ARMY / MARINE CORPS

GROUND ROBOTICS MASTER PLAN

Version 3

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1. Executive Summary

The Project Manager (PM), Robotic Systems Joint Project Office (RS JPO), initiated development of the Ground Robotics Master Plan (GRMP) in response to senior leadership direction to provide an effective means of assessing criticality of ground robotic Science and Technology (S&T) Projects to Current and Future Capability Gaps and S&T Shortfalls, and to identify linkages to Acquisition/Contingency Programs. GRMP Version 3 (V3) represents the third iteration of this publication. The initial U.S. Army/U.S. Marine Corps Ground Robotics Master Plan, Version 1 (V1), published in July 2005, provided a registry of Army and Marine Corps ground robotic Acquisition/Contingency Programs and S&T Projects. Version 2 (V2) updated the V1 registry and implemented the Technology Assessment and Transition Management (TATM) Process and Tool Suite. The TATM Process and Tool Suite were modified to support GRMP V2 development, and further modified to automate several GRMP functions for V3.

Acquisition Programs, Contingency Programs and S&T Projects were updated in V3 Appendices A, B and C, respectively, utilizing data inputs received from a RS JPO Data Call issued on 1 December 2006. No ground robotics Force Operating Capability (FOC) or Capability Gap updates were received for Version 3 from the User community. Consequently, based on instructions provided in the GRMP V3 Data Call email forwarded on 12 February 2007, GRMP data input used for the GRMP V2 Coordinating Integrated Product Team (CIPT) assessment process was assumed to be current and was used for the GRMP V3 CIPT assessment process. Specific User operational requirements for Acquisition and Contingency Programs were added to V3 for the first time and are found in Tables 1.1 and 1.2 below. Requirements will be added to Appendices A and B for subsequent GRMP versions. They could not be added in V3 due to unavailability of the information in time to modify the TATM Tool Suite software to accommodate this change.

Maneuver, Maneuver Support, and Combat Service Support CIPTs met in their respective work sessions during the March 2007 GRMP V3 Conference and rated criticality of each Acquisition/ Contingency Program and S&T Project against Current Capability Gaps. Ratings were made using a scale from 1 to 5 with 4 representing essential to filling the Gap and 5 considered critical to filling the Gap. These assessments, as an output of the TATM Process, provided the data input to the Tool Suite for developing GRMP Version 3. Analysis of CIPT assessments against applicable Capability Gaps utilizing the TATM Tool Suite produced the following ratings of essential or critical by one or more of the CIPTs:

- Eight of ten Acquisition Programs,
- Eighteen of twenty-seven S&T Projects, and
- Eight of fourteen Contingency Programs.

Version 3 is a continuation of the evolutionary process to produce a true Master Plan for all Army and Marine Corps ground robotics Acquisition/Contingency Programs and S&T Projects matched against User requirements. Expectations for V3 were not fully realized. Complexities inherent in the GRMP development process and involvement of multiple organizations with a variety of conflicting priorities and obligations exacerbated the issues. For instance, Capability Gaps were not updated and included only the Current Gaps provided for GRMP V2. These were determined to be inconsistent by two of the three CIPTs. The PM RS JPO remains committed to development of the objective GRMP, to include Future Gaps and S&T Shortfalls. Accordingly, the RS JPO GRMP Team carefully reviewed feedback from the March 2007

conference that revealed, among other improvements, a need to educate participants about the GRMP development process. In response, the RS JPO plans to conduct a GRMP Tour to brief Army/Marine Corps ground robotic stakeholders on GRMP objectives, benefits, and the GRMP development process before the next GRMP conference is held. A number of actions are planned to improve the GRMP development process, including better preparation for future conferences and CIPT work sessions. Primary among these actions is to convince User proponents to submit updates to Capability Gaps (both Current and Future) and S&T Shortfalls so that these can be included in the next CIPT assessment process. A full list of improvements is included in paragraph 6, Path Ahead.

Table 1.1: Acquisition Program Requirements

Agency	Program of Record	Requirement
PM FCS (BCT) UGV	SUGV	Operational Requirements Document for the Future Combat Systems, ACAT 1D, Release Date: 31 January 2005, JROC Approved
PM FCS (BCT) UGV	MULE	Operational Requirements Document for the Future Combat Systems, ACAT 1D, Release Date: 31 January 2005, JROC Approved
PM FCS (BCT) UGV	ARV	Operational Requirements Document for the Future Combat Systems, ACAT 1D, Release Date: 31 January 2005, JROC Approved
PM FCS (BCT) UGV	ANS	Operational Requirements Document for the Future Combat Systems, ACAT 1D, Release Date: 31 January 2005, JROC Approved
PM-FPS	MDARS	MDARS Capability Production Document (CPD), Approved 18 January 2007
RS JPO	Assault Breacher Vehicle (ABV)	Operational Requirements Document for Assault Breacher Vehicle (ABV), ACAT III (NO. LOG 1.81), Approved 6 May 2002
RS JPO	MV-4 Mechanical Anti-Personnel Mine Clearing System (MAPMCS)	Capability Production Document for the Area Clearance Family of Systems, Increment I, ACAT III, Milestone C Decision, Draft Version 1.3, Dated 11Aug06

Table 1.2: Contingency Program Requirements

Agency	Contingency Program	Requirement
ARDEC	SWORDS	Multi-National Corps - Iraq (MNC-I); MNC-I-020305-1, 7Feb05
RS JPO	Dragon Runner	MEF Requirement
RS JPO	EyeBall R1	New Requirement Pending
RS JPO	Gladiator	MROC Validated Gladiator Tactical Unmanned Vehicle ORD (MROC-DM 54-2004)
RS JPO	HD-1	REF Ten Line Request
RS JPO	LVUSS	REF Ten Line Request & Joint Urgent Operational Needs Statement CC-0111
RS JPO	MARCbot IV	Joint Urgent Operational Needs Statement CC-0111
RS JPO	Negotiator	Being Investigated to Possibly Meet JUONS CC-0111: MARCbot For MNC-I (19Jul2006)
RS JPO	PackBot Explorer	JUONS CC-0088: Talon & PACBOT Robots For EOD Teams (17May06)
RS JPO	PackBot - FIDO	JUONS CC-0088: Talon & PACBOT Robots For EOD Teams (17May06) JUONS CC-0103: Classified Title (6Jun06) JUONS CC-0111: MARCBOT For MNC-I (19Jul2006)
RS JPO	PackBot MTRS Mk 1	JUONS CC-0088: Talon & PACBOT Robots For EOD Teams (17May06)
RS JPO	PackBot Scout	JUONS CC-0088: Talon & PACBOT Robots For EOD Teams (17May06)
RS JPO	PipeCruiser	REF Gotham Ten Line Request
RS JPO	RC-60	2004 Universal Need Statement: OIF - EOD Remote Robot Capability - 04188UA
RS JPO	RC-HMMWV	JUONS CC-0092: RC-HMMWV C-IED (31May06)
RS JPO	R-Gator	Congressional Plus-up
RS JPO	Talon 3B / MTRS Mk2	JUONS CC-0071: Engineering Robots (Talon III) (28Apr06)
RS JPO	ThrowBot	New Requirement Pending

2. Introduction

The PM RS JPO initiated development of an integrated GRMP in response to direction from senior Army and Marine Corps leadership in 2005. The GRMP is intended to provide Army and Marine Corps ground robotic stakeholders a common information resource document, as well as a comprehensive plan that links robotic S&T Projects and Acquisition/Contingency Programs to User Current Capability Gaps, Future Capability Gaps, and S&T Shortfalls. The pressing need for reliable ground robotic systems capable of detecting and warning of the presence of hidden improvised explosive devices (IEDs), chemical and biological agents, and related threats to ground troops employed by insurgents in combat zones greatly increases the importance of making every S&T dollar count toward filling critical User capability gaps. In addition, the GRMP provides decision makers a tool for making critical resource decisions.

The RS JPO has recognized from the beginning that development of the GRMP would be an evolutionary process because of the diversity and complexity of the task. For instance, many stakeholders are involved in Army/Marine Corps ground robotics, including Users, materiel developers, S&T developers, sustainers, and industry. A variety of missions are supported, including mine and area clearance, chemical/biological agent detection, surveillance and reconnaissance, area obscuration, force protection and direct fire/indirect fire, among numerous others. GRMP V3 moves the development process further along the evolutionary path.

Management of the development of and updates to the GRMP utilizes the management framework shown in Figure 2-1. The Maneuver, Maneuver Support and Combat Service Support CIPTs met in work sessions in Huntsville to develop inputs for Version 3 during the March 2007 conference. As was done for Version 2 in June 2006, each CIPT identified the Acquisition/Contingency Programs and S&T Projects that were applicable to User capability gaps within their mission area. The CIPTs then assessed and assigned criticality ratings to Acquisition/Contingency Programs and S&T Projects identified as applicable to User capability gaps. Applicability and criticality assessment data provide the basis for generation of the TATM Process and Tool Suite outputs shown in this updated GRMP V3.

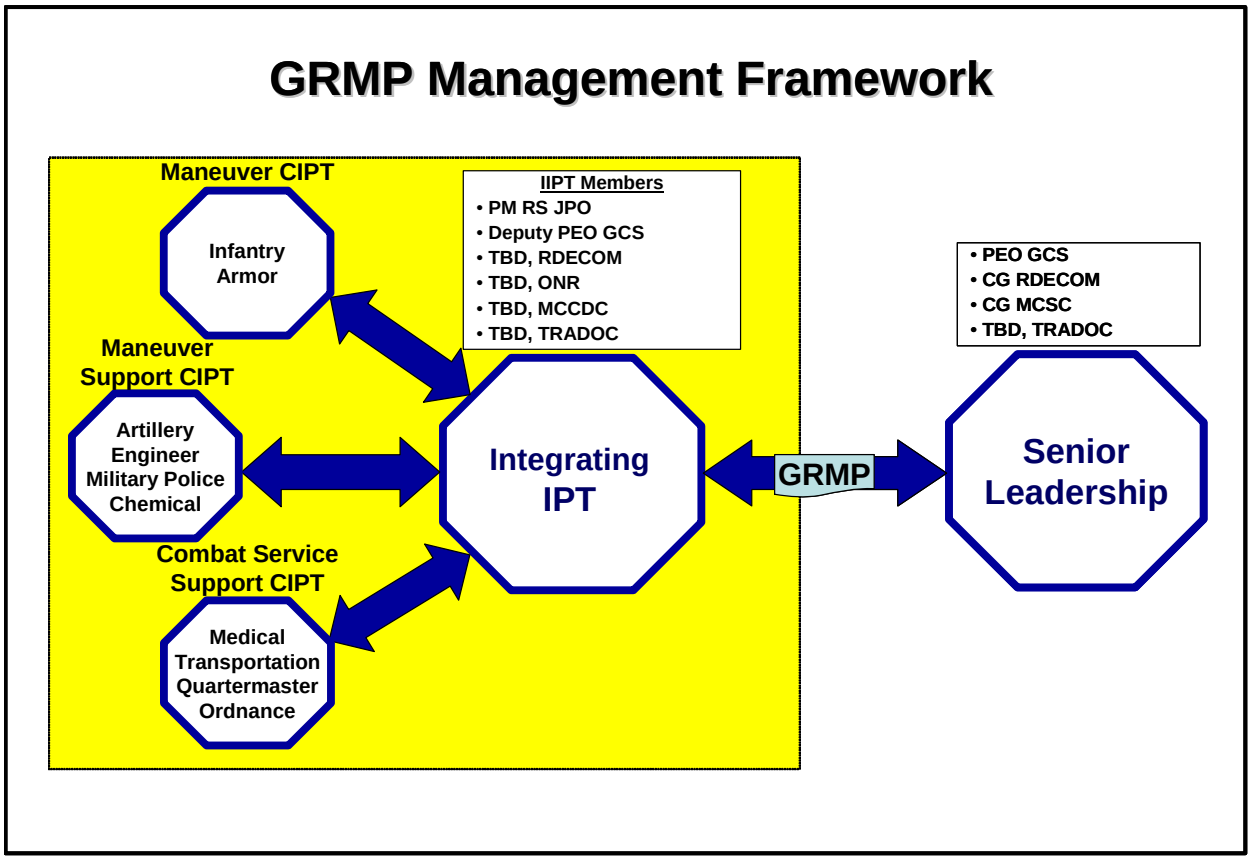

Figure 2-1: GRMP Management Framework Overview

The Acquisition and Contingency Programs, S&T Projects, and User capability gaps identified in this document are described in Appendices A through D listed below. Appendix E is a list of acronyms used in GRMP V3.

- Appendix A: Acquisition Programs
- Appendix B: Contingency Programs
- Appendix C: S&T Projects for Robotics
- Appendix D: User Force Operating Capabilities (FOC) & Future Naval Capabilities (FNC)
- Appendix E: Acronyms

The following assumptions aid in understanding the contents of this document:

- Some programs/projects have multiple organizations responsible for both execution and use of developed technologies. In most cases, only the lead organization is identified.
- Some technologies are developed outside the Army and Marine Corps; for example by the Defense Advanced Research Projects Agency, the Air Force and the Navy. GRMP Version 3 does not address these projects, except in specifically identified instances.
- Some technology development projects are addressing common requirements, especially command, control and communications (C3) and sensor/imaging issues that will improve combat capability for all unmanned systems, not just ground vehicles. Not all of these projects are identified in GRMP Version 3.

3. TATM Implementation

3.1. Overview

The TATM Process, which is described in great detail in V2 of the GRMP, provides information to support detailed transition planning by identifying and linking development schedules, critical events and risks for S&T Projects and system development programs. The process also provides information to support S&T Project resource decisions, transition risk management, and systems engineering planning.

PM RS JPO recognized that there was great potential for the TATM Process and Tool Suite to assist in the overall planning process for Army/Marine Corps ground robotics. Subsequently, PM RS JPO arranged for the Defense Acquisition University (DAU) to present an overview of the TATM Process and Tool Suite at the initial GRMP Conference held in May 2005. The ground robotics community is currently in its second year of TATM implementation. A ground robotic management framework, depicted in Figure 2.1 above and described in detail in V2, was put in place in 2006. This framework supports the development of individual technology transition plans as well as integrated and coordinated technology transition plans across the Ground Robotics community. Once coordination is complete, the RS JPO will forward this integrated plan to the Army/Marine Corps level for incorporation in the overall planning process.

3.1.1. TATM Process

The TATM Process provides a disciplined assessment procedure and supports an Integrated Product Team (IPT) in managing the transition process throughout the life cycle of a system.

The process provides a common methodology to:

- conduct technology assessments,
- develop technology transition roadmaps,
- link S&T Projects to specific PM programs and milestones,
- conduct technical risk assessments,
- conduct non-technical risk assessments, and
- develop and implement comprehensive transition risk management programs.

The process provides visibility into both S&T Project and Acquisition Program areas (milestones, schedules, status, and risk) allowing the acquisition community to prepare for transition. For example:

- S&T managers can mature the technology to the necessary level and synchronize the technology development plans with Acquisition Program transition windows,
- PMs can prepare to integrate technologies into their systems and programs,
- Sustainers can identify categories of support that must be addressed and develop an overall supportability strategy, and
- Warfighters can prepare to integrate technologies into the future battlefield or operational environment.

3.1.1.1. Inputs

The TATM process begins by capturing inputs from the PM, S&T, User, and Sustainer communities through an IPT environment which facilitates communication among these

stakeholders. This information provides the foundation for clear understanding of the current status of technologies and the path forward for successful technology transition.

Initially, the related elements that influence each other, and are intended to be synchronized, must be identified. For the TATM process these input elements are:

- User requirements and FOC/FNC coordination,
- Acquisition Program definition,
- S&T Project definition, and
- Sustainment plan definition.

3.1.1.2. Technology Assessment

Using the User requirements, Acquisition Program and S&T Project descriptions, and sustainment plans, the CIPT conducts an initial technology assessment. The purpose is to assess:

- technology maturity as defined by technology readiness levels and maturation plan,
- applicability and criticality of the project from the PM and User perspectives,
- probability of successfully maturing the technology given the maturation plan, schedule and funding, and
- sustainment impact of the technology.

3.1.2. TATM Tool Suite

The TATM Tool Suite is a Web Enabled database product that stores the information generated from all stages of the TATM process. It provides a Graphical User Interface (GUI) that will store S&T, platform and FOC/FNC gap data required to support technology assessment activities and to assist in the transition of technologies to the User. It provides reports for making critical decisions and managing risks that are involved in transitioning S&T Projects to an Acquisition Program or meeting FOC/FNC gaps. Some reports focus on helping Acquisition Programs identify S&T Projects that align with their schedules. Other reports allow the User community to monitor the status of S&T Projects with a focus on meeting FOC/FNC gaps. All reports generated by the TATM Tool Suite can be tailored to meet individual needs via Microsoft Office products.

It is planned that these capabilities will be fully implemented and defined in GRMP Version 4.

4. Analysis (CIPT/Overall)

Each of the CIPTs analyzed all S&T Projects, Acquisition Programs and Contingency Programs against the FOC/FNC gaps that were submitted by the User communities. To keep the analysis common between all CIPTs, the color coded criticality legend shown in Table 4-1 and criticality assessment ratings shown in Table 4-2 were used with the TATM Process. The User led the assessment of the criticality ratings. To combine all three CIPT results, the highest rating from any CIPT was taken and combined into one matrix. The combined matrix values were counted and the results are shown in section 4.1 below.

Table 4-1: Criticality Legend

Color Key	
	Criticality Rating 4 or 5
	Criticality Rating 3
	Criticality Rating 1, 2, or Not Applicable to any gaps

Table 4-2: Criticality Assessment Ratings

Criticality Assessment Values	
1	Little to No Value
2	Contributing
3	Important
4	Essential
5	Critical

4.1. Results

The results shown in the following tables reflect the number of times CIPTs determined that Acquisition/Contingency Programs and S&T Projects were applicable to specific capability gaps. Table 4.1.1-1 below shows that the FCS MULE-T is applicable to 30 capability gaps. In addition, the numbers in the "Criticality to Gaps" columns show the number of times an Acquisition/Contingency Program or S&T Project was given a criticality rating from 1 through 5. For instance, Table 4.1.1-1 below shows that the FCS MULE-T was assessed as "important" (criticality rating 3) 10 times. Similarly, the FCS MULE-T was assessed as "critical" (criticality rating 5), a total of 8 times.

4.1.1. Acquisition Programs

Eight Acquisition Programs were rated as essential or critical against a capability gap defined by the User in at least one of the CIPTs.

Two Acquisition Programs were rated as important or lower against a capability gap defined by the User in at least one of the CIPTs.

Table 4.1.1-1: Acquisition Program Activities vs. Gaps as Rated by All CIPTs

Acquisition Programs	Criticality To Gaps					Applicability Count	
	1	2	3	4	5		
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Transport (MULE-T)	0	6	10	6	8	30	
Future Combat Systems (FCS) Small Unmanned Ground Vehicle (SUGV)	0	2	18	8	0	28	
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) ARV-Assault (Light) (ARV-A(L))	0	1	10	6	2	19	
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Countermine MULE-C	0	0	6	6	6	18	
Future Combat Systems (FCS) Autonomous Navigation System (ANS)	1	4	4	6	1	16	
Future Combat Systems (FCS) ARV Assault (ARV-A)	0	0	7	6	2	15	
Future Combat Systems (FCS) ARV Reconnaissance, Surveillance, and Target Acquisition (ARV-RSTA)	0	0	9	4	2	15	
MV-4 Mechanical Anti-Personnel Mine Clearing System (MAPMCS)	0	0	0	2	0	2	
Mobile Detection Assessment Response System (MDARS)	2	3	3	0	0	8	
Assault Breacher Vehicle (ABV)	0	0	2	0	0	2	

4.1.2. S&T Projects

Eighteen S&T Projects were rated as essential or critical against a capability gap defined by the User in at least one of the CIPTs.

Six S&T Projects were rated as important or lower against a capability gap defined by the User in at least one of the CIPTs.

Three S&T Projects were rated as contributing or lower against a capability gap defined by the User in at least one of the CIPTs.

Table 4.1.2-1: S&T Project Activities vs. Gaps as Rated by All CIPTs

	Criticality To Gaps					Applicability	
S & T Projects	1	2	3	4	5	Count	
Robotic Research Program Technology	0	5	25	3	0	33	
Joint Architecture for Unmanned Systems (JAUS)	0	2	7	2	14	26	
TAGS-CX CS/CSS R&D and Experiments	1	6	9	8	2	26	
Dismounted Common Handheld Controller (DCHC) and DCHC - Weaponized (DCHC-W)	0	21	2	2	0	25	
Near Autonomous Unmanned Systems (NAUS)	0	4	7	13	0	24	
Robotics Collaboration (RC)	0	5	13	1	0	19	
Collaborative Engagement Experiment (CEE)	0	9	8	1	0	18	
Battlefield Extraction-Assist Robot (BEAR)	0	4	3	0	7	14	
Computer Assisted Robotic Manipulation (CARMAN)	0	10	2	1	0	14	
Family of Unmanned Systems Experiment (FUSE)	1	8	3	1	0	13	
Modular Wearable Computer (MOWC)	1	0	11	0	1	13	
Robotic Combat Casualty Care Payloads for UGVs	0	0	0	1	10	11	
Robotic Combat Casualty Extraction and Evacuation (RCCEE)	0	0	1	1	9	11	
Hands-Free UGV Control	0	0	1	8	1	10	
FMTV Robotic Convoy	1	2	0	1	4	8	
Common Robotic System for Convoy Operations (CRSCO) Joint Capability Technology Demonstration (JCTD)	0	5	0	1	1	7	
CUGR ACTD Thrust Area 2: CBRN Unmanned Ground Vehicle (CUGV)	0	4	2	1	0	7	

S & T Projects	Criticality To Gaps 1	2	3	4	5	Applicability Count	
Robotic Combat Force Health Protection Payloads for UGVs	0	0	0	6	1	7	
Joint Forward Area Automated Decontamination (JFAAD)	2	1	1	0	0	4	
SUGV Range Extension (SRE)	0	11	7	0	0	18	
SUGV Range Extension - Immediate (SRE-I)	0	9	7	0	0	16	
Autonomous Robotic Countermine Capability (ARC2)	0	0	9	0	0	9	
Omni Directional Inspection System (ODIS-T3)	1	0	4	0	0	5	
PointCom: Semi-Autonomous UGV Control with Intuitive Interface SBIR	0	2	1	0	0	3	
Computer Assisted Tele-Operation (CATO)	0	3	0	0	0	3	
Sentinel	0	2	0	0	0	2	
Force Protection Joint Experiment (FPJE)	0	1	0	0	0	1	

4.1.3. Contingency Programs

Eight Contingency Programs were rated as essential or critical against a capability gap defined by the User in at least one of the CIPTs.

Five Contingency Programs were rated as important or lower against a capability gap defined by the User in at least one of the CIPTs.

One Contingency Program was rated as contributing or lower against a capability gap defined by the User in at least one of the CIPTs.

Table 4.1.3-1: Contingency Program Activities vs. Gaps as Rated by All CIPTs

Contingency Programs	Criticality To Gaps 1	2	3	4	5	Applicability Count	
PackBot Scout	1	9	8	1	0	19	
PackBot / MTRS Mk 1	1	6	2	5	0	14	
Talon 3B/MTRS MK 2	1	6	2	4	0	13	
MARCbot IV	0	5	1	6	0	12	
PackBot - FIDO	1	2	4	0	4	11	
Combat Autonomous Mobility System (CAMS)	0	2	2	5	0	9	
Remote Control-High Mobility Multipurpose Wheeled Vehicle (RC-HMMWV)	0	0	6	1	0	7	
PackBot Explorer	0	0	0	2	0	2	

Contingency Programs	Criticality To Gaps 1	2	3	4	5	Applicability Count	
Special Weapons Observation Reconnaissance Direct-action System (SWORDS)	10	8	1	0	0	21	
Gladiator	2	3	10	0	0	15	
Dragon Runner	1	10	1	0	0	12	
HD-1	0	4	5	0	0	9	
EyeBall R1	4	2	1	0	0	7	
R-Gator	0	5	0	0	0	5	

4.1.4. Capability Gaps

Thirty-four of the thirty-eight gaps were identified to have developmental activities rated as essential or critical by at least one of the CIPTs.

Four of the thirty-eight gaps were identified to have developmental activities rated as important or lower by at least one of the CIPTs.

NOTE: Paragraph numbers shown in the left column of each Criticality Assessment Table in the remainder of this document refer to Capability Gap Statement paragraphs in Appendix D. Abbreviated Capability Gap Statements are also shown adjacent to the paragraph numbers to assist the reader in understanding the table's contents.

Table 4.1.4-1: Gaps vs. All Activities as Rated by All CIPTs

Capability Gap	Criticality To Gaps 1	2	3	4	5	Applicability Count	
4.8.3 Detect explosive hazards in time to plan and execute by-pass or neutralizing operations.	1	11	9	6	2	29	
4.7.3 Detect explosive hazards at standoff distances.	1	10	9	6	2	28	
2.15.3 Provide UMS with common controller.	6	3	12	4	2	27	
2.7.3 Tamper resistant, frequency hopping UGV to provide real-time location and imagery data.	2	5	10	6	0	23	
4.9.3 Detect explosive hazards in time to plan and execute by-pass maneuvers or neutralizing operations.	2	8	5	6	2	23	
2.20.3 Autonomously conduct collaborative UMS operations.	1	5	4	6	5	21	
3.6.3.10 Enhanced force health care provider and protection.	0	9	3	4	5	21	
4.10.3 Detect explosive hazards in an urban environment.	0	8	5	6	2	21	
2.14.3 Autonomous ability to search, detect and distribute real-time location and imagery data on targets.	0	8	8	4	0	20	
3.6.3.1 Enhanced Future Force initial medical treatment capability.	1	3	7	4	5	20	
3.6.3.4 Utilize unmanned vehicles, robotics and advanced standoff equipment.	1	3	8	3	5	20	

Capability Gap	Criticality To Gaps					Applicability Count	
	1	2	3	4	5		
3.7.3 Detect and warn Soldiers of CBRN and toxic industrial hazards and provide mass casualty decontamination.	0	4	7	7	2	20	
5.6.3.4 Protection and surveillance system operational in extreme weather (Iraq).	2	5	11	2	0	20	
2.17.3 Detect, ID and destroy mines and IEDs at improved stand off distances; conduct area/route clearance.	3	5	8	1	1	18	
2.8.3 Distribute information to unit leaders and operator at same time.	3	4	6	5	0	18	
3.6.3.2 Robotic systems and advanced standoff equipment to recover wounded/injured personnel from high risk areas.	1	2	7	3	5	18	
3.6.3.5 Recover wounded Soldiers from high-risk areas, with minimal exposure.	1	2	7	3	5	18	
3.6.3.6 Facilitate immediate evacuation and transport under harshest combat or environmental conditions.	1	2	7	3	5	18	
3.9.3 Tactical delivery of supplies and equipment in hostile environments.	0	2	8	5	3	18	
2.6.3 Autonomous ability to search, locate, provide imagery and react to IEDs.	0	4	11	1	0	17	
3.6.3.3 Robotic systems to facilitate immediate evacuation and transport under harshest combat or environmental conditions.	0	2	7	3	5	17	
5.6.3.1 360 degree surveillance and detection of ground approaches to ammunition caches.	2	12	2	1	0	17	
2.11.3 Autonomous ability to search, detect, locate and engage targets in MOUT.	0	5	4	3	2	14	
2.10.3 Autonomous, real-time day/night ability to search, locate and designate targets in a specified area.	0	4	3	6	0	13	
2.16.3 Autonomous capability to react to tampering or intrusion threats.	0	4	8	1	0	13	
2.19.3 Provide non-lethal range equal to lethal range capability to enable rapid transition from MCO to SASO.	0	1	6	4	0	12	
3.6.3.11 Robust C3 Structure for medical evacuation operations.	0	2	3	4	3	12	
3.6.3.7 Medical evacuation platforms that provide attended “enroute care.”	0	3	3	2	4	12	
3.6.3.8 Automated and semi-automated systems for life support.	0	3	3	2	4	12	
4.6.3 Dispose of UXO and visually/virtually mark obstacles.	1	3	6	2	0	12	
2.18.3 Autonomous ability to search, locate and designate targets for smart or precision munitions; ID and engage LOS targets.	1	2	3	3	0	9	
3.6.3.9 Advanced storage systems and transportation devices to ensure temperature integrity and in-transit visibility.	0	1	5	0	2	8	
3.8.3 Far Forward just-in-time tactical resupply to small units under fire.	0	2	2	1	3	8	

Capability Gap	Criticality To Gaps					Applicability Count	
	1	2	3	4	5		
2.13.3 Autonomous ability to search, locate and designate targets for smart or precision munitions.	0	0	4	2	1	7	
2.9.3 All weather & terrain day/night UMS ability to search, detect and distribute recon data.	0	18	10	0	0	29	
5.6.3.3 24 hour/7 day a week surveillance coverage.	1	12	5	0	0	19	
5.6.3.2 Provide intruder alert to a Quick Reaction Force location.	0	9	6	0	0	15	
2.12.3 Autonomous ability to search buildings from stand-off and provide imagery of targets inside.	0	6	3	0	0	9	

4.2. Detailed Analysis

4.2.1. Maneuver CIPT

4.2.1.1. Overview

The Maneuver CIPT focuses on the functions and capabilities of the Infantry and Armor branches of the Army and equivalent elements of the Marine Corps. The employment of Maneuver forces involves movement in combination with fires to achieve a position of advantage with respect to the enemy in order to accomplish the mission.

4.2.1.2. Results

Table 4.2.1.2-1: Activities vs. Gaps as Rated by Maneuver CIPT

	Criticality To Gaps					Applicability Count
	1	2	3	4	5	
Acquisition Programs						
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) ARV-Assault (Light) (ARV-A(L))	0	5	11	0	0	17
Future Combat Systems (FCS) Small Unmanned Ground Vehicle (SUGV)	0	4	10	0	0	15
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Transport (MULE-T)	0	8	4	0	0	14
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Countermine MULE-C	0	3	4	0	0	10
Future Combat Systems (FCS) Autonomous Navigation System (ANS)	1	4	1	1	0	7
Mobile Detection Assessment Response System (MDARS)	0	2	3	0	0	5
Assault Breacher Vehicle (ABV)	0	0	1	0	0	1
S & T Projects						
Robotic Research Program Technology	0	4	14	3	0	28
Collaborative Engagement Experiment (CEE)	0	9	8	1	0	18
Near Autonomous Unmanned Systems (NAUS)	0	9	5	4	0	18
Dismounted Common Handheld Controller (DCHC) and DCHC - Weaponized (DCHC-W)	0	6	2	2	0	10
Joint Architecture for Unmanned Systems (JAUS)	0	4	2	1	0	8

	Criticality To Gaps					Applicability Count
	1	2	3	4	5	
Robotic Combat Casualty Extraction and Evacuation (RCCEE)	0	0	0	0	0	7
Family of Unmanned Systems Experiment (FUSE)	0	5	1	1	0	7
TAGS-CX CS/CSS R&D and Experiments	0	5	2	0	0	7
SUGV Range Extension (SRE)	0	7	0	0	0	7
Robotics Collaboration (RC)	0	4	2	0	0	6
SUGV Range Extension - Immediate (SRE-I)	0	5	0	0	0	5
Computer Assisted Tele-Operation (CATO)	0	3	0	0	0	3
FMTV Robotic Convoy	0	2	0	0	0	2
Computer Assisted Robotic Manipulation (CARMAN)	0	2	0	0	0	2
PointCom: Semi-Autonomous UGV Control with Intuitive Interface SBIR	0	2	0	0	0	2
Sentinel	0	2	0	0	0	2
CUGR ACTD Thrust Area 2: CBRN Unmanned Ground Vehicle (CUGV)	0	0	1	0	0	1
Joint Forward Area Automated Decontamination (JFAAD)	0	1	0	0	0	1
Hands-Free UGV Control	0	0	1	0	0	1
Modular Wearable Computer (MOWC)	0	0	1	0	0	1
Contingency Programs						
Special Weapons Observation Reconnaissance Direct-action System (SWORDS)	10	7	0	0	0	19
Gladiator	0	2	10	0	0	12
Talon 3B/MTRS MK 2	0	6	4	0	0	10
PackBot / MTRS Mk 1	0	6	4	0	0	10
Dragon Runner	0	7	1	0	0	8
MARCbot IV	0	3	3	0	0	6
PackBot Scout	0	5	1	0	0	6
HD-1	0	2	3	0	0	5
PackBot - FIDO	0	0	4	0	0	4
R-Gator	0	3	0	0	0	3
EyeBall R1	1	1	1	0	0	3
Combat Autonomous Mobility System (CAMS)	0	2	0	0	0	2

Table 4.2.1.2-2: Gaps vs. Activities as Rated by Maneuver CIPT

Capability Gap	Criticality To Gaps 1	2	3	4	5	Applicability Count
2.9.3 All weather & terrain day/night UMS ability to search, detect and distribute recon data.	0	16	8	0	0	25
4.8.3 Detect explosive hazards in time to plan and execute by-pass or neutralizing operations.	0	7	9	0	0	17
4.7.3 Detect explosive hazards at standoff distances.	0	6	11	0	0	17
5.6.3.3 24 hour/7 day a week surveillance coverage.	0	12	2	0	0	15
2.7.3 Tamper resistant, frequency hopping UGV to provide real-time location and imagery data.	0	8	4	3	0	15
2.20.3 Autonomously conduct collaborative UMS operations.	0	8	3	4	0	15
5.6.3.4 Protection and surveillance system operational in extreme weather (Iraq).	1	5	6	0	0	14
2.15.3 Provide UMS with common controller.	1	2	6	1	0	14
2.17.3 Detect, ID and destroy mines and IEDs at improved stand off distances; conduct area/route clearance.	3	5	6	0	0	14
2.14.3 Autonomous ability to search, detect and distribute real-time location and imagery data on targets.	0	8	3	1	0	12
2.11.3 Autonomous ability to search, detect, locate and engage targets in MOUT.	0	6	5	1	0	12
2.6.3 Autonomous ability to search, locate, provide imagery and react to IEDs.	0	3	8	0	0	11
4.6.3 Dispose of UXO and visually/virtually mark obstacles.	1	2	7	0	0	10
5.6.3.1 360 degree surveillance and detection of ground approaches to ammunition caches.	0	9	0	1	0	10
5.6.3.2 Provide intruder alert to a Quick Reaction Force location.	0	9	1	0	0	10
2.12.3 Autonomous ability to search buildings from stand-off and provide imagery of targets inside.	0	6	3	0	0	9
2.10.3 Autonomous, real-time day/night ability to search, locate and designate targets in a specified area.	0	4	4	1	0	9
2.16.3 Autonomous capability to react to tampering or intrusion threats.	0	7	1	0	0	8
2.18.3 Autonomous ability to search, locate and designate targets for smart or precision munitions; ID and engage LOS targets.	1	2	4	0	0	7
2.8.3 Distribute information to unit leaders and operator at same time.	0	3	2	1	0	6
2.19.3 Provide non-lethal range equal to lethal range capability to enable rapid transition from MCO to SASO.	0	1	4	0	0	6
3.6.3.4 Utilize unmanned vehicles, robotics and advanced standoff equipment.	1	1	1	0	0	5

Capability Gap	Criticality To Gaps					Applicability Count
	1	2	3	4	5	
3.6.3.5 Recover wounded Soldiers from high-risk areas, with minimal exposure.	1	2	0	0	0	5
3.6.3.6 Facilitate immediate evacuation and transport under harshest combat or environmental conditions.	1	2	0	0	0	5
2.13.3 Autonomous ability to search, locate and designate targets for smart or precision munitions.	0	0	5	0	0	5
3.6.3.1 Enhanced Future Force initial medical treatment capability.	1	1	0	0	0	4
3.6.3.3 Robotic systems to facilitate immediate evacuation and transport under harshest combat or environmental conditions.	0	2	0	0	0	4
3.6.3.2 Robotic systems and advanced standoff equipment to recover wounded/injured personnel from high risk areas.	1	1	0	0	0	2
3.6.3.7 Medical evacuation platforms that provide attended “enroute care.”	0	0	0	0	0	2
3.6.3.8 Automated and semi-automated systems for life support.	0	0	0	0	0	2
3.9.3 Tactical delivery of supplies and equipment in hostile environments.	0	1	0	0	0	1
3.7.3 Detect and warn Soldiers of CBRN and toxic industrial hazards and provide mass casualty decontamination.	0	0	1	0	0	1
4.9.3 Detect explosive hazards in time to plan and execute by-pass maneuvers or neutralizing operations.	0	1	0	0	0	1

4.2.2. Maneuver Support CIPT

4.2.2.1. Overview

The Maneuver Support CIPT focuses on the functions and capabilities of the Artillery, Engineer, Military Police and Chemical branches of the Army and equivalent elements of the Marine Corps. These branches/elements provide fire support and operational assistance (mine clearance, force protection, decontamination, etc.) to the Maneuver force.

4.2.2.2. Results

Table 4.2.2.2-1: Activities vs. Gaps as Rated by Maneuver Support CIPT

	Criticality To Gaps					Applicability
	1	2	3	4	5	Count
Acquisition Programs						
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Countermine MULE-C	0	1	5	5	5	16
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) ARV-Assault (Light) (ARV-A(L))	0	0	7	6	2	15
Future Combat Systems (FCS) ARV Assault (ARV-A)	0	0	7	6	2	15
Future Combat Systems (FCS) ARV Reconnaissance, Surveillance, and Target Acquisition (ARV-RSTA)	0	0	9	4	2	15
Future Combat Systems (FCS) Small Unmanned Ground Vehicle (SUGV)	0	0	9	4	0	13
Mobile Detection Assessment Response System (MDARS)	2	3	0	0	0	13
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Transport (MULE-T)	0	3	5	2	0	10
Future Combat Systems (FCS) Autonomous Navigation System (ANS)	0	1	3	4	1	9
Assault Breacher Vehicle (ABV)	0	0	1	0	0	2
MV-4 Mechanical Anti-Personnel Mine Clearing System (MAPMCS)	0	0	0	2	0	2
S & T Projects						
Force Protection Joint Experiment (FPJE)	0	0	0	0	0	11
Joint Architecture for Unmanned Systems (JAUS)	0	1	7	2	0	10

	Criticality To Gaps					Applicability
	1	2	3	4	5	Count
Dismounted Common Handheld Controller (DCHC) and DCHC - Weaponized (DCHC-W)	0	5	2	0	0	7
CUGR ACTD Thrust Area 2: CBRN Unmanned Ground Vehicle (CUGV)	0	4	2	1	0	7
Robotic Research Program Technology	1	3	3	0	0	7
Collaborative Engagement Experiment (CEE)	0	3	1	0	0	6
Omni Directional Inspection System (ODIS-T3)	1	4	0	0	0	6
Family of Unmanned Systems Experiment (FUSE)	5	0	0	0	0	5
Modular Wearable Computer (MOWC)	1	0	3	1	0	5
FMTV Robotic Convoy	1	1	0	1	0	4
Joint Forward Area Automated Decontamination (JFAAD)	2	1	1	0	0	4
Sentinel	0	0	0	0	0	4
Autonomous Robotic Countermine Capability (ARC2)	0	0	3	0	0	3
Computer Assisted Robotic Manipulation (CARMAN)	0	0	0	0	0	2
TAGS-CX CS/CSS R&D and Experiments	1	1	0	0	0	2
Common Robotic System for Convoy Operations (CRSCO) Joint Capability Technology Demonstration (JCTD)	0	0	0	0	0	2
Near Autonomous Unmanned Systems (NAUS)	0	0	0	0	0	1
Robotics Collaboration (RC)	0	0	0	0	0	1
Computer Assisted Tele-Operation (CATO)	0	0	0	0	0	1
Applique Robotic Kit (ARK) High Mobility Engineer Excavator (HMEE) III	0	0	0	0	0	1
OmniDirectional Unmanned Vehicles	0	0	0	0	0	1
SUGV Range Extension (SRE)	0	0	0	0	0	1
SUGV Range Extension - Immediate (SRE-I)	0	0	0	0	0	1
Contingency Programs						
PackBot - FIDO	1	1	6	0	0	8
Gladiator	4	1	0	0	0	7
Dragon Runner	1	6	0	0	0	7
Talon 3B/MTRS MK 2	1	1	5	0	0	7
PackBot / MTRS Mk 1	1	1	5	0	0	7
PackBot Scout	1	5	1	0	0	7
MARCbot IV	1	5	0	0	0	6

	Criticality To Gaps					Applicability
	1	2	3	4	5	Count
HD-1	0	2	4	0	0	6
Special Weapons Observation Reconnaissance Direct-action System (SWORDS)	0	4	1	0	0	5
EyeBall R1	3	1	0	0	0	5
Negotiator	0	0	0	0	0	4
Combat Autonomous Mobility System (CAMS)	0	1	2	0	0	3
RC-60	0	0	0	0	0	2
PackBot Explorer	0	0	0	0	0	2
PipeCruiser	0	0	0	0	0	2
Large Vehicle Undercarriage Search System (LVUSS)	0	0	0	0	0	1

Table 4.2.2.2-2: Gaps vs. Activities as Rated by Maneuver Support CIPT

Capability Gap	Criticality To Gaps 1	2	3	4	5	Applicability Count
2.7.3 Tamper resistant, frequency hopping UGV to provide real-time location and imagery data.	3	3	9	3	0	30
2.6.3 Autonomous ability to search, locate, provide imagery and react to IEDs.	1	5	8	1	0	23
2.20.3 Autonomously conduct collaborative UMS operations.	2	4	3	3	5	20
2.8.3 Distribute information to unit leaders and operator at same time.	5	3	5	4	0	19
5.6.3.1 360 degree surveillance and detection of ground approaches to ammunition caches.	2	8	3	0	0	15
2.9.3 All weather & terrain day/night UMS ability to search, detect and distribute recon data.	0	6	4	0	0	15
2.14.3 Autonomous ability to search, detect and distribute real-time location and imagery data on targets.	0	2	6	3	0	15
5.6.3.4 Protection and surveillance system operational in extreme weather (Iraq).	1	0	8	2	0	14
2.15.3 Provide UMS with common controller.	5	0	7	2	0	14
4.8.3 Detect explosive hazards in time to plan and execute by-pass or neutralizing operations.	2	5	4	0	1	12
4.7.3 Detect explosive hazards at standoff distances.	2	5	4	0	1	12
4.9.3 Detect explosive hazards in time to plan and execute by-pass maneuvers or neutralizing operations.	2	5	4	0	1	12
4.10.3 Detect explosive hazards in an urban environment.	1	5	4	1	0	11
5.6.3.2 Provide intruder alert to a Quick Reaction Force location.	0	4	5	0	0	11
2.16.3 Autonomous capability to react to tampering or intrusion threats.	0	1	7	1	0	10
2.10.3 Autonomous, real-time day/night ability to search, locate and designate targets in a specified area.	0	1	0	5	0	9
2.19.3 Provide non-lethal range equal to lethal range capability to enable rapid transition from MCO to SASO.	0	1	4	4	0	9
2.17.3 Detect, ID and destroy mines and IEDs at improved stand off distances; conduct area/route clearance.	0	0	3	1	1	7
5.6.3.3 24 hour/7 day a week surveillance coverage.	1	1	3	0	0	6
2.13.3 Autonomous ability to search, locate and designate targets for smart or precision munitions.	0	0	1	2	1	6
2.18.3 Autonomous ability to search, locate and designate targets for smart or precision munitions; ID and engage LOS targets.	0	0	0	3	0	5
2.11.3 Autonomous ability to search, detect, locate and engage targets in MOUT.	0	0	0	2	2	5
3.7.3 Detect and warn Soldiers of CBRN and toxic industrial hazards and provide mass casualty decontamination.	0	0	0	1	0	1

4.2.3. Combat Service Support CIPT

4.2.3.1. Overview

The Combat Service Support CIPT focuses on the functions and capabilities of the Medical, Transportation, Quartermaster and Ordnance branches of the Army and equivalent elements of the Marine Corps. These branches/elements provide the support necessary to sustain all elements of operating forces in theater, including supply, maintenance, transportation and health services.

4.2.3.2. Results

Table 4.2.3.2-1: Activities vs. Gaps as Rated by Combat Service Support CIPT

	Criticality To Gaps					Applicability Count
	1	2	3	4	5	
Acquisition Programs						
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Transport (MULE-T)	0	3	3	4	8	18
Future Combat Systems (FCS) Small Unmanned Ground Vehicle (SUGV)	0	1	7	4	0	12
Future Combat Systems (FCS) Multi-function Utility/Logistics and Equipment (MULE) Countermine MULE-C	0	0	0	2	4	6
Future Combat Systems (FCS) Autonomous Navigation System (ANS)	0	1	1	1	0	3
S & T Projects						
TAGS-CX CS/CSS R&D and Experiments	0	0	8	8	2	18
Dismounted Common Handheld Controller (DCHC) and DCHC - Weaponized (DCHC-W)	0	14	0	1	0	15
Joint Architecture for Unmanned Systems (JAUS)	0	0	0	1	14	15
Battlefield Extraction-Assist Robot (BEAR)	0	4	3	0	7	14
Robotics Collaboration (RC)	0	1	12	1	0	14
Robotic Research Program Technology	0	2	11	0	0	13
Near Autonomous Unmanned Systems (NAUS)	0	1	2	9	0	12
SUGV Range Extension (SRE)	0	5	7	0	0	12
SUGV Range Extension - Immediate (SRE-I)	0	5	7	0	0	12
Robotic Combat Casualty Extraction and Evacuation (RCCEE)	0	0	1	1	9	11

	Criticality To Gaps					Applicability Count
	1	2	3	4	5	
Computer Assisted Robotic Manipulation (CARMAN)	0	8	2	1	0	11
Robotic Combat Casualty Care Payloads for UGVs	0	0	0	1	10	11
Hands-Free UGV Control	0	0	1	8	1	10
Modular Wearable Computer (MOWC)	0	0	8	0	1	9
Robotic Combat Force Health Protection Payloads for UGVs	0	0	0	6	1	7
Common Robotic System for Convoy Operations (CRSCO) Joint Capability Technology Demonstration (JCTD)	0	5	0	1	1	7
Autonomous Robotic Countermine Capability (ARC2)	0	0	6	0	0	6
Family of Unmanned Systems Experiment (FUSE)	0	3	2	0	0	5
FMTV Robotic Convoy	0	0	0	0	4	4
Omni Directional Inspection System (ODIS-T3)	0	0	4	0	0	4
CUGR ACTD Thrust Area 2: CBRN Unmanned Ground Vehicle (CUGV)	0	0	0	1	0	1
Force Protection Joint Experiment (FPJE)	0	1	0	0	0	1
PointCom: Semi-Autonomous UGV Control with Intuitive Interface SBIR	0	0	1	0	0	1
Contingency Programs						
PackBot Scout	0	1	6	1	0	8
MARCbot IV	0	1	0	6	0	7
Remote Control-High Mobility Multipurpose Wheeled Vehicle (RC-HMMWV)	0	0	6	1	0	7
Talon 3B/MTRS MK 2	0	0	1	4	0	5
PackBot / MTRS Mk 1	0	0	0	5	0	5
PackBot - FIDO	0	1	0	0	4	5
Combat Autonomous Mobility System (CAMS)	0	0	0	5	0	5
R-Gator	0	2	0	0	0	2
PackBot Explorer	0	0	0	2	0	2

Table 4.2.3.2-2: Gaps vs. Activities as Rated by Combat Service Support CIPT

Capability Gap	Criticality To Gaps 1	2	3	4	5	Applicability Count
3.6.3.10 Enhanced force health care provider and protection.	0	9	3	4	5	21
3.7.3 Detect and warn Soldiers of CBRN and toxic industrial hazards and provide mass casualty decontamination.	0	4	7	7	2	20
3.6.3.1 Enhanced Future Force initial medical treatment capability.	0	3	7	4	5	19
3.6.3.4 Utilize unmanned vehicles, robotics and advanced standoff equipment.	0	3	8	3	5	19
3.9.3 Tactical delivery of supplies and equipment in hostile environments.	0	2	8	5	3	18
3.6.3.2 Robotic systems and advanced standoff equipment to recover wounded/injured personnel from high risk areas.	0	2	7	3	5	17
3.6.3.3 Robotic systems to facilitate immediate evacuation and transport under harshest combat or environmental conditions.	0	2	7	3	5	17
3.6.3.5 Recover wounded Soldiers from high-risk areas, with minimal exposure.	0	2	7	3	5	17
3.6.3.6 Facilitate immediate evacuation and transport under harshest combat or environmental conditions.	0	2	7	3	5	17
4.8.3 Detect explosive hazards in time to plan and execute by-pass or neutralizing operations.	0	4	4	6	2	16
4.7.3 Detect explosive hazards at standoff distances.	0	4	4	6	2	16
4.9.3 Detect explosive hazards in time to plan and execute by-pass maneuvers or neutralizing operations.	0	4	4	6	2	16
4.10.3 Detect explosive hazards in an urban environment.	0	4	4	6	2	16
3.6.3.7 Medical evacuation platforms that provide attended “enroute care.”	0	3	3	2	4	12
3.6.3.8 Automated and semi-automated systems for life support.	0	3	3	2	4	12
3.6.3.11 Robust C3 Structure for medical evacuation operations.	0	2	3	4	3	12
2.15.3 Provide UMS with common controller.	0	2	4	4	2	12
3.8.3 Far Forward just-in-time tactical resupply to small units under fire.	0	2	2	1	3	8
3.6.3.9 Advanced storage systems and transportation devices to ensure temperature integrity and in-transit visibility.	0	1	5	0	2	8
4.6.3 Dispose of UXO and visually/virtually mark obstacles.	0	1	2	2	0	5

5. Conclusions

This GRMP V3 moves the GRMP development process closer to realization of a comprehensive Army/Marine Corps management plan for ground robotics. Data call requests resulted in updates to Acquisition/Contingency Programs and S&T Projects. These updates formed the basis for criticality ratings performed by the CIPTs during work sessions at the V3 Conference in March 2007. Some assessments were not performed due to unavailability of FOC/FNC and capability gap information as well as unavailability of some ground robotic stakeholders. Technology Readiness Levels (TRLs) related to S&T Projects were received and are reflected in Appendices C and D. One area in GRMP V3 that was not in previous versions is inclusion of specific User requirements for Acquisition/Contingency Programs which are identified in Tables 1.1 and 1.2 following the Executive Summary. Participation improved in CIPT work sessions compared to those conducted for GRMP V2. For instance, program manager representatives participated in all three CIPT work sessions for the first time. The Combat Service Support (CSS) CIPT work session had participation by all four stakeholders (PM, S&T, User and Sustainer) involved in ground robotics for the first time. Finally, TATM Process and Tool Suite modifications, tailored to GRMP development, were made to automate several functions that were performed manually for V2.

6. Path Ahead

GRMP V3 Conference participants were asked to provide feedback on how to improve the GRMP development process. The response was outstanding, reflecting a sincere interest in helping to achieve an objective master plan for Army/Marine Corps ground robotics. Consolidated recommendations are listed in the following subparagraphs.

6.1 Continue to mature GRMP so it ultimately represents a comprehensive Army/Marine Corps ground robotics planning document. Key features to be added include:

- On-going Ground Robotics Technology Readiness Assessments.
- Roadmaps that show dates and funding streams to achieve technology project maturity.
- Critical technology projects mapped to Acquisition Program insertion points.
- Complete listing of Current Force Capability Gaps, Future Force Capability Gaps and S&T Shortfalls with criticality assessments linked to S&T Projects.
- Horizontal Technology Integration efforts identified for management tracking and POM process.

6.2 Provide CIPT Guidelines explaining the CIPT assessment process performed during work sessions. These guidelines were developed and copies will be provided to participants for review and comment. Guidelines will also be provided as handouts prior to start of CIPT work sessions at each conference.

6.3 Provide electronic copies of Acquisition/Contingency Program and S&T Project briefings, quad charts, as well as U.S. Army Training and Doctrine Command (TRADOC) Gap Analyses to each CIPT Lead prior to start of work sessions.

6.4 Provide conference agenda, CIPT Assessment Matrices and copies of User identified Capability Gaps to CIPT Leads for dissemination to CIPT members approximately 2 weeks prior to the next conference.

6.5 Request that TRADOC provide AKO web site access to latest Capability Gap documentation, to include Current Gaps, Future Gaps and S&T Shortfalls.

6.6 Request each Acquisition/Contingency Program POC identify the approved requirement and Capability Gaps addressed on the data sheet or quad chart submitted.

6.7 Request each S&T Project proponent include Capability Gaps addressed, TRLs, and Acquisition/Contingency Program supported, if applicable, on data sheets or quad charts. U.S. Army S&T Projects should track to the most recent approved TRADOC Capability Gap Analysis.

6.8 Provide a TATM SME for each CIPT work session during future conferences. New CIPT agenda items that are the result of GRMP development expansion will be discussed in the VTC or face-to-face as discussed in item 6.16 below.

6.9 Tailor TATM training for the GRMP and offer on-site training at stakeholder locations that request TATM training. Provide CIPT Leads any additional TATM training as requested. CIPT Leads that have been through the process before may not need further training. New or substitute CIPT Leads can be trained the day before start of a conference if desired.

6.10 Provide an electronic copy of current GRMP version to each CIPT for their use during work sessions.

6.11 Continue to urge participation by all GRMP stakeholders. It is vital to the success of any future GRMP development to have participation from all Army/Marine Corps ground robotics stakeholders. It is also important that participants be represented by the same faces as much as possible so that the GRMP development process becomes familiar. Of course, it is recognized that the same faces will not always be available for various reasons.

6.12 Link GRMP to Science & Technology Enterprise Management (STEM) to enable access to Army Technology Objectives (ATOs). This link can be established by providing STEM/ATO access to a GRMP Team member. The ATO information can then be accessed and entered into the RS JPO TATM Tool Suite and possibly eliminate the need for data calls on S&T Project data already in the STEM database. In the future, an automated link can be implemented to prevent re-keying of data if the TATM Process and Tool Suite is granted access to transfer or receive data from the STEM environment.

6.13 Request User combat developers update Capability Gaps using latest Army/Marine Corps approved gaps prior to the next GRMP conference. Capability Gaps received to support V1 and V2 were inconsistent in terms of wording and do not appear to track directly with TRADOC approved Current Force Capability Gaps. As stated earlier, Capability Gap updates were not received to support GRMP V3 development. As suggested before, the solution to this deficiency requires the presence of a ground robotics lead (for all Army ground robotics other than FCS) at TRADOC Headquarters level to orchestrate participation by subordinate combat developer commands.

6.14 Allow sufficient time for Acquisition/Contingency Program and S&T Project presentations during GRMP conferences. As stated in items 6.3 and 6.4 above, electronic copies of briefing materials, quad charts, Capability Gaps, assessment matrices, and related documentation will be made available for each CIPT to use during future CIPT work sessions.

6.15 TDY funding for essential User stakeholders to be addressed in cases where the participating organization notifies the RS JPO action officer that TDY funds are unavailable.

6.16 Schedule a VTC or face-to-face meeting with CIPT Leads approximately one month prior to future GRMP conferences. CIPT Leads should invite other GRMP participants of their choosing to participate in VTC or face-to-face meeting as appropriate. This VTC or face-to-face

meeting will be used to discuss any new GRMP development issues, conference agenda or logistics, and questions or concerns.

6.17 The RS JPO GRMP Team will document conference minutes and action items and distribute to GRMP participants within two weeks after the conference. Action item status will be distributed to GRMP participants periodically.

6.18 Capability Gap Statements listed in Appendix D were cross referenced to robotic capabilities identified in the latest Joint Ground Robotics Enterprise (JGRE) Technology Advisory Board (TAB) process. Coordination with the JGRE TAB process will be expanded in future GRMP versions.