Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Army											Date: February 2016	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602712A *I Countermine Systems*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	-	28.597	36.568	26.497	-	26.497	26.663	26.996	27.531	28.067	-	-
H24: *Countermine Tech*	-	20.239	19.445	20.821	-	20.821	20.930	21.238	21.658	22.077	-	-
H35: *Camouflage & Counter-Recon Tech*	-	4.858	5.623	5.676	-	5.676	5.733	5.758	5.873	5.990	-	-
HB2: *COUNTERMINE COMPONENT TECHNOLOGY (CA)*	-	3.500	11.500	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates, designs, and evaluates technologies to improve countermine/counter improvised explosive device, signature management and counter-sensor capabilities. Focus areas are sensor components, sub-components and software algorithms to improve detection of mines, explosive threats and directed energy; novel methods to defeat mines and explosive threats; and signature management technologies to reduce the reconnaissance capabilities of enemy forces. The technologies being investigated are for both mounted and dismounted applications. Project H24 advances state of the art Countermine technologies to accurately detect threats with a high probability, reduce false alarms, and enable an increased operational tempo. Project H35 evaluates and develops advanced sensor protection, signature management and deception techniques for masking friendly force capabilities and intentions.

Work in this PE is related to and fully coordinated with PE 0602120A (Sensors and Electronic Survivability), PE 0602622A (Chemical, Smoke and Equipment Defeating Technology), PE 0602624A (Weapons and Munitions Technology), PE 0602709A (Night Vision Technology), PE 0602784A (Military Engineering Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603606A (Landmine Warfare and Barrier Advanced Technology), and PE 0603710A (Night Vision Advanced Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this PE is performed by the Army Research, Development and Engineering Command (RDECOM)/Communications-Electronics Research, Development and Engineering Center (CERDEC)/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Army					Date: February 2016
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602712A *I Countermine Systems*			
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	29.428	25.068	26.497	-	26.497
Current President's Budget	28.597	36.568	26.497	-	26.497
Total Adjustments	-0.831	11.500	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	11.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.831	-			

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: HB2: *COUNTERMINE COMPONENT TECHNOLOGY (CA)*		
Congressional Add: *Program Increase*	3.500	4.000
Congressional Add: *Explosives Detection Technology*	-	7.500
Congressional Add Subtotals for Project: HB2	3.500	11.500
Congressional Add Totals for all Projects	3.500	11.500

Exhibit R-2A, RDT&E Project Justification: PB 2017 Army			Date: February 2016
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602712A / *Countermine Systems*	Project (Number/Name) H24 / *Countermine Tech*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
H24: *Countermine Tech*	-	20.239	19.445	20.821	-	20.821	20.930	21.238	21.658	22.077	-	-

A. Mission Description and Budget Item Justification

This project investigates, designs and evaluates new countermine components, sub-components and software algorithms for detection, discrimination and neutralization of individual mines, minefields and other explosive threats. The goals of this project are to accurately detect threats with a high probability, reduce false alarms and enable an increased operational tempo.

This project supports Army science and technology efforts in the Ground Maneuver, Command, Control, Communications and Intelligence, Air and Soldier portfolios.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Communications-Electronics Research, Development and Engineering Center (CERDEC)/Night Vision and Electronic Sensors Directorate, Fort Belvoir, VA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Standoff Sensors for Explosive Hazard Detection	5.054	9.961	10.511
Description: This effort addresses the challenges of sensing and confirming potential in-road and/or roadside threats at standoff ranges. The effort focuses on understanding the phenomenologies that impact sensor design concepts and steer novel technologies that provide the primary means for detecting anomalies. The result is higher-confidence target detection and improved clutter/background filtering. Examples of candidate technologies include Forward Looking (FL) Electro-Optic/Infrared (EO/IR) and Ground Penetrating Radar (GPR) sensors, which are used to detect surface and shallow buried targets. This effort also investigates new sensor technologies, to confirm buried threats at deeper depths.			
FY 2015 Accomplishments: Integrated dual band FL GPR and EO/IR sensors on a brassboard demonstrator; conducted phenomenology studies to determine feasibility of fusion of multiple sensor modalities for improved detection; extended detection depth of low parity Doppler interferometer using seismic sources.			
FY 2016 Plans: Validate dual band FL GPR components using new phased arrays; explore polarization phenomenologies with Short Wave Infrared (SWIR) through Long Wave Infrared (LWIR) waveband sensors to discriminate man-made objects; investigate vibration sensors to distinguish targets from clutter; explore ground profiling sensors (Light Detection and Ranging (LIDAR), X-band radar)			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Army		Date: February 2016
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602712A / *Countermine Systems*	**Project (Number/Name)** H24 / *Countermine Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
to improve FL GPR data by removing surface clutter; study new identification and confirmation sensors, such as autonomous Neutron Gamma sensors. ***FY 2017 Plans:*** Will continue the investigation of vibration sensing and polarization technologies for the discrimination of man-made objects; will continue the investigation of advanced processing techniques to combine FL GPR and FL vibration sensor data in order to reduce false alarm rates; will continue to investigate new sensors for identification and confirmation of threats; will investigate microwave sensors, as well as digital receivers, for increased sensitivity of FL GPR sensors in order to help discriminate concealed explosive hazards on roadsides; will explore techniques to detect wires from standoff distances.			
Title: Chemically Specific Detection of Explosive Threats ***Description:*** This effort investigates emerging chemical explosive hazard detection technologies, including Home Made Explosives (HMEs), to address Warfighter needs. The effort will provide technologies for standoff detection and confirmation of emerging threats and production facilities, and it is complimentary to the work being accomplished under PE 0602622A/Project 552. ***FY 2015 Accomplishments:*** Improved algorithms and signal processing to maximize discrimination and reduce false alarms of explosive components; conducted data collections in various conditions to determine detection and identify capabilities against explosive compounds, using quantum dots for close proximity sensing and Quantum Cascade Lasers (QCLs) for stand-off trace detection. ***FY 2016 Plans:*** Analyze data collected in various conditions, and optimize sensitivity and spectral selectivity of new polymer-based quantum dot sensors using remote and hand held excitation sources; investigate new technologies to extract surface vapor signals.	4.509	2.858	-
Title: Dismounted Explosive Hazard Detection Technology ***Description:*** This effort investigates emerging component technologies to enhance detection of explosive hazards, including metallic and non-metallic landmines, Improvised Explosive Devices (IEDs), HMEs, and Explosively Formed Penetrators (EFPs). Emphasis is on increased coverage area, higher detection rates and increased discrimination probabilities. Technologies that provide low Size, Weight, and Power (SWaP) solutions are considered and studied to ensure solutions are viable for Soldier-portable applications. This effort also investigates advanced signal processing and detection algorithms for increased real-time feedback for threat detection and identification, and it collects data to inform studies investigating methods to reduce the operator's cognitive burden. ***FY 2015 Accomplishments:*** Conducted laboratory data collections using GPR, wide bandwidth metal detectors, and position measurement sensors mounted in a handheld emulation platform to establish a correlated dataset; conducted experiments to determine highly accurate sensor	5.495	3.626	7.500

Exhibit R-2A, RDT&E Project Justification: PB 2017 Army		Date: February 2016
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602712A / *Countermine Systems*	**Project (Number/Name)** H24 / *Countermine Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
position to improve display of sweep location and subsurface threats; developed near real-time detection and processing capability; conducted trade studies to determine the best combination of novel components and sensors for real-time detection and identification of buried explosive hazard threats using Nuclear Quadrupole Resonance (NQR), GPR and frequency domain metal detectors. ***FY 2016 Plans:*** Conduct data collections in relevant simulated environments to refine the best combination of novel components and sensors for real-time detection and identification of buried explosive hazard threats, including atomic magnetometers for NQR, GPR, and frequency domain metal detectors; explore advanced signal processing approaches using correlated data from various modalities and determine optimal data processing and algorithm techniques; utilize outcome of optimal datasets as feedback to sensor redesigns and experimentation; determine highly accurate sensor position to improve feedback to reduce the operator's cognitive burden and improve clutter rejection. ***FY 2017 Plans:*** Will refine data collection processes to incorporate controlled, relevant outdoor environments with refined combinations of novel components and sensors that will be used for real-time detection and identification of buried explosive hazard threats; will continue to investigate advanced signal processing approaches and to design optimal data algorithms and processing techniques; will conduct data collections and analyses to verify the accuracy of sensor position designs and to determine the level of improvement in feedback to operators to reduce cognitive burden and reduce clutter.			
Title: Explosive Hazard Neutralization Technologies ***Description:*** This effort investigates emerging neutralization technologies and techniques to address Warfighter needs to effectively neutralize explosive hazards (to include HMEs). ***FY 2015 Accomplishments:*** Investigated fiber laser based techniques for low or high-order neutralization of explosive threats at standoff ranges.	1.181	-	-
Title: Counter Explosive Hazard Phenomonology ***Description:*** This effort investigates potential long term solutions to nonconventional explosive hazard threats. It leverages recent lessons learned to investigate new ideas and emerging technologies to counter explosive hazards through gaining a better understanding of how to detect, neutralize and mitigate the threat. The effort includes a series of innovative exploration and discovery events focused on the identification of new ideas and concepts in structured and organized framework, enabling the Army to identify/assess opportunities to leverage technologies traditionally associated with other arenas, such as the intelligence community, big data, and the financial industry. ***FY 2015 Accomplishments:***	4.000	3.000	2.810

Exhibit R-2A, RDT&E Project Justification: PB 2017 Army		Date: February 2016
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602712A / *Countermine Systems*	**Project (Number/Name)** H24 / *Countermine Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Instigated a series of knowledge capture events with industry and academia; developed novel and innovative research efforts in counter-IED detection; began analysis of research areas focusing on non-traditional approaches (such as crowd sourcing and novel sensors) identified as having high potential for significant breakthroughs. ***FY 2016 Plans:*** Continue the series of knowledge capture events with industry and academia; focus efforts on characterizing counter-IED detection phenomenology; continue analysis and begin validation of research areas focusing on non-traditional approaches. ***FY 2017 Plans:*** Will continue the ongoing series of innovative investigation and informational events with industry and academia to collect information on previously unexplored phenomenologies; based on the knowledge gained from FY15 and FY16 knowledge capture events, will evaluate and validate nonconventional Counter Explosive Hazard (CEH) technologies for buried or concealed explosive hazard detection, such as multi-static GPR, polarized ultraviolet (UV) radiation, and explore novel passive radio frequency (RF).			
Accomplishments/Planned Programs Subtotals	20.239	19.445	20.821

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Army			Date: February 2016
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602712A / *Countermine Systems*	Project (Number/Name) H35 / *Camouflage & Counter-Recon Tech*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
H35: *Camouflage & Counter-Recon Tech*	-	4.858	5.623	5.676	-	5.676	5.733	5.758	5.873	5.990	-	-

A. Mission Description and Budget Item Justification

This project investigates, designs and evaluates techniques for masking friendly force capabilities and intentions. The project pursues technologies to reduce the susceptibility of sensor systems to detection and targeting by threat forces, as well as to develop next generation camouflage coatings and paints. Novel technologies are investigated, such as novel optics designs combined with signal processing, spectral filtering, and threat sensing algorithms.

This project supports Army science and technology efforts in the Command, Control, Communications and Intelligence portfolio.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Communications-Electronics Research, Development and Engineering Center (CERDEC)/Night Vision and Electronic Sensors Directorate, Fort Belvoir, VA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Camouflage and Counter-Reconnaissance Technology for Advanced Spectral Sensors	4.858	5.623	5.676
Description: This effort investigates and advances new techniques to reduce susceptibility of sensors and camouflage to detection by lasers, Electro-Optic (EO) sensor systems and Infrared (IR) sensor systems. The primary objectives are to reduce the reflectivity of currently fielded and emerging EO and sensors and next generation camouflage due to incoming energy from lasers as well as EO and IR sensor systems.			
FY 2015 Accomplishments: Investigated uncooled Focal Plane Array (FPA) vulnerabilities and exploitation against multiple laser threats; conducted initial studies into adaptive protection for Long Wave Infrared (LWIR) sensors; incorporated large format array sensor protection solution into hardware/software demonstrators; evaluated multispectral camouflage to include thermal signature reduction technology.			
FY 2016 Plans: Study uncooled FPA resiliency against laser threats; investigate uncooled FPA protection including Micro-electromechanical Systems (MEMS) devices and tunable IR filters; investigate best approach to harden Day-TV cameras against laser threats; investigate methods of laser protection for high performance cooled IR sensors, including linear and non-linear optical			

Exhibit R-2A, RDT&E Project Justification: PB 2017 Army		Date: February 2016
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602712A / *Countermine Systems*	**Project (Number/Name)** H35 / *Camouflage & Counter-Recon Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
approaches. Explore spectral response of next generation lightweight camouflage net systems, as well as different methods to imbed a thermal pattern into the net systems; optimize the performance of multispectral camouflage to counter emerging threats. ***FY 2017 Plans:*** Will investigate sensor vulnerabilities to future laser threats, and will develop algorithms and explore new materials, devices, and strategies to counter these threats; will develop sensor protection technologies that can be applied across multiple platforms; will continue to investigate techniques to minimize the spectral signatures of two-sided camouflage nets for desert and woodland environments; will investigate the colors, patterns and materials needed to design arctic camouflage patterns with minimal spectral signatures; will research future urban camouflage solutions for both vehicles and dismounts; will explore hyperspectral sensor technology to locate both red force and blue force targets in obscured locations.			
Accomplishments/Planned Programs Subtotals	4.858	5.623	5.676

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Army			Date: February 2016
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602712A / *Countermine Systems*	Project (Number/Name) HB2 / *COUNTERMINE COMPONENT TECHNOLOGY (CA)*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
HB2: *COUNTERMINE COMPONENT TECHNOLOGY (CA)*	-	3.500	11.500	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Countermine Systems applied research.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Program Increase ***FY 2015 Accomplishments:*** Conducted research on improved vehicular mounted forward looking anomaly sensing, which aids operators by visually scanning forward to cue potential buried or concealed tactical and unexploded ordnance (UXO) threats, in-road and roadside; and the confirmation of explosive threats, including UXO, using handheld and/or robotic sensors, which utilizes a combination of sensor inputs to increase capability. ***FY 2016 Plans:*** This is a Congressional Interest Item	3.500	4.000
Congressional Add: Explosives Detection Technology ***FY 2016 Plans:*** This is a Congressional Interest Item	-	7.500
Congressional Adds Subtotals	3.500	11.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

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