# **GROUND COMBAT SYSTEMS**

The Program Executive Office Ground Combat Systems (PEO GCS) serves as the "system of systems integrator" of the ground combat systems for the armed forces and leads Army transformation efforts toward future systems while maintaining a current combat-ready force. GCS is a command partner in the Tank-automotive and Armaments Command (TACOM) Life Cycle Management Command. The PEO encompasses a number of project management offices.

For example, the Project Manager for the Heavy Brigade Combat Team (PM HBCT) serves as the life-cycle manager for the major combat vehicles in the Army's heavy forces, including the Abrams, M88, Bradley, M113, M109 and Knight family of vehicles. Combined, these fleets total 32,682 platforms in various stages of their life cycles under PM HBCT's management purview, and total program funding through fiscal year (FY) 2013 of approximately \$36.8 billion. PM HBCT's responsibilities include the design, development, production, fielding and sustainment (reset, recap and upgrade) of safe, reliable and lethal ground combat systems. Product Manager Abrams manages approximately 8,325 platforms within the Abrams family of vehicles, including M1A1, M1A1 AIM and M1A2 SEP tanks, M88A1/A2 recovery vehicles and M104 Wolverine Assault Bridge.

# M1A1, M1A1 AIM and M1A2 SEP Tanks

The M1 Series Abrams Tank provides the Army with mobile, protected firepower and will remain the cornerstone of the Army's counterattack and containment forces as the Army transforms to the Future Force. The Abrams tank provides soldiers with the lethality, survivability and staying power to successfully close with and destroy enemy forces on the integrated battlefield. The 120 mm main gun on the M1A1 and M1A2, combined with the powerful 1,500-hp turbine engine and special armor, make the Abrams tank particularly suitable for attacking or defending against large concentrations of heavy armor forces on a highly lethal battlefield and for other roles that require shock effect and mobile direct firepower to support Army mission requirements.

Two major programs maintain and recapitalize the Abrams fleet: the M1A2 systems enhancement program (SEP) and the M1A1 Abrams integrated management (AIM) program.

The M1A2 program provides the Abrams with advanced improvements in lethality, survivability and fighting ability required to defeat future threats. It is the Army's first digitized, direct-fire combat vehicle.



M1A2 Abrams tank

The M1A2 has a digital command-andcontrol system that provides situational awareness updates to all the other tanks in a unit. Vetronics architecture ties all electronic components in the tank together and provides increased survivability and supportability. The commander's independent thermal viewer (CITV) gives it a hunter-killer capacity, allowing the M1A2 to engage one target while simultaneously tracking another. The M1A2 also has improved onboard diagnostics that allow the tank to self-diagnose faults without any additional special tools or equipment.

Further M1A2 improvements, through the SEP, are under way. The M1A2 SEP is the backbone of the Army's first digitized division and the counterattack corps of the Army's current force. It is the only weapon system that can withstand the impact of high-energy warheads and remain lethal in full spectrum operations. It has integrated combat command and control (IC<sup>3</sup>), which incorporates Force XXI Battle Command Brigade and Below (FBCB<sup>2</sup>) to provide real-time command and control and situational awareness.

Its sights use the latest thermal-imaging system (second-generation forward-looking infrared [FLIR]) for increased lethality and survivability. The M1A2 SEP tank takes advantage of computer/electronic industry advances by including improved electronics developed since the introduction of the M1A2.

The SEP package includes a new computerized mass-memory unit and color maps and displays. A thermal management system increases electronic reliability and decreases crew fatigue.

Production deliveries of the M1A2 SEP tank began in September 1999. These vehicles were used extensively during OIF, in which they were proven to be capable of handing full spectrum operations.

The Army must sustain the readiness and reduce the operations and support costs of approximately 4,300 older M1A1 Abrams main battle tanks in its active and reserve component units.

The **Abrams Integrated Management** (AIM) Program is the recapitalization program for the M1A1 tank. Under AIM, M1A1 tanks are completely disassembled at Anniston Army Depot, Ala. The depot refurbishes many of the tank's components.

The assemblies are then shipped to the Joint Systems Manufacturing Center (JSMC) in Ohio, where General Dynamics Land Systems reassembles the tanks to a zero time/zero miles standard.

The AIM program has fielded tanks to units at Fort Hood, Texas, and in Germany. Annual production now stands at 135 tanks per year and will continue until 2012.

In addition, AIM serves as the venue to apply modifications and upgrades to the tank, including embedded diagnostics. AIM also serves as a means to combat electronic obsolescence by introducing improved linereplaceable units for those that face technical obsolescence. The AIM process also incorporates redesigned hull and turret network boxes.

The M88A2 Heavy Equipment Recovery Combat Utility Lift and Evacuation System (HERCULES) is a full-tracked, heavy armored vehicle developed to accomplish safe, effective and independent battlefield recovery operations.

It implements swift and effective combat evacuations through the battlefield recovery operations of towing, winching and lifting. The Hercules uses the M88A1 chassis modified to significantly improve towing, winching, lifting and braking characteristics. It is the primary recovery support for the 70-ton M1 Abrams tank, the Wolverine and other heavy combat vehicles.

The M88A2 includes a 1,050-hp engine; a 35-ton boom; overlay armor; a 140,000pound, single-line, constant-pull main winch; and a 3-ton auxiliary winch for deploying the main winch cable. When compared to the M88A1, these upgrades improve towing power by 25 percent, lifting capability by 40 percent and winching ability by 55 percent.

The system is in full-rate production and deployment. Fielding began in July 1997, and it achieved first unit equipped in July 1997.

The M104 Wolverine Heavy Assault Bridge (HAB) is an M1A2 Abrams SEP variant and is operated by a two-man crew. The 26-meter bridge can span gaps of up to 24 meters to support heavy maneuver operations at 16 kph.

The bridge is computer-controlled and automatically compensates for minor deviations in launch-site elevation and terrain rack and cant. The crew can launch the bridge under armor in five minutes and retrieve it in less than 10 minutes.

The M104 Wolverine enables decisive maneuver by allowing units to span tank ditches, road craters and partially damaged bridge sections up to 24 meters wide at combat speeds.

## **Product Manager Bradley**

Product Manager Bradley manages approximately 6,452 M2/3A2, M2/3A2 ODS and M2/3A3 Bradleys, approximately 13,943 M113 series platforms, as well as the M7/A3 Bradley fire-support team (BFIST) vehicles and the M707/M1200 Knight family of vehicles.

The Bradley M2A3 Infantry/M3A3 Cavalry Fighting Vehicle (IFV/CFV) facilitates enhanced command-and-control capabilities, provides mobile protected transport of an infantry squad to critical points on the battlefield, and performs cavalry scout and other essential missions in the 21st century. Upgrades in this program include advanced technology in the areas of command and control, lethality, survivability, mobility and sustainability, required to defeat current and future threat forces while remaining operationally compatible with the main battle tank. The M2/M3 vehicle armament includes the 25 mm M242 Bushmaster cannon, the TOW II missile system and a 7.62 mm M240C machine gun.

The M2A3/M3A3 provides overwatching fires to support dismounted infantry



The A3 is the consummate digitized platform, with a core electronics architecture on a 1553 data bus and an improved target acquisition system that includes a full ballistic fire-control package with hunter-killer functionality via a commander's independent viewer (CIV). Optical improvements also include two secondgeneration FLIRs and day television cameras, which can be displayed to the squad members in the back of the vehicle via the rear-mounted squad leader's display. This feature significantly improves the realtime situational awareness for the entire dismounted or mounted crew.

The A3 integrated combat commandand-control (IC<sup>3</sup>) package incorporates the Army's digital command-and-control suite of automated messages, overlays and friend-or-foe graphics that meet the Army's objectives for a fully digitized force. This same digital command-andcontrol capability was incorporated into the A2 Operation Desert Storm (ODS), including a squad leader's display for messages and graphics.

The A3 variants reflect the latest iterations of a fighting vehicle family that includes the Bradley M2/M3A0, A1, A2, A2 ODS, IFV/cavalry fighting vehicle (CFV), Bradley fire-support team (BFIST) vehicle and M2A2 ODS engineer vehicle. Additional Bradley variants, based on the associated tracked M270 multiple-launch rocket system (MLRS) chassis, range from command-and-control systems to armored medical treatment vehicles.

The Bradley Operation Desert Storm-Situational Awareness (ODS-SA) M2/M3 A2 conversion implements a digital architecture and will benefit the fleet by mitigating obsolescence and providing commonality. The M2/M3 A2 ODS-SA system consists of a modified BFVS A2 ODS turret and chassis. The two-man turret consists of a gun/turret stabilization system, a 25 mm gun, a coaxial 7.62 mm machine gun, ammunition feed/storage systems, a dual-tube TOW missile launcher with a launcher erection mechanism/drive and a TOW launcher elevation drive, gunner's and commander's stations, gunner's and commander's sight systems, and a turret processor with associated subsystems and sensors. The chassis contains the power train, suspension system, the driver's station and the squad compartment. The A2 ODS SA electronics architecture is based on a dual redundant MIL-STD-1553B serial data bus. All major turret system units are linked through this bus for signal and data transfer. Sight imagery and graphics data are routed as RS-170 video signals to the operators.

The A2 ODS SA system has the Improved Bradley Acquisition Subsystem (IBAS) for the gunner that replaces the Bradley Eyesafe Laser Rangefinder (BELRF) integrated sight unit (ISU) in the A2 ODS. The sight has a day TV and a forward looking infrared (FLIR) channel, both with a narrow and wide field of view. The sight images are displayed as video images to the gunner and commander on cathode ray tube (CRT)based biocular virtual image displays. The IBAS also has a gunner's monocular directview optics port for the day view channel and a laser rangefinder for target ranging. The line of sight is inertially stabilized. The M7 BFIST SA vehicle is the fire-support team (FIST) version of the Bradley ODS SA, and is scheduled for first unit equipped to the 81st BCT, Washington National Guard, in October 2010.

The M113 Family of Vehicles (FOV) provides a highly mobile, survivable and reli-





able tracked-vehicle platform that, with upgrades, is able to keep pace with Abramsand Bradley-equipped units and is adaptable to a wide range of current and future battlefield tasks through the integration of specialized mission modules. Although not presently in new production, the 13,943 M113 FOV systems now in Army vehicle inventories constitute a significant percentage of present and future heavy division assets. Recent activities within the M113 FOV focused on upgrading several models of the vehicles to meet or exceed the mobility characteristics of the supported maneuver force. The most recent upgrade to see wide fielding is the A3 reliability improvement for selected equipment (RISE). RISE provides various derivatives within the FOV with major performance improvements in mobility, reliability and survivability through installation of a 275-hp 6V53T engine with an X-200-4A transmission. Coupled with reconfiguration of the driver's station and several other vehicle subsystems, these improvements provide battlefield mobility commensurate with the supported Abrams/Bradley maneuver force. Moreover, the increased performance provided by this and other upgrade packages permits a range of enhanced survivability options.

M7/A3 Bradley Fire Support Team (BFIST). The BFIST program is executing to the Army campaign plan and will complete modularization of the force in FY 2013 with 20 heavy brigades of A3 BFISTs and 11 heavy brigades of M7 BFISTs. BFIST vehicles are required to conduct various mission scenarios including reconnaissance and surveillance, reporting of enemy activity in the area of operations, reporting of hazards and obstacles to movement, and the coordination of indirect fire support. Both versions have equivalent mobility, survivability, signature and night-vision capability and consume common repair parts with the maneuver force they support. Target designation for all available laser-guided munitions is required, including those delivered by mortars and airborne platforms. Dismount operations are required under some conditions. Extensive and real-time communications with other members of the force and rear-area command posts is required for mission success. Interoperability in the netcentric array of



other systems demands full compatibility with the newest C<sup>4</sup>ISR equipment and procedures.

The M7 BFIST is one of the two models that replaces all the M981s (FISTVs) in the active force at the company FIST operational facility. The M7 BFIST integrates both existing and improved FIST mission equipment packages onto an M3A2 Operation Desert Storm (ODS) chassis. Some of the mission equipment, such as the G/VLLD, will be taken directly from displaced FISTVs and stowed. Features incorporated from the M3A2 ODS chassis include the 25 mm gun, 7.62 coaxial machine gun, precision lightweight global positioning system (GPS) receiver (PLGR) and the Bradley eyesafe laser rangefinder. The current M7 BFIST uses the integrated sight unit, which is also used as the gun sight for self-defense. The M7 BFIST uses the stand-alone computer unit (SCU), the ruggedized handheld computer and the forward observer system with full interoperability with advanced field artillery tactical data system (AFTADS) fire-support networks. The inertial navigation system (INS) provides navigational capability based on a blended inertial/GPS solution. The mission processor unit (MPU) calculates target grid location by processing information received from the INS, and mission information from the targeting station control panel (TSCP) serves as the primary operator interface. The TSCP functions are controlled through a series of menus. The TSCP controls the 1553B data bus. The MPU sends processed information back to the TSCP and SCU for display and routing over the single-channel ground and the airborne radio system to external fire-support elements. The first unit equipped with the M7 BFIST was the 3rd Infantry Division in FY 2000.

The second model BFIST is the A3 BFIST. The A3 BFIST incorporates the FIST mission equipment package (MEP) with a digitized M3A3 chassis. Features incorporated from the M3A3 chassis include: the commander's independent viewer with 360-degree traverse and the improved Bradley acquisition system (IBAS), both second-generation FLIRs, to improve tar-

M7/A3 Bradley fire support team (BFIST)



M1200 Armored Knight

get acquisition and target engagement; the 25 mm gun; 7.62 coaxial machine gun; PLGR; and digital command-and-control enhancements. The first unit equipped for the M3A3 BFIST was the 4th Infantry Division.

An effort is under way to incorporate the fire-support sensor system (FS<sup>3</sup>) onto the A3 digitized BFIST. In addition to the improved features of the M3A3, the A3 BFIST with FS<sup>3</sup> will allow the fire-support team to detect, identify and designate targets for precision munitions at greater ranges while remaining "buttoned up"protected by the vehicle's armor. The new ranges will meet Office of Research and Development requirements and will also allow for laser-guided smart munitions, laser-guided bombs, and missiles for rotary- and fixed-wing aircraft. The first unit equipped with the M3A3 BFIST with FS3 is scheduled to be the 3rd Infantry Division in March 2011.

**M707 Knight/M1200 Armored Knight.** The M707 Knight was developed and fielded during the late 1990s. Based on the M1025A2 Humvee chassis, the M707 features a mission equipment package fully adapted to support the U.S. Army Field Artillery Combat Observation Lasing Team (COLT) mission with G/VLLD and ANTAS-4 sensors. In 2003, the M707 was enhanced with an FS<sup>3</sup> second-generation FLIR based on the LRAS3.

Fielded to both Infantry and heavy brigade combat teams (IBCTs/HBCTs), Knights consist of a laser designator and rangefinder, thermal imager, digital command-and-control system, blended inertial/global positioning system navigation and targeting capability, and a self-defense weapon. COLTs use the Knight precision targeting systems, along with the forward observer system (FOS) software, to provide precise far-target location and laser designation for conventional ordnance, laserguided munitions and precision-guided projectiles such as Excalibur.

First fielded in 2008, the M1200 Armored Knight provides improved survivability for the COLTs. Integrating the M707 mission equipment package onto the more survivable M1117 armored security vehicle chassis, the M1200 Armored Knight adds 360degree continuous cupola rotation, CREW II, high-frequency radio capability, and M2HB .50-caliber capability. To date, more than 200 M1200 Armored Knights have been fielded to support operations in Iraq and Afghanistan. In addition, 45 systems are scheduled to be fielded to IBCTs and HBCTs through the remainder of fiscal year FY 2010, and additional Armored Knights will continue to be fielded via new production or reset in FY 2011.

The last year of procurement to meet the authorized acquisition objective of 465 is FY 2011, and product improvements are currently under way to incorporate targeting under armor (TUA) onto the M1200 Armored Knight. The program will accomplish this by incorporating a common remotely operated weapons system II (CROWS II) and a common remote stabilized sensor system (CRS3) onto the Armored Knight. This capability will put the soldier under armor for operations, with no degradation in capability, and add an optional fourth crew-member station. Additional efforts are under way to upgrade the MEP and software to a more open architecture. The program is currently funded for 416 upgraded TUA Knights and will begin fielding in FY 2013.

## **Product Manager Fire Support Platforms**

Product Manager Fire Support Platforms manages approximately 1,934 platforms, including the M109A6 Paladin/M992A2 FAASV System, the Paladin/Carrier Ammunition Tracked (CAT) and Paladin Integrated Management (PIM) program vehicles.

Paladin/FAASV. The M109A6 Paladin

155 mm self-propelled howitzer provides the primary indirect fire support to modular HBCTs and armored cavalry regiments. Like the earlier M109 models, the M109A6 Paladin is a fully tracked, armored vehicle. The enhanced Paladin configuration is achieved through extensive modifications to existing M109A2/A3 vehicle hulls and the subsequent introduction of an entirely new turret structure. The Paladin includes an onboard Paladin Digital Fire-Control System (PDFCS) that provides ballistic computation, weapon control, a vehicle location/navigation system, secure radio communications systems, an improved M284 cannon and M182A1 gun mount, automotive improvements, improved ballistic and nuclear-biological-chemical protection, driver's night-vision capability, and built-in test equipment. Additional chassis upgrades include a remotely actuated travel lock (for quicker site occupation and displacement), longer torsion bars (to help support the new turret) and a low-heat rejection engine with an improved cooling system. Described as the first digitized combat vehicle in the Army's inventory, the Paladin has improved responsiveness, survivability, lethality and reliability compared to the earlier M109s.

A parallel U.S. Army recapitalization effort was seen in the M992A2 Field Artillery Ammunition Supply Vehicle (FAASV). The basic M992A0 FAASV emerged from an industry research and development project designed to provide self-propelled field artillery units with a ballistically protected vehicle capable of performing critical resupply and support functions. The FAASV system was type classified and entered production in 1983. It was based on an M109 howitzer chassis that provided the resupply asset with mobility and survivability characteristics commensurate with the supported cannon element. The system is paired on a one-for-one basis with the Army's M109A6 Paladin self-propelled howitzer.

Paladin/FAASV Integrated Management (PIM/CAT). The PIM program is a sustainment program engineered to improve readiness, avoid components' obsolescence and increase sustainability of the M109A6 Paladin and the M992A2 FAASV platforms out to the year 2050. PIM will leverage fleet commonality for key components including the Bradley engine, transmission, final drives and suspension. PIM uses the existing M109A6 main armament, recently designed cab structure, and the Chief of Section Protection while replacing outmoded chassis components with advanced components from the Bradley fighting vehicle to increase sustainability and commonality across the HBCT. PIM also incorporates select technologies from the non-line-of-sight cannon (NLOS-C), including a (modified electric) projectile



rammer and modern electric-gun drive systems to replace the current hydraulically operated elevation and azimuth drives that were designed in the early 1960s. The M109 FOV platforms will be fitted with Blue Force Tracker capability to ensure compatibility with future architectures. These upgrades and better communication technology will significantly improve operational awareness on the battlefield and reduce the logistics footprint within the HBCT. The new electric-gun drives and rammer components as well as a microclimate air conditioning system will be powered by the Common Modular Power System (CMPS). CMPS, which will also be installed on Stryker and has been installed on Humvee demonstrator vehicles, is based on architecture jointly developed by the Army Tank-Automotive Research Development and Engineering Center and the Program Executive Office-Ground Combat Systems. Once delivered to the field, the PIM vehicles will give HBCT commanders a more sustainable vehicle, providing commanders increased confidence in their artillery fleet.

### PM Joint Lightweight Howitzer

The Project Manager for the Joint Lightweight Howitzer takes a joint (Army and Marine Corps) perspective in managing the development, acquisition, testing, systems integration, product improvement and fielding of the M777A2 155 mm joint lightweight howitzer system, designed to enhance strategic mobility and provide the infantry soldier and marine with effective and responsive fire support. Their task is to provide a world-class, supportable howitzer system to artillery cannoneers, permitting them to accomplish their missions.

The Lightweight 155 mm Howitzer (LW155), also known as the M777A2, pro-

vides direct, reinforcing and general support fires to maneuver forces. The first ground system to make extensive use of high-strength titanium alloy for its major structures, the LW155 has achieved an almost 50 percent reduction in weight from the previous system. It is an excellent example of a successful joint service program, with the Marine Corps and Army working together to develop, produce and field the howitzer and its Digital Fire Control System (DFCS). The DFCS enables the weapon to program and fire the improved Excalibur precision-guided munition to ranges in excess of 25 miles, providing the capability to deliver precision fire on the battlefield.

The LW155 uses the M776 155 mm cannon, giving it a maximum firing range of approximately 30 kilometers with rocket assisted projectiles and 24.7 kilometers with standard rounds. It has a maximum firing rate of four rounds per minute and a sustained rate of two rounds per minute. The M777A1 is fitted with onboard electronics, giving it self-locating, self-laying and digital communications similar to the M109A6 Paladin.

The M777A1 was unconditionally approved for use by Army units in January



2007. The M777A2, which adds the ability to fire the Excalibur precision-guided munition, was approved for use in September 2007.

The LW155 was first fielded by the Marine Corps in April 2005, and since then the 10th, 11th, 12th and 14th Marines and the schoolhouses have been fielded. The Army has been fielding the system to its Stryker brigades, fires brigades, National Guard and schools. The LW155 has seen significant action in Afghanistan, receiving high marks for its performance. The LW155 has also been fielded through foreign military sales to Canadian forces who have used it extensively in Afghanistan with very positive feedback. Australia accepted its first LW155 delivery in August 2010. Field service representatives have been deployed to support M777A2 weapons in theater and provide continuous technical and supply support to ensure that systems are fully supported and maintained at a high state of system readiness.

Every fielding by the LW155 office has been conducted on schedule. In October 2009, Army Forces Command contacted the LW155 office to discuss the possibility of immediately equipping an IBCT with the LW155. This urgent requirement created challenges because IBCTs were never intended to receive the LW155, the new equipment training (NET) team was already scheduled to train another unit, the Army did not want to forego any upcoming fieldings to make this happen, and the unit was deploying in just three months. Understanding the importance of this task, the LW155 office quickly identified all the constraints. An innovative plan was developed, allowing the 4-25 FA to be fielded by taking weapons that had already been fielded to the 1st Stryker Brigade and sending them directly to the port at Philadelphia, Pa. An additional six weapons were borrowed from the 1-321 FA at Fort Bragg, N.C., and were sent to Fort Drum, N.Y., to support NET. Meanwhile, the NET team was split in two, and an alternative program of instruction was developed to support the needs of this light unit. The result was the successful equipping of the 4-25 in Afghanistan with the LW155 with no adverse effects to other fieldings.

At present, 955 LW155s have been ordered, with approximately 638 fielded. While the prime contractor is BAE Systems of the United Kingdom, a strong U.S. supply chain accounts for about 70 percent of the production and assembly work. Final

M777 joint lightweight howitzer

M119A2 howitzer



integration and assembly is at a state-ofthe-art lean manufacturing facility established in Hattiesburg, Miss.

In addition to the M777 series howitzers, other towed artillery systems being supported in U.S. Army inventories include the M119A2 105 mm howitzer as well as the M198 155 mm howitzer.

The **M119A2** is a lightweight 105 mm howitzer that provides continuous close fires to the Infantry brigade combat teams. The system weighs 4,270 pounds and is air assault/air-drop capable. It has a range of 19.5 kilometers with rocket assisted munitions (14 kilometers unassisted). It fires all currently fielded U.S. munitions and has a rate of fire of six rounds per minute. Each M119A2 section has seven crew members. The M119A2 is fielded as two eight-gun batteries for each M119A2 battalion.

The M119 was originally acquired in 1986 as a nondevelopmental item from Royal Ordnance Plc. The original 147 howitzers were manufactured in the United Kingdom and the balance produced at Rock Island Arsenal, Ill. The current fleet of M119A2s in the inventory from the first production run is 382 systems. U.S. fire control and a low-temperature-capable recuperator were implemented as the M119A1 in 1991. The light artillery system improvement program resulted in the M119A2, which possessed a number of improvements to enhance the ease of operation and maintenance of the weapon system. Approved prime movers include the Humvee and 2.5-ton and 5-ton trucks.

In 2004, it was determined that U.S. Army modularity requirements had in-

creased the M119A2 authorized acquisition objective to 893 systems. A decision to reenter production was made by the general officer steering committee. In 2005, the Program Executive Officer for Ground Combat Systems (PEO GCS), through the commanding general, TACOM Life Cycle Management Command, endorsed the make-or-buy recommendation to produce the M119A2 towed howitzer at Rock Island Arsenal. The analysis was conducted under the authority of 10 USC 4532 and in accordance with the Army Industrial Base Process, Army Regulation 700-90 dated December 14, 2004. Cannons would continue to be produced at Watervliet Arsenal, N.Y., and basic issue items for the system are being purchased out of the government supply system. Production at Rock Island and Watervliet Arsenals commenced with the receipt of the FY 2005 Defense Supplemental funding. The last weapon order was in FY 2009, and the last deliveries will be taken in FY 2012. A full materiel release of these new production howitzers was approved by the commanding general, U.S. Army TACOM Life Cycle Management Command, in June 2008.

A program to integrate a digital firecontrol capability onto the M119A2 howitzer (becoming the M119A3 howitzer) was approved by the PEO GCS and the commanding general of the Field Artillery School Center of Excellence in January 2008. Direction was provided to maximize commonality across the IBCTs to the maximum extent possible, thus minimizing the IBCT logistics footprint. Leveraging the software for the M777A2 155 mm howitzer maximizes commonality in operation and training while minimizing program cost, schedule and risk. The requirement for this capability is the materiel change package for digitization of the M119A2 105 mm light towed howitzer. The application of a digital fire control will allow the digitized M119A2 to emplace and displace faster, provide more responsive fires and allow the system to become more survivable on the battlefield.

To provide even greater range and lethality for light-unit fire-support elements, the Army began fielding the **M198 155 mm Towed Howitzer** in early 1979. As a successor to the older M114A1 155 mm towed system, the 15,750-pound (original fielded weight) M198 provided a maximum range of 30 kilometers (with rocketassisted projectiles) and the capability to fire a broader range of ammunition options than those available for 105 mm units. Normally towed by a 5-ton truck, the M198 can also be moved by a CH-47D Chinook helicopter or Air Force assets, C-130 and larger.

The Project Manager for Mine Resistant Ambush Protected (MRAP) Vehicles program has been rapidly fielding highly survivable, mobile, multimission vehicles to the joint force to meet urgent operational requirements. MRAP vehicles are commercial off-the-shelf vehicles designed from the ground up to reduce casualties and increase survivability for personnel subjected



M198 155 mm towed howitzer

#### The Stryker



to mine explosions, improvised explosive device detonations and small-arms fire. Multiple missions are being supported by the MRAP fleet, including recon, convoy operations, troop transport, ambulance, combat engineer and explosive ordnance disposal missions for maneuver units.

The **Ground Combat Vehicle**, managed by PM GCV as a part of PEO Ground Combat Systems, will take an incremental development approach that enables initial fielding by 2017, while establishing a basis from which to adapt.

The GCV's modular design will allow for growth in size, weight, power and cooling which enables rapid integration of improved capabilities in subsequent increments. In addition, the vehicle's modular design, particularly for armor and armaments, will provide commanders with configuration and employment options and complements the Army's versatile mix of forces.

The ground combat vehicle effort is part of a holistic Army plan to modernize its combat vehicle fleet. This includes incorporating mine resistant ambush protected vehicles into the fleet while modernizing current vehicle fleets including Stryker. The first ground combat vehicle will be an infantry fighting vehicle offering a highly survivable platform for delivering a nineman infantry squad to the battlefield. The GCV is the first vehicle that will be designed from the ground up to operate in an improvised explosive device (IED) environment. It is envisioned to have greater lethality and ballistic protection than a Bradley, greater IED and mine protection than an MRAP, and the cross-country mobility of an Abrams. The GCV will be highly survivable, mobile and versatile, but the Army has not set specific requirements such as weight, instead allowing industry to propose the best solution to meet the requirements.

In February 2010, the program executive office released a request for proposal (RFP) for the technology development phase of the infantry fighting vehicle being developed under the GCV effort. The GCV acquisition program will follow Department of Defense best acquisition practices and be a competitive program with up to three contract awards. GCV development will consist of three phases: technology development, engineering and manufacturing design, and low-rate initial production. The Army anticipated awarding the first contracts for the technology development phase in the fourth quarter of fiscal year 2010.

The **Project Manager for Stryker Brigade Combat Team (PM SBCT)** develops, produces and sustains the full range of safe, reliable, supportable and effective Stryker vehicle systems, a diverse fleet of medium-weight vehicles capable of being rapidly deployed to trouble spots around the world.

Stryker Family of Vehicles. The Stryker is an eight-wheeled combat platform, and the Stryker family of vehicles consists of 10 unique mission equipment packages incorporated into the common combat vehicles platform configurations. In 2000, the Stryker was the first new combat vehicle to be acquired by the Army for more than 20 years. The procurement of the Stryker emerged from the following challenge given in 1999 by then-Army Chief of Staff GEN Eric K. Shinseki: "We must provide early entry forces that can operate jointly without access to fixed forward bases, but we still need the power to slug it out and win decisively." The response was brigade combat teams and the Stryker family of vehicles. The Army's responsibility to satisfy 21st-century requirements for effective full spectrum operations requires an improved capability for the rapid deployment of highly integrated, combined arms forces possessing overmatching capabilities, exploiting the power of information and human potential, and combining the advantages of both light and mechanized forces across the full range of military and nonmilitary operations.

To date, Strykers have accumulated more than 25 million combat miles in Op-

eration Enduring Freedom and Operation Iraqi Freedom. The primary design has two variants: the M1126 infantry carrier vehicle (ICV) and the M1128 mobile gun system (MGS).

The ICV is a troop transport vehicle capable of carrying nine infantry soldiers and their equipment and requires a crew of two: a driver and a vehicle commander. There are eight other ICV configurations with combat service and combat support roles. Those configurations include the M1130 commander's vehicle, the M1127 reconnaissance vehicle, the M1131 A1 firesupport vehicle, the M1129 A1 mounted mortar carrier, the M1134 antitank guided missile vehicle, the M1132 engineer squad vehicle, the M1133 medical evacuation vehicle and the M1135 nuclear-biologicalchemical reconnaissance vehicle. The MGS is based on the ICV but modified to incorporate a 105 mm turreted gun, an autoloader system and a crew of three. The ICV is armed with a remote weapons station that supports the M2 .50-caliber machine gun or the Mk 19 automatic grenade launcher, the M6 countermeasure device (smoke grenade launcher) and an integrated thermal weapon sight.

The Stryker supports communications suites that integrate the single-channel ground-and-air radio system (SINCGARS) radio family; enhanced position location reporting system (EPLRS); Force XXI Battle Command Brigade and Below (FBCB<sup>2</sup>) or Blue Force Tracker (BFT); global positioning system (GPS); high-frequency (HF) and multiband very high and ultrahigh frequency (VHF/UHF) radio systems. The Stryker provides up to 14.5 mm of ballistic protection. General Dynamics Land Systems produces the Stryker, which is powered by a 350-hp diesel engine, runs on eight wheels that possess a run-flat capability and has a central tire inflation system. It also incorporates a vehicle height management system.

#### **Robotic Systems Joint Project Office**

PEO GCS's Robotic Systems Joint Project Office (RS JPO) takes a joint (Army and Marine Corps) perspective in managing the development, acquisition, testing, systems integration, product improvement and fielding of robotic systems that will form the backbone of the combat force of the future. RS JPO is spearheading development of the systems to employ the latest sensors, remote navigation and commandand-control technologies to integrate robotics into the battlefield. Speeding these technologies to the battlefield has the po-

Multifunctional, agile, remote-controlled robot IV



tential to revolutionize combat operations. Per the Army Acquisition Executive Policy Memorandum of November 24, 2009, the RS JPO serves as the life-cycle manager for all current and future Army unmanned ground systems. The following are priorities of the RS JPO mission: support the joint warfighter, modernize current unmanned systems, facilitate the transformation to the Future Force, apply continuous process improvement, conduct sound systems-engineering practices and develop the workforce. A healthy partnership with industry, academia, government research centers and the user community has enabled the RS JPO to develop, acquire, field and sustain robotic systems, while exceeding warfighter expectations. The RS JPO vision is continuous improvement of unmanned system capabilities to meet current and future joint warfighter objectives. Support to the joint warfighter in overseas contingency operations has greatly accelerated acquisition and fielding time lines.

Delivering safe, effective unmanned systems with a variety of mission payloads in response to joint urgent operational needs statements has created a number of opportunities as well as challenges for the RS JPO and its partners. Operational needs from theater have defined mission requirements for ground robots from explosive ordnance disposal (EOD) to area- and route-clearance and reconnaissance and surveillance. This has resulted in the proliferation of ground robots on the battlefield. Initially, EOD units and route-clearance teams adopted ground robots to interrogate and neutralize improvised explosive devices or unexploded ordnance. Warfighters have since identified mission applications for robots to inspect vehicles; search caves, rubble and tunnels; extend reach; and provide enhanced situational awareness. The U.S. industrial base has grown to meet the demand for unmanned systems. This growth is evident across all sectors of the market, including basic and applied research at academic institutions and government laboratories, prototyping and commercialization by small businesses, and manufacturing, production and sustainment operations by traditional defense contractors, automotive suppliers, new companies and government organizations.

In the rush to field robots to Operation Iraqi Freedom (OIF) in 2003, commercial offthe-shelf equipment was procured and fielded to get systems in the hands of soldiers and marines as quickly as possible. Initially, demand for robots outpaced the supply capability of industry. Industry responded by increasing production capability, which spawned a number of subtier suppliers and upstart robotic companies. As competition increased, innovative, highquality products ensued. This dynamic seven-year period has created a configuration management and interoperability challenge for the RS JPO. A key tenet of RS JPO's strategic vision is the development, application and certification of a set of interface specifications and open architecture standards that will enable interoperability, payload integration and product improvement. RS JPO, serving as the system integrator of payloads on any robotic platform, is responsible for managing space, weight and power trades. This will drive the Army and Marine Corps to a family of robotic platforms with a common set of payload, communication and command-and-control interface standards. The benefits of this discipline are potential plug-and-play mission payloads, common controllers and true modularity of systems.

As the attention of U.S. military forces has shifted from Iraq to Afghanistan, the RS JPO is responding to additional requirements and new applications for ground robots. Combat in Operation Enduring Freedom (OEF) is significantly different from that in OIF. Unlike in Iraq, the transportation, communication and utility infrastructures are rugged mountain trails and mud huts. In Afghanistan, smaller, lighter robots with increased agility and mobility will be needed by infantry units and maneuver elements hiking the high-altitude trails. Also, more EOD and route-clearance robots will be needed with the continuing buildup of force. Hazardous material and explosives detection sensors, high-resolution cameras, dextrous manipulators and other payloads will be required to enhance warfighter capability in OEF. The RS JPO is poised to meet these emerging ground robotic requirements. Modernization and standardization of "veteran" assets from OIF will occur during a reset process. Reset and new procurements will facilitate the transformation to the Future Force.

Regardless of how robots are integrated into the heavy, Infantry or Army modernization brigade combat teams, interoperability and modular payloads are two necessities. These capabilities can be delivered to the warfighter only through the collaboration and cooperation of the RS JPO and its partners. The RS JPO is committed to building strategic and tactical relationships to support the joint warfighter in the lifecycle management of unmanned systems.