MIKE YEO // MELBOURNE

UNIHABITED GROUND VEHICLES – TRIALLED IN COMBAT AND USEFUL FOR SUPPORT MISSIONS

Like many other innovations that have found potential use in the battlefield today, the first, semi-widespread use of the Unmanned Ground Vehicle (UGV) can be traced by to the German military during the second world war. This was the German Goliath Light Charge Carrier, a tracked, remotely controlled demolition vehicle that was used as a mobile mine against opposing troops, vehicles or strongpoints.

Based on a French design used without much success in the trenches of the Western Front in World War One, the Goliath was available in both electrical and petrol-driven versions, and was steered remotely via a joystick control box. The control box was connected to the vehicle by a 650-metre (2,130 ft), triple-strand cable attached to the rear of the vehicle for control and transmitting power to the electric driven version. Two of the strands were used to move and steer the Goliath, while the third was used for detonating the 60 or 100 kg (130 or 220 lb) high explosive charge carried on board.

Despite being used on most of the fronts the Germans fought in since its introduction in 1942, the Goliath was not considered a success. It was relatively expensive, slow with a poor ground clearance, and was too heavy to be easily man-portable. Meanwhile, in action its trailing control cables and thin amour meant it was vulnerable to enemy fire although its effect was pronounced if it managed to reach its target.

EOS remote weapon station on Bushmaster. Credit: CoA / Neil Ruskin

Fast forward to today and the UGV has made a comeback into armies' thinking. The improvements in technology that have seen unmanned systems proliferate in the air and maritime space has also made its presence felt in the land domain. Gone are the clunky and limiting physical control cables, while improvements in autonomous technology and artificial intelligence has meant that UGVs are capable of performing a more diverse mission set than being a remotely controlled IED.

These include the obvious kinetic role armed with machine guns, light cannon or even guided missiles. However, other roles include reconnaissance, casualty evacuation, ordnance disposal or even to serve as a "pack mule", carrying heavy and/or bulky loads in support of friendly troops, in effect reducing personnel requirements for such tasks. The ordnance disposal role is a familiar sight already, with Explosive Ordnance Disposal (EOD) UGVs already in the inventory of military and police forces worldwide.

Using autonomous UGVs to move supplies or take on other riskier tasks would have the advantage of reduction in the risk to the personnel manning the vehicles, given the experience coalition forces in Afghanistan and Iraq have of these resupply convoys being targeted for attacks by insurgents. However, such operations are very much still a potential thing of the future, with UGV development still in its relative infancy and militaries for the most part yet to think through what they want these vehicles to do.

Nevertheless, the UGV has already started to see combat, with the Russian Uran-9 undertaking combat trials in the ongoing Syrian Civil War with Russian military units serving in the theatre. The Uran-9 is a 10-ton tracked combat UGV armed with a single 30mm automatic cannon and four anti-tank guided missiles, designed to operate in close combat providing fire support to friendly forces, which in theory would make it suited to the "small footprint" Russian intervention in Syria.

A performance report of the 3rd Central Research Institute of the Ministry of Defence of the Russian Federation, has since poured cold water on the Uran-9, saying the UGV functioned poorly during the trials. Several issues were highlighted. The main one was its tendency to lose contact with its ground control station in combat conditions, particularly in congested urban environments.

The U.S. iRobot Warrior, using a tool on the end of its arm, is able to grab, lift and carry heavy items. The arm can lift up to 350 pounds and the Warrior can carry a payload of up to 150 pounds. (Photo Credit: Courtesy of iRobot)

Despite this, the wider UGV market does appear to have potential, with one research entity estimating that this segment will be worth just over $10 billion by 2025. In Australia, Defence has started its first steps into exploring this new technology, with Queensland based company Praesidium Global contracted in June 2018 to supply four UGVs to the Army for a 12-month user evaluation trial at a total cost of $2 million. Then-Defence Minister Christopher Pyne said during the announcement that Army will use the trials to "continue to explore the utility of robotics and autonomous systems and develop an understanding of how they can be best employed to support our soldiers."

Praesidium Global offers a range of UGV technologies, including M.A.P.S (Mission Adaptable Platform System), a medium sized semi-autonomous unmanned platform capable of supporting a variety of missions; Scout, a small UGV designed specifically for internal carriage in armoured vehicles; and Pathfinder, touted as the world's first air-droppable UGV system designed to conduct tasks in denied or non-permissive areas.

Pyne said the purchase was an excellent example of Defence supporting Australian sovereign defence industry, with Praesidium Global's offering chosen over the offerings from other more-established global players, in line with Defence's vision to create and support an Australian sovereign defence industry.

AN AUSSIE SUCCESS

Another Australian company which looks to have a bright future in this field, although they do not have any UGVs in their product line up, is Canberra-based Electro Optic Systems (EOS). The technology company, which operates in the space and defence market, has over the past decade or so become an Australian export success in the defence industry, where it has found a market for its family of fully stabilised Remote Weapon Stations (RWS) that can be integrated on various vehicle platforms and used for different mission profiles.

EOS says that its RWS offerings are designed with a high level of commonality and modularity to offer clients a flexible firepower solution. These range from the lightweight R150, the R400 Mk.2 and Mk.2 Dual, the heavier dual-weapon R600 up to the fully armoured T2000 turret. The R150 is designed for carrying machine guns up to 12.7mm calibre, while both R400 versions and the R600 capable of handling a 30mm autocannon, while the T2000 can mount high-performance cannons from 25mm through to the new XM913 50mm SuperShot plus a coaxial machine gun.

All of these are integrated with "advanced surveillance capabilities including stabilized long-range sensors and battlefield sector scanning with up to 200 programmable target reference points for rapid engagement of possible targets directly from surveillance mode" which Justin Olde, Program Manager at EOS, says will allow the operator to command the weapon station to slew directly to that reference point if a target is detected in the vicinity by another friendly battlefield sensor, allowing for faster engagement times

In Australia, the Army's Bushmaster protected mobility vehicle is fitted with RWS from EOS, while the Hawkei PMV has also been successfully integrated with the same RWS. The company is teaming up with South Korea's Hanwha to offer the Redback Infantry Fighting Vehicle fitted with the T2000 turret and an RWS for Land 400 Phase 3 tender.

South Korea is just one of the export markets that EOS has found success in. According to Group CEO Ben Greene, 95% of the company's revenue comes from exports, which includes the R600 RWS for Singapore's Terrex 8x8 infantry carrier along with customers in Europe, Asia and the Middle East. The company is partnering with Orbital ATK and Oshkosh in the United States, which has seen its RWS fitted onto the latter company's MRAP All Terrain Vehicle (M-ATV) and Joint Light Tactical Vehicle (JLTV).

Olde also discussed work EOS has carried out with unmanned systems, telling APDR that the "combination of proven remote control capabilities, lightweight, high reliability, straightforward integration and simple user interface make the EOS Weapon Station range well suited to employment on UGVs".

He noted that EOS's range of RWS have been integrated onto a large range of different unmanned platforms, with its "relatively simple" mechanical and electrical interface meaning that integration with a UGV or any other type of vehicle is "a straightforward affair". Its fire control software has also been endorsed for remote and autonomous use by the US Defense Department.

EOS was first integrated onto the Northrop Grumman Mobile Armed Dismount Support System (MADSS) and had already conducted live firing tests more than a decade ago. Olde also revealed that since then the R150, R400 and R600 weapon stations have been integrated on UGVs from Praesidium, MILREM, IAI and Pratt and Miller.

When asked if there have been any challenges integrating the weapons stations on UGVs, Olde told APDR that the bearer used to carry the control signal data link between the system and the operator was the biggest challenge. EOS only allows "Operator in the loop" control of the weapon, meaning that the decision to fire the weapon always rests with a human operator and is not controlled by an autonomous system. Consequently, a robust and capable data link to carry the signal is needed, following which mechanical and electrical integration would be "relatively easy".

EXPANDING LINEUP OF UGV PLATFORMS

If EOS wants to expand the presence of its RWS offerings into the UGV market, it will have no shortage of platforms to integrate with. The major players in the defence industry, along with a host of smaller ones, have been putting forward their own products in the UGV space as military step up their interest. Under the U.S. Army's Squad Multipurpose Equipment Transport (SMET) program, four types of UGVs were chosen for a series of trials in December 2017.

These were the 8x8 version of General Dynamics Land Systems' (GDLS) Multipurpose Unmanned

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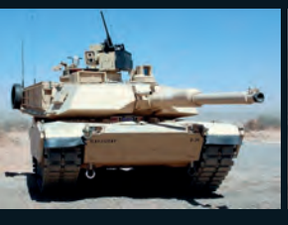




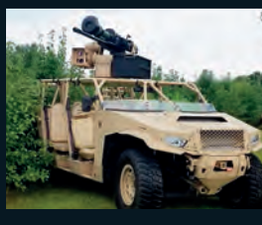

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While conducting a Gunnery Exercise the Ripsaw Unmanned Ground Vehicle engages a stationary BMP target at a distance of 700 meters, using the M2 .50 caliber machine gun. (Photo Credit: U.S. Army photo)

Tactical Transport (MUTT); the Polaris MRZR-X which is an optionally manned vehicle based on the popular Polaris MRZR series of all-terrain vehicles; the Howe & Howe Punisher, and the HDT Global Hunter Wheeled Offload Logistics Follower (WOLF). All four types were put through their paces by the 1st Brigade of the 10th Mountain Division during the division's major readiness exercise in November 2018.

The SMET program is looking to develop a system to help carry equipment and provide mobile power generation for small infantry units. But the vehicles could take on additional missions in the future, acting as weapons carriers, small ambulances, and more. The GDLS MUTT is a UGV that is available in both wheeled and tracked versions, with the former further split into 4x4 and 8x8 versions. It is intended as a "pack mule" UGV, although it can also be used as a fire support vehicle fitted with an integrated weapon station packing a weapon such as a minigun.

Israel is another country that has gone into UGV use, and despite not having gone into it on any scale comparable to its use of unmanned aircraft, the Israeli military has had experience using UGVs in an operational setting after using them to patrol the volatile border with the Gaza Strip and reportedly using unmanned engineering vehicles to clear obstacles during operations.

IAI has developed two such vehicles; the first of these being the Sahar, a 6x6 UGV designed for detecting and clearing improvised explosive device (IEDs). It has hydraulic arms at the front fitted with articulating blades for digging up and grabbing IEDS. IAI says the Sahar integrates multiple sensors to detect IEDs hidden in complex environments and can "engage and remove them as necessary using the blade installed on the vehicle. The system operation, manoeuvre, and detection are done autonomously without danger to human life."

The Sahar can also carry out other missions, with Intelligence, Surveillance and Reconnaissance (ISR) sensors and radars, and remotely controlled weapons being payload options. As of late 2018 development of the Sahar is complete and is undergoing trials with an unnamed customer.

A less conventional UGV developed by IAI is an unmanned variant of the 72-ton Caterpillar D9 armoured bulldozer. Incongruously named the Panda, the company says that this behemoth is capable of construction, trail blazing in hard off-road conditions, and removing large or suspicious obstacles without risk to human life. The company added that it had been awarded a procurement contract "following a prolonged process of development and demonstrating the system's capabilities, including comprehensive tests of the technology's maturity and its efficient and safe integration in battlefield scenarios".

Both UGV types are capable of several levels of operational autonomy depending on mission or operator choice and are fitted with cameras and radars for use in manual operations with an operator controlling the UGV in a secure remote trailer.

Meanwhile BAE Systems in the United Kingdom has unveiled the Ironclad UGV. This is a tracked, battery powered UGV that is able to run silently up to a range of 50km, and BAE says that the UGV is "small enough to negotiate tight urban environments, but maintains the mobility needed to handle extreme cross-country terrain, and "can also be fitted to carry out reconnaissance, combat and casualty evacuation roles".

A unique feature of the Ironclad is what was described by Craig Fennell, Future Programmes Director at BAE Systems Land (UK), as a "modular connection system (that) allows two vehicles to be connected together to handle additional loads, such as a specialised stretcher".

Speaking at the unveiling of the Ironclad in 2017, Fennell also said that "the next step is for Ironclad to act autonomously as part of a battlegroup, interacting with other vehicles and ground troops to follow mission objectives", adding at the time that this was already being tested on existing vehicles as the technology was being developed.

As such it is not inconceivable that the future battlefield could very well see unmanned, autonomous systems carrying out all sorts of tasks ranging from the mundane to the downright dangerous, reducing (although not totally eliminating) human input, oversight and risk. And given the pace of technological development, who is to say that this day may not be as far off into the future that some would think?