Equipping Joint Warfighters Through Modernization of Unmanned Ground Systems (UGS)

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This article discusses the Program Executive Office Ground Combat Systems (PEO GCS) Robotic Systems Joint Project Office's (RS JPO's) actions and strategy for equipping joint warfighters through modernization of UGS capabilities. The initial section provides an RS JPO overview and a historical perspective on the mission application growth over time associated with ground robot employment in *Operations Enduring* and *Iraqi Freedom* (*OEF/OIF*). The next section details the RS JPO's robot modernization strategy, a 3-axis approach centered around a family of common mobility platforms equipped with modular mission equipment packages. Improvements to the base platforms for increased agility, mobility, size, weight, power, cooling, and transportability will be addressed. Finally, the article discusses the RS JPO's Unmanned Systems Road Map, emerging requirements, and future technology enablers.

The Mini-EOD, which delivers a man-portable system to support dismounted operations in the rugged terrain and elevations of Afghanistan, searches through a field. (U.S. Army photo courtesy of RS JPO.)

In line with the Army's modernization initiative, the RS JPO emphasizes getting the right capabilities in the hands of Soldiers and Marines, while developing versatile capabilities required for future challenges. The RS JPO leads all aspects of UGS life-cycle management to ensure that safe, effective, and supportable capabilities are provided while meeting applicable cost, schedule, and performance. With more than 6,000 robotic systems fielded to date, these systems have proven to be combat enablers and permit our Soldiers to perform some of the most dangerous jobs on the modern asymmetric battlefield. Capability enhancements reflect the lessons learned from ongoing operations and better posture robotic systems for a broader range of relevant applications. The RS JPO also manages the Joint Robotic Repair and Fielding (JRRF) activity to provide sustainment support for robotic platforms that includes training, maintenance, assessment, and accountability. JRRF detachments in *OEF* and *OIF* provide theater support sustainment capability for all robots in theater.

Overview of Current Portfolio

The majority of current ground robotic systems are commercial-off-the-shelf (COTS) equipment that were procured and fielded against Joint Urgent Operational Needs Statements (JUONS), addressing capability gaps that were determined to be urgent and compelling. The stalwarts of RS JPO's robotic system fleet include the MarcBot, Talon, PackBot, and Mini-Explosive Ordnance Device (EOD). These man-transportable (35–110 pounds) robotic systems are used to identify and neutralize roadside bombs and other improvised explosive devices (IEDs), and are designed for locating, identifying, and disarming explosive and incendiary devices and collecting forensic evidence. The RS JPO currently has one fully funded program of record (POR) reflected in the FY10–15 Program Objective Memorandum (POM) for route clearance, which includes the M160 (MV-4B) Mechanical Anti-Personnel Mine-Clearing System and Man-Transportable Robotic System Route Clearance small robot.

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Support to overseas contingency operations (OCO) has greatly accelerated acquisition and fielding timelines. Delivering safe, effective unmanned systems with a variety of mission payloads in response to JUONS has created numerous 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, to area and route clearance, to reconnaissance and surveillance. This has resulted in the proliferation of ground robots on the battlefield. The U.S. industrial base has grown to meet the demand for unmanned systems. This growth is evident across all sectors of the market, from basic and applied research at academic institutions and government laboratories; to prototyping and commercialization by small businesses; to manufacturing, production, and sustainment operations by traditional defense contractors, automotive suppliers, new companies, and government organizations.

Modernization

The RS JPO's platform modernization strategy is threefold:

- Recap existing assets currently supporting OCO.
- Integrate a host of capability improvements stemming from theater requirements.
- Execute operational assessments of advanced robotic capabilities in conjunction with emerging requirements.

This strategy takes maximum advantage of existing systems by making necessary improvements in both capability and reliability, while adapting to mitigate the risk of uncertainty caused by an evolving threat. It also promotes commonality and interoperability in parts, operation, maintenance, and support of future systems.

Thousands of COTS, or modified COTS, ground robots have been used in tens of thousands of missions, incurring hundreds of thousands of hours of operation. In many instances, the same robot has been repaired multiple times and put back in the fight without major overhaul. Rapid Fielding Initiatives (RFIs) have resulted in a variety of platforms and platform generations, creating configuration management and sustainment challenges. Robots are issued as theater-provided equipment (TPE) and turned over from one unit to another during the relief in place, transfer of authority process. As the drawdown of military force in Iraq commences, units turn in their TPE robots to one of the JRRF activities in *OIF*. These systems are inspected and overhauled from top to bottom. Platform modernization entails chassis upgrades, replacement of robot manipulator arms, migration to laptop-based operator control units, and system software and embedded processor enhancements (which incorporate the hooks for future upgrades to semi-autonomous operations, digital

mapping, and modular payload integration). Assets are then postured for refielding based on U.S. Central Command priorities, primarily to support the *OEF* surge. This modernization of the existing ground robot fleet will provide an additional 3-year operational life per platform, while improving the health of the U.S. industrial base.

The second initiative of the JPO's modernization strategy is to integrate a host of capability improvements from lessons learned from the fight and theater requirements. These enhancements include everything from increased agility to improved situational awareness 360-degree sensing; video recording; and chemical, biological, radiological, nuclear, and explosive detection. Some of these technology improvements are bundled in a plan with the Joint IED Defeat Organization (JIEDDO) to integrate, test, assess, and field more than 1,500 robots in the upcoming months.

The third tenet of the RS JPO's modernization strategy involves conducting operational assessments of advanced robotic capabilities in conjunction with emerging requirements. These efforts are typically performed in conjunction with operational units or other user representatives and other government agencies including the U.S. Army Training and Doctrine Command (TRADOC), Rapid Equipping Force, Asymmetric Warfare Division, JIEDDO, and Army laboratories. One example of an RFI and operational assessment that has had great success is the Mini-EOD. Warfighters required a lighter, more agile robot for IED interrogation and explosive ordnance disposal. The Mini-EOD delivers a man-portable (34.5 pound) system to support dismounted operations in the rugged terrain and elevations of Afghanistan. More than 200 systems have been delivered and approximately 100 more will be fielded by October.

A Talon ordnance disposal robot prepares to unearth a simulated IED during an exercise. The Talon is an element of RS JPO's robotic system fleet. (U.S. Navy photo by MC3 Kenneth G. Takada.)

Unmanned Ground Vehicle (UGV) Emerging Requirements

Unmanned systems can support future forces and expanded operational environment concepts by serving as economy of force assets and enhancing force protection by providing standoff operational capabilities for many warfighter functions. TRADOC has developed an Initial Capabilities Document for a family of unmanned systems, which supports the development of underpinning requirements documents for ground, air, and maritime systems. The Maneuver Center of Excellence has convened the first Joint Ground Robotics Integration Team (JGRIT) summit, which resulted in an integrated list of combat-developer desired capabilities that UGVs are expected to fulfill in the coming years. Common throughout the JGRIT list of UGV future capabilities is the need for interoperability between UGVs and manned platforms.

To set the foundation for this, the RS JPO has embarked on an initiative involving the development and application of standards for integration across UGVs, leveraging open architecture and open interfaces to address problems with proprietary robotic system architectures. The expected result of this effort will culminate with a set of standards coalesced in a series of profile documents containing open standards and interface specifications to achieve modularity, commonality, and interchangeability across payloads, UGV control, video/audio standards, data, and communication links. The purpose of this effort is to establish standards to enhance competition, lower life-cycle costs, and provide warfighters with enhanced robotic capabilities that enable commonality and joint interoperability within the unified battle command.

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The RS JPO currently has one fully funded POR reflected in the FY10–15 POM for route clearance, which includes the M160 (MV-4B) Anti-Personnel Mine Clearing System seen here. (U.S. Army photo courtesy of RS JPO.)

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Opportunities and Recommendations

The RS JPO has equipped joint warfighters with unmanned system capabilities while mitigating several significant challenges. A lack of POR requirements and associated funding in the POM necessitates creative solutions to realize product improvements and system sustainment. Reactionary modifications and payload integrations have created configuration management, obsolescence, sustainment, and interoperability challenges. It will become a major challenge to continue to meet operational needs without having a stable funded budget line for COTS robotic systems and support; therefore, reset funds have been requested in the FY12–17 POM submission. Ground robotic systems must be an established part of a unit's table of organization and equipment and integrated into the brigade combat team structure. This will embed robotic systems in predeployment training and doctrine, synchronized within the Army Force Generation cycle, while providing a common basis for modernization.

As robotics technology advances, future land combat forces will gain significant new operational capabilities, permitting paradigm shifts in the conduct of ground warfare that are a result of significantly greater survivability, flexibility, and sustainability. It is anticipated that robotics platforms will be integrated with other unmanned air, ground, and sea assets and unattended ground sensor networks to enhance overall operations within a fully integrated and seamless global information grid. In the near- and mid-term, it is anticipated that robots will continue to operate under some human control. However, as technology progresses, robots will require less human interaction and will be capable of higher levels of autonomy and independent operation. Principal limiting factors on the degree of autonomy of robotic systems used by military forces remain the reliability of the system and the complexity of the task environment. Robots operating in a task environment that is complex and containing unpredictable and changing conditions will require highly reliable sensing and decision-making technologies. Until these technologies are developed and proven, humans will continue to manipulate robots based on abilities and the conditions in which they operate.

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