bypasses; participating in the digging of tank ditches; destroying landing fields and airfields; participating in the preparation of strong points and hauling obstacle materials.

M9 Armored Earthmover (Michael Jerchel) 0589690



General arrangement drawing of M9 Armored Combat Earthmover which can be used for a variety of battlefield missions 0069297

Survivability tasks include: the digging of hull defilade positions for armour; construction of defensive positions for command-and-control operations; construction of earth berms for protection; hauling material for protective shelters; clearing fields of fire; and digging slots for vehicle-mounted TOWs and other battlefield weapons.

The M9 is air-portable in C-130, C-141B and C-5A transport aircraft. It is unarmed but has a smoke grenade launcher. Other equipment includes a standard NBC system (ventilated facepiece), a radio and the operator can utilise standard night vision goggles.

It has an amphibious capability after minimal preparation and armour protection is provided for the engine, power train and the operator.

The hull of the M9 is made of welded aluminium armour. At the front of the vehicle is the 6.7 m^3 capacity scraper bowl (ballast compartment), hydraulically operated apron and positive load ejector.

The driver is seated towards the middle of the vehicle on the left side and is provided with a cupola providing 360° vision. A lighter hatch cover (weight 81.65 kg) than those fitted to early vehicles has been introduced; the hatch incorporates vision blocks in place of the earlier periscopic vision devices.

The Cummins V903C diesel engine is positioned to the right of the driver's compartment. The Clark Model 13.5 HR 3610-2 transmission is below the engine and the steer unit is to the rear, coupled to the final drives.

On-vehicle equipment includes a 15.2 litre/s bilge pump and a Carco P30 planetary-winch with a line pull of 15,900 kg, using a 19 mm diameter wire rope 60 m long.

The M9 ACE can also be used to tow trailers and other equipment as it has a maximum drawbar pull of 14,059 kg. It is fully amphibious with preparation, being propelled in water by its tracks. The M9 is not suitable for operating in fast-flowing rivers.

The dozer blade is mounted on the apron and dozing and scraping are accomplished by raising and lowering the entire front of the vehicle by means of the hydropneumatic suspension.

This consists of eight sets of 711 mm diameter steel road wheels with the drive sprocket at the rear. The hydropneumatic suspension allows the M9 to be tilted to apply the dozing effort to one corner of the blade. The capability of the vehicle for operations such as dozing can be nearly doubled by self-loading the bowl with approximately 8,000 kg of earth, which is used as ballast.

Late production vehicles incorporate six new system improvements, including an all-steel dozer blade furnished by the US Government.

The US Army Anniston Army Depot has overhauled M9 ACE vehicles as well as incorporating a number of improvements as part of a Product Improvement Package (PIP).

Turkish M9 ACE

The Turkish company of FNSS Savunma Sistemleri has been awarded a contract by the TFLC for the supply of 12 AEV plus one hull for ballistic tests.

This is very similar to the US Army's BAE Systems US Combat Systems M9 Armoured Combat Earthmover (ACE).

The Turkish AEV will have a crew of two rather than having a crew of one and will have more up to date sub systems as some of the original ones are no longer manufactured.

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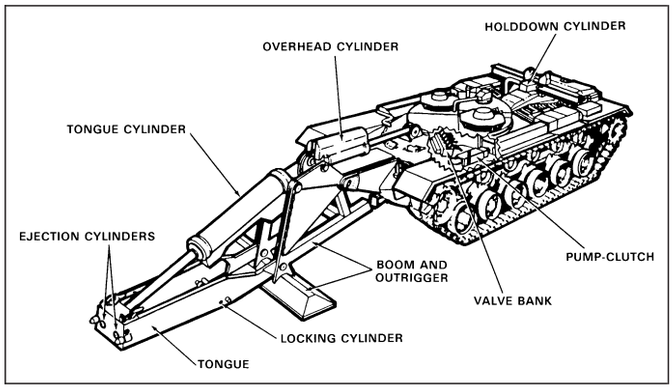

Drawing of M48 AVLB without its bridge 1133713

The M48, M48A1 and M48A2 were all powered by a 12-cylinder petrol engine which developed between 810 and 825 hp at 2,800 rpm, while the M48A3 was powered by a now L3 Propulsion Systems (originally Teledyne Continental Motors) 12-cylinder diesel (AVDS-1790-2A) engine which developed 750 hp at 2,400 rpm, giving the vehicle an increased operational range.

In Fiscal Year 1978 the US Army requested USD20.9 million to convert 136 M48A1 and M48A2 tanks into M48A5 AVLBs. (These vehicles now have M60 AVLB launcher components and the AVDS-1790-2D diesel engine.)

NAPCO Inc of Hopkins, Minnesota, has provided complete AVLB system support including training, technical assistance, special tools packages, spare parts and technical manuals.

In US Army service the M48/M60 AVLBs replaced by the much more capable General Dynamics Land Systems Wolverine Heavy Assault Bridge (HAB) based on a modified M1 Abrams MBT chassis.

It was expected that the M48/M60 AVLB would be replaced on a one for one basis by the M1 based Wolverine HAB but this programme has now been cancelled and the last of 43 vehicles was completed by General Dynamics Land Systems in late 2003.

It is expected that the remaining US Army/Marine Corps M48/M60 AVLB will be replaced by the M1A1 based Joint Assault Bridge. The US Marine Corps placed its first order for six JAB on M1A1 Abrams MBT chassis in 2007. Details of the Joint Assault Bridge are provided in a separate entry in *IHS Jane's Land Warfare Platforms: Support & Unmanned*.

It should be noted that while BAE Systems has supplied a batch of JAB launching mechanisms which have been installed on M1 Abrams MBT hulls for trials there was another competition.

Description

The basic chassis of the M60 AVLB is almost identical to that of the M60 MBT, except that the driver is located aft of his MBT location and accommodation is made in the same area for the commander, since the MBT turret is removed in the AVLB configuration. The diesel engine and transmission are at the rear.

Early M48 AVLBs had two one-person turrets, each with a .50 (12.7 mm) M2 HB Browning machine gun, but these were later removed and replaced by two conventional hatch covers. The crew of two comprises the driver and commander.

The suspension is of the torsion bar type and consists either side of six dual rubber-tyred roadwheels with the idler at the front and the drive sprocket at the rear, with three track-return rollers. Hydraulic shock-absorbers are fitted at the first, second and sixth roadwheel stations.

The bridge weighs 13,380 kg and is made primarily of aluminium. It is carried folded and launched over the front of the vehicle hydraulically as follows: the AVLB is driven up to the obstacle and halted, the bridge is raised hydraulically into the vertical, unfolded and lowered into place and the launcher detached. The complete launch can be accomplished from under cover.

The bridge takes three minutes to launch and can be recovered from either end. Recovery time is between 10 and 60 minutes depending on ground conditions. The bridge has an overall length of 19.202 m and can span a gap up to 18.288 m. Overall bridge width is 3.96 m, 3.81 m of which is usable roadway, with each trackway 1.486 m wide. Its maximum capacity is 54,431 kg.

Variants

M60 Razorback

The upgraded AVLB based on a M60 chassis with a new powerpack only reached the prototype stage.

Tandem AVLB

This system, developed by Israel Military Industries and based on a modified M48/M60 MBT chassis, is covered in another entry in *IHS Jane's Land Warfare Platforms Logistics, Support & Unmanned*.

Specifications

	M60 Armoured Vehicle Launched Bridges
Dimensions and weights	
Crew:	2
Length	
overall:	11.28 m
without bridge:	8.648 m
span:	18.288 m
deployed:	19.202 m
Width	
overall:	4.002 m
hull:	3.64 m
roadway:	3.96 m (useable roadway width 3.81 m)
Height	
overall:	3.9 m
without bridge:	3.04 m
Ground clearance, overall:	0.36 m
Track, vehicle:	2.921 m
Track width, normal:	711 mm
Length of track on ground:	4.235 m
Weight	
combat:	55,205 kg
unladen:	41,730 kg (without bridge)
load capacity:	54,431 kg
Ground pressure, standard track:	0.92 kg/cm^2
Mobility	
Configuration, running gear:	tracked
Power-to-weight ratio:	13.59 hp/t
Speed, max speed:	48.28 km/h
Range, main fuel supply:	500 km
Fuel capacity, main:	1,420 litres
Fording, without preparation:	1.219 m
Gradient:	30%
Vertical obstacle, forwards:	0.914 m
Trench:	2.59 m
Engine	L3 Combat Propulsion Systems AVDS-1790–2A AVDS-1790–2D, 12 cylinders, diesel, 750 hp at 2,400 rpm
Gearbox	
model:	Allison CD-850-6
forward gears:	2
reverse gears:	1
Electrical system, vehicle:	24 V
Batteries:	6 × 12 V, 100 Ah
Survivability	
Night vision equipment, vehicle:	yes
NBC system:	yes
Armour, hull/body:	steel

Status

Current users are known to be Israel, Pakistan (M48), Portugal, Singapore (12 M60), Spain, Taiwan and the US Army and Marine Corps. In US Army service this AVLB has been partly replaced by the Wolverine Heavy Assault Bridge (HAB) based on a modified M1 MBT chassis.

Contractor

General Dynamics Land Systems, Headquarters & Sterling Heights Complex.

US Army/Marine Corps Joint Assault Bridge (JAB)

Development

In mid-2005 BAE Systems Global Combat Systems Newcastle-upon-Tyne facility supplied a modified TITAN launch system to the US Marine Corps for integration into a General Dynamics Land Systems M1A1 Main Battle Tank (MBT) chassis.

This is used to launch and recover the current US Marine Corps Military Load Class 60/70 steel scissors bridge that is today launched from an obsolete M60 tank chassis.

The first M1A1-based bridge layer demonstrator was completed in late 2006 with the conversion work carried out by the US Army Anniston Depot which has considerable experience in the overhaul and upgrade of armoured fighting vehicles, including the M1A1 MBT.

Following extensive trials with this prototype system in 2007, BAE Systems Global Combat Systems was awarded a contract worth USD9 million to integrate six of the JAB launchers on US Marine Corps M1A1 Abrams MBT chassis. These six units were preceded by a further two prototype systems that were completed in 2008.

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Trucks

Australia

Mack Model RM6866RS (6 × 6) truck

Development

The Mack Model RM6866RS (6 × 6) truck was produced in Australia by Mack Trucks Australia Pty Limited as the Truck, Cargo, Heavy, MC3. It is a version of the basic US Mack 'R' series. Three prototypes were produced (in Australia) in 1978. After evaluation, an order was placed in 1981 for 906 units. These were all delivered by the end of 1986. In 1988, a further 19 units were built and delivered, bringing the total to 925.

During 1993 a contract to upgrade 541 of these trucks was awarded to Mack Trucks Australia Pty Limited. The contract, worth AUD8.77 million, involved the replacement of mechanical suspension units with an SA441W air suspension system and was scheduled to take two years.

In 1994 an extension to the contract was issued to cover the remainder of the Australian Army's Mack fleet, together with modifications on Cargo/Cargo with Winch variants to fit container twist locks. Between 1994 and April 1996, 288 cargo variants were fitted with eight container twist locks to enable the transport of a 20 ft ISO container or one, two or three 6 ft containers. This work was carried out around Australia in Mack branches and dealers. Also in 1994, four dump truck variants were converted to Truck, Tanker, Fuel variants under the Bushranger project. This work was carried out in Brisbane.

Between 1999 and 2000, 185 Cargo, Army Tractor/Medium Gun and Cargo, Crane variants had the Abbey CTM 3000 hydraulic crane removed and replaced with Hiab 090-3 cranes.

The Heavy Recovery Vehicle MC3 is a Mack Model RM6866RS (6 × 6) truck chassis that has undergone major modifications. The HRV entered operational service with the Australian Army in April 2005 and replaced the earlier Truck, wrecker, heavy, MC3.

Under Phase 2a of the Australian Department of Defence's Defence Matériel Organisation (DMO) multiphase project, Project Land 121; Project Overlander a project to reduce the in-cab noise of the Mack Model RM6866RS was undertaken. By mid-2008 all the required noise reduction kits (cabin insulation and air-conditioning kits) had been delivered and approximately 400 vehicles had been modified before a minor design defect in the air-conditioning halted progress. Work towards correcting the defect was scheduled, with installation of the remaining kits to follow.

Truck, Cargo, Heavy, MC3 with standard cargo/troop carrying body and tarpaulin (Ron Fry) 1124780

Also under Phase 2a of Land 121 a contract to modify the Mack gun tractor fleet with twist locks was signed in December 2006. The modification programme commenced in May 2007 and was scheduled for completion by the end of 2008.

Phase 2a of Land 121 addressed capability shortfalls within the current field vehicle and trailer fleet that are a result of significant occupational health and safety issues. Phase 2A was an 'umbrella project' for six separate sub-projects.

By mid-2011 it was stated that 863 of the original 906 Mack RM6866RS trucks delivered remained in service. The 19 examples delivered during 1988 were in the process of being converted into Truck Tanker Fuel - Aviation.

The Mack Model RM6866RS fleet will be replaced under Project Land 121.

It was announced in December 2005 that Land 121 tenders involving medium/heavy vehicles and modules (known as the MHC segment) had been released to a shortlist of nine companies, these being the then ADI Limited, the then DaimlerChrysler Australia-Pacific, General Dynamics Land Systems-Australia, MAN Nutzfahrzeuge, Mack Trucks Australia, Scania Australia, the then Stewart & Stevenson, the then Tenix Defence, and Terex Corporation.

By early 2006 three Requests For Tender (RFT) worth up to AUD600 million and covering Phase 3a of Land 121 had been issued. These initial Land 121 Phase 3a RFTs involved superseding the ADF's high-readiness fleet of 1,400 medium, heavy and light vehicles, 1,300 trailers and 1,200 specialist modules. Land 121 Phase 3b, the replacement of the remaining bulk of the fleet, was to follow on from Phase 3a.

With the second pass approval of Land 121, Phases 3a and 3b ceased to exist as independent phases. Phase 3a became Phase 3, Phase 3b became Phase 5, and Land 121 Phase 4 emerged. With the second pass approval of Land 121 the total quantity required under the new standalone Phase 3 requirement increased to 2,090 vehicles, 1,506 of these armoured. The total value of Land 121 Phase 3 reached around AUD3.3 billion.

Late-2007, BAE Systems (medium/heavy), the now Mercedes-Benz Australia Pacific Pty Ltd (light), and Haulmark Trailers Australia (trailers) were announced as preferred tenderers for Phase 3 of Land 121, the quoted value of

Truck, Cargo, Heavy, MC3 carrying mobile hospital shelter/containers (Barry Marriott) 0009605

Truck, Cargo, Heavy, MC3 with winch, laden with timber and coupled to a 20-tonne plant trailer (Ron Fry) 0121280

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Manipulator arm:	
Max vertical reach:	2.70 m
Max horizontal reach:	1.90 m

Status
Lynx-E is available, with the Lynx-C variation currently in development.

Contractor
Jordan Electronic Logistics Support (JELS), Amman.

Korea (South)

ROBHAZ-DT3

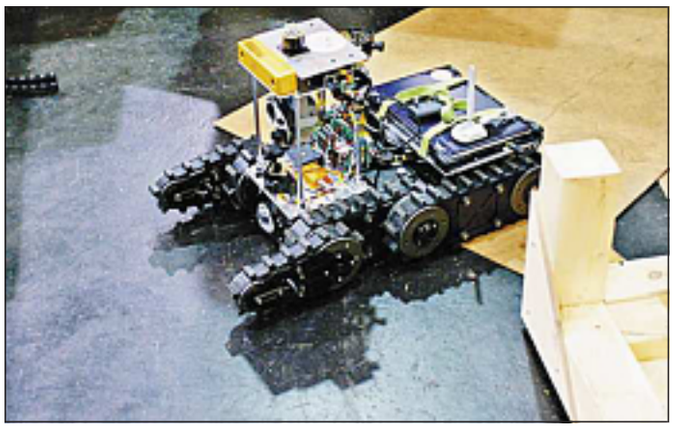
Type
Small tracked chemical, biological, radiological and nuclear (CBRN) detection UGV.

Development
The ROBHAZ-DT3 has been designed by the Korea Institute of Science and Technology to carry out civilian and military missions in operational environments that are characterised by rather uneven terrain and other hazards, such as mines, explosives and chemical warfare agents.

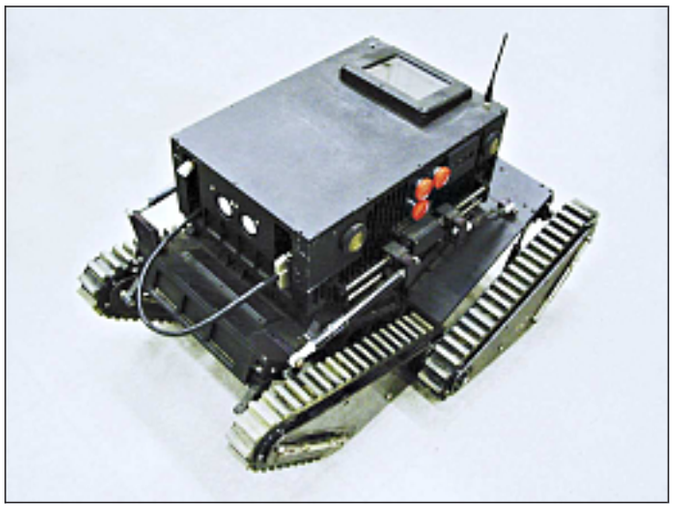
The robot was developed under the National Dual-Use Technology Development Project worth approximately USD3.5 million which commenced in 1999 and was completed in 2004.

Although the ROBHAZ-DT3 was specifically destined to be deployed with the South Korean armed forces in Iraq for detection and patrolling missions, the commercialisation of the robot was undertaken by the Yujin Robotic and the first ROBHAZ-DT3 was exported to the Japan disaster rescue organisation and later to Australia for research purposes.

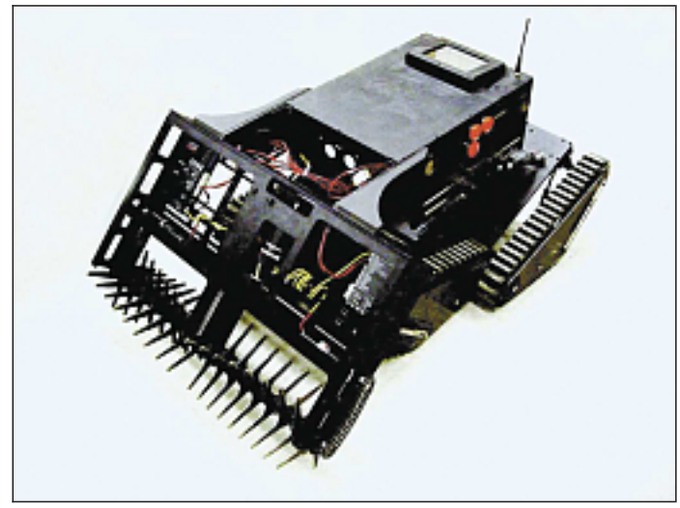
Description
The ROBHAZ-DT3 employs a passive double-track mechanism which provides adaptability and increases mobility in rough terrains. Each of the tracks is supported through an individual single motor, while a shock absorber is placed between the front and rear track components.



A sensor integrated version of the ROBHAZ-DT3
(Korean Institute of Science and Technology) 1334476



ROBHAZ-DT platform (KAIST) 1298775



ROBHAZ-DT (KAIST) 1298776

The platform is comprised of three parts, the front and rear body with their respective tracks, and a travel limit mechanism. The passivity of the system is accomplished through a hinge joint used to bring together the front and rear body. Thus, configurations can be implemented on the platform which can affect the stability of the vehicle in uneven or rough terrains.

For obstacle detection, eight ultrasonic sensors are mounted on the vehicle which are sustained by the water-proof, dust and shock resistant capabilities of the ROBHAZ.

The platform adheres to a plug-and-play principle which is supported by a two speed mode transmission system.

The integrated control system consists of a Linux central processing unit (CPU) mother-board, two controllers and two BLDC controllers which enhance the responsive control towards the equal distribution of the calculation load of the platform.

The communication between the operator and the robot is facilitated through the wireless local area network (LAN).

Specifications
ROBHAZ-DT3

Height:	0.47 m
Width:	0.74 m
Length:	0.29 m
Weight:	39 kg
Max speed:	10 km/h
Endurance:	1 h
Ground clearance:	N/A
Max gradient climb:	40°
Manoeuvrable speed:	2.5 km/h
Manipulator arm:	
Max lift capacity:	
(extended):	N/A
(unextended):	1 kg
Manipulator arm attachments:	
Gripper max length:	N/A
Gripper max strength:	44 N (depending on the mission configuration)
Weight:	13.5 kg
Battery life:	1 h
Battery type:	Lithium polymer
CBRN sensor package:	
Radiation measuring range:	10 nSv/h to 1 Sv/h
Gases detected:	O_2, CO, H_2S, Combustible gases

Status
In service with the South Korean armed forces as well in Japan and Spain. Also exported to Australia.

Contractor
Korea Institute of Science and Technology, Seoul
Yujin Robotic Company.

Scobot 100

Type
Small tracked reconnaissance UGV.

Description
The Scobot 100 is a quiet (>60 db) UGV fitted with four independently controlled tracks.

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