Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army											Date: May 2017	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602618A *I Ballistics Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	-	118.221	85.436	85.309	-	85.309	86.797	88.861	89.956	93.699	-	-
H80: *Survivability And Lethality Technology*	-	93.221	85.436	85.309	-	85.309	86.797	88.861	89.956	93.699	-	-
HB1: *SURVIVABILITY AND LETHALITY TECHNOLOGIES (CA)*	-	25.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates and evaluates materials and technologies, and designs and develops methodologies and models required to enable enhanced lethality and survivability. Project H80 focuses on applied research of lightweight armors and protective structures for the Soldier and vehicles; kinetic energy active protection; crew and components protection from ballistic shock and mine-blast; insensitive propellants/munitions formulations; novel multi-function warhead concepts; affordable precision munitions design; and techniques, methodologies, and models to analyze combat effectiveness, and identify vulnerabilities of current and emerging technologies; and developing a demonstrator with associated methods and tools for injury prediction of vehicle occupants during under-body blast events.

Work in this PE makes extensive use of high performance computing and experimental validation and builds on research transitioned from PE 0601102A (Defense Research Sciences)/Project H42 (Materials and Mechanics) and Project H43 (Ballistics); and utilizes emerging materials from PE 0602105A (Materials Technology) and applies it to specific Army platforms and the individual Soldier applications.

The work in this PE complements and is fully coordinated with efforts in PE 0602120A (Sensors and Electronic Survivability), PE 0602303A (Missile Technology), PE 0602601A (Combat Vehicle and Automotive Technology), PE 0602624A (Weapons and Munitions Technology), PE 0602705A (Electronics and Electronic Devices), PE 0602716A (Human Factors Engineering), PE 0602786A (Warfighter Technology), PE 0603125A (Combating Terrorism-Technology Development), PE 0603001A (Warfighter Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle Advanced Technology), PE 0603313A (Missile and Rocket Advanced Technology), and PE 0708045A (Manufacturing 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 Laboratory (ARL), Aberdeen Proving Ground, MD.

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army					Date: May 2017
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602618A / *Ballistics Technology*		
B. Program Change Summary ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
Previous President's Budget	117.801	85.436	89.905	-	89.905
Current President's Budget	118.221	85.436	85.309	-	85.309
Total Adjustments	0.420	0.000	-4.596	-	-4.596
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	3.000	-			
• SBIR/STTR Transfer	-2.580	-			
• Adjustments to Budget Years	0.000	0.000	-3.816	-	-3.816
• Civ Pay Adjustments	0.000	0.000	0.220	-	0.220
• Other Adjustments 2	0.000	0.000	-1.000	-	-1.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	**FY 2016**	**FY 2017**
Project: HB1: *SURVIVABILITY AND LETHALITY TECHNOLOGIES (CA)*		
Congressional Add: *Program Increase*	20.000	-
Congressional Add: *Improved Armor Technologies*	5.000	-
Congressional Add Subtotals for Project: HB1	25.000	-
Congressional Add Totals for all Projects	25.000	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602618A / *Ballistics Technology*	Project (Number/Name) H80 / *Survivability And Lethality Technology*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
H80: *Survivability And Lethality Technology*	-	93.221	85.436	85.309	-	85.309	86.797	88.861	89.956	93.699	-	-

A. Mission Description and Budget Item Justification

This Project investigates, designs and develops materials, methods and models that provide Soldier protection by enhancing survivability and lethality. Specific technology and research thrusts include: lightweight armors and protective structures; crew and component protection from ballistic shock and/or mine-blast; insensitive high energy propellants/munitions to increase lethality and reduce propellant/munitions vulnerability to attack; novel kinetic energy (KE) penetrator concepts to maintain/improve lethality; novel multi-function warhead concepts to enable defeat of a full-spectrum of targets (anti-armor, bunker, helicopter, troops); and techniques, methodologies and models to analyze combat effectiveness and identify vulnerabilities of current and emerging technologies; and developing a demonstrator and associated methods and analysis tools for injury prediction (due to underbody blast).

This Project sustains Army science and technology efforts supporting the Ground, Lethality and Soldier/Squad 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 Research Laboratory (ARL), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Underbody Blast & Occupant Protection	5.165	2.220	1.598
Description: This effort investigates and designs tools, techniques, and technologies for protection against mine/improvised explosive device (IED) blast threats, ballistic shock mitigation, and fuel/ammunition fires to enable survivability of current and future platforms. This research is coordinated with Program Element (PE) 0602601A (Armor Applied Research) and PE 0603005A (Combat Vehicle Survivability).			
FY 2016 Accomplishments: Investigated structural damage and response due to buried blast and penetrator threats and proposed novel protection solutions to defeat these threats; designed active mechanisms including momentum transfer and other technologies to mitigate lower-extremity injuries.			
FY 2017 Plans: Investigate active and adaptive concepts, such as threat detection, to protect against buried blast and penetrator threats.			
FY 2018 Plans:			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602618A / *Ballistics Technology*	**Project (Number/Name)** H80 / *Survivability And Lethality Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Will advance development of protection mechanisms to defeat penetrator mines; continue development of blast protection hull designs for ground platforms.			
Title: Low Cost Hyper-Accuracy Munition Technologies ***Description:*** This effort designs advanced components/subsystems to enable a broad spectrum of future affordable direct and indirect fire precision munitions. The focus is on a multidisciplinary approach to munition systems design by coupling physics-based models of interior ballistics, launch dynamics, flight mechanics, and high-gravitational force guidance, navigation, and control (GN&C) technologies. The goal is for smaller, cheaper and lighter munition components enabling low-collateral-damage precision munitions for future asymmetric operations in military operations on urban terrain (MOUT). ***FY 2016 Accomplishments:*** Developed nonlinear methods to assess flight dynamics and stability and to enhance control algorithm development for precision munitions; evaluated inertial navigation technologies to improve abilities to hit moving targets; and developed new electro-optic/ infrared-based navigation capabilities and assess associated in-lab maneuver performance of precision munitions. ***FY 2017 Plans:*** Advance development of nonlinear methods to assess aerodynamics and flight dynamics through coupled simulations, and apply to predict various geometry related flow interactions; and utilize various flight experiments to assess flight behavior of high maneuverability airframes and man-portable precision concepts such as use of video guidance to track and hit a moving target. ***FY 2018 Plans:*** Will conduct end-to-end launch and guided flight demonstration of moving target intercept on laboratory range with low cost components in moderate size, weight, and power package; will define critical technologies, scientific challenges, and engineering issues that inhibit precision weapons and future vehicle-mounted weapons against advanced threats.	3.706	3.758	3.779
Title: Disruptive Energetics and Propulsion Technologies ***Description:*** This effort investigates, evaluates, models, and informs the selection of propulsion and energetic materials and technologies to validate novel energetic materials concepts (such as nano-structural and insensitive) that exploit managed energy release required for improving the effectiveness and reducing the vulnerability of future gun/missile systems and warheads. This effort builds on disruptive energetic materials discovery efforts in PE 0601102A (Defense Research Sciences)/Project H43 (Ballistics) to synthesize new materials with energy content up to ten times that of Research Department Explosive (RDX). ***FY 2016 Accomplishments:*** Matured synthetic research on disruptive energetic materials, including nanodiamond-based materials and boron-based materials, confirming shock pressure/temperature enhancement and measuring energies delivered to target; designed laboratory experimental capabilities for evaluating gram-scale quantities of disruptive energetic materials to determine potential for further exploration and scale-up; explored methods to reduce power required to accelerate rounds for medium-caliber weapons	10.433	8.307	8.377

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602618A / *Ballistics Technology*	**Project (Number/Name)** H80 / *Survivability And Lethality Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
using computational fluid dynamics (CFD)-based models; and designed chemistry, thermodynamics, and multi-phase physics associated with increases in propellant burn rate sensitivity as a function of pressure to improve propellant efficiency and performance. ***FY 2017 Plans:*** Expand synthetic research for multiple classes of disruptive energetic materials; develop multiscale models to understand and predict chemical reactions, thermomechanical processes, and chemical compatibility of disruptive energetic materials; develop experimental and computational methods to improve understanding of initiation mechanisms; and use CFD-based models to explore methods to reduce power requirements in medium caliber weapons and begin extension to larger caliber systems. ***FY 2018 Plans:*** Will characterize performance of materials produced for both propellant and energetic applications; predict reactive material response to insult using an experimentally-validated multiscale model; accurately model the effects of microstructure on the dynamic response of energetic material composites; predict the burning rates of nitrate ester-based formulations with disruptive energetics additives; and extend computational models to adequately predict the behavior of three-dimensional (3D) solid propellants.			
Title: Lethal and Scalable Effects Technologies ***Description:*** This effort identifies and models preferred options to reduce energy/mass required to defeat emerging armor threats and to provide multi-purpose capabilities for revolutionary future lethality. In addition, this effort investigates technology options for scaling warhead lethality to enhance urban Warfighting capabilities including control of collateral damage. ***FY 2016 Accomplishments:*** Developed energy requirements and associated mechanisms to adapt large caliber performance to a shoulder fired system; investigated new mechanisms that take advantage of increased energy availability from enhanced gun efficiencies and new energetic materials to increase lethal capabilities; and explored new concepts to utilize lower energies on target to achieve effects ranging from non-lethal to lethal. ***FY 2017 Plans:*** Investigate new launch mechanisms that enable significant increases in muzzle energies using enhanced gun efficiencies (such as recoil and muzzle blast reductions) and new energetic materials; develop new mechanisms that take advantage of target vulnerabilities to reduce required energy levels to defeat specific targets; and develop physics-based simulations and experiments to explore new modular lethality concepts that efficiently redistribute available energy into multiple impacts / bursts. ***FY 2018 Plans:***	5.344	5.670	5.724

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602618A / *Ballistics Technology*	**Project (Number/Name)** H80 / *Survivability And Lethality Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Will develop affordable, robust kinetic energy lethal capabilities for medium and large caliber cannons; explore next generation warhead concepts that can defeat multiple types of threat targets; continue developing game-changing concepts for cooperative, distributed, and/or modular lethality; and seek to explain non-lethal mechanisms.			
Title: Survivability/Lethality Analyses ***Description:*** This effort devises state-of-the-art survivability/lethality/vulnerability methodologies to dynamically model the interaction of conventional ballistic threats against future weapon systems. ***FY 2016 Accomplishments:*** Matured methodologies that characterize behind-helmet blunt trauma and assess the associated injury incapacitation probabilities for soldiers; matured predictive ammunition vulnerability methodologies (vulnerability to unintended ammunition detonation due to incoming round); matured tools, techniques, and methodologies for ballistic survivability/lethality analysis to ensure analysis tools are relevant and credible for developmental and modernized Army systems in their operational context; and conducted validation and verification of mature ballistic vulnerability and lethality codes ***FY 2017 Plans:*** Develop technically robust methodologies for characterizing the interactions between emerging threats and military targets to provide quantitative results to support formal evaluation of Army systems, design trade space examinations and milestone decisions; mature engineering-level system-of-systems methodologies that will provide leadership with a sound scientific understanding of the complex relationships between combat effectiveness, evolving technical and tactical threats, and Army systems. ***FY 2018 Plans:*** Will design, develop, and validate scientifically sound and user-friendly predictive methodologies for determining threat-target interaction outcomes for novel targets and threat mechanisms, to provide quantitative estimates for supporting formal evaluation of Army systems, design trade space examinations and milestone decisions; mature engineering-level complex systems methodologies that can run stand-alone or with humans in-the-loop; and provide system developers and decision makers with credible investigations of the complex relationships among new technologies, combat effectiveness, evolving threats, non-traditional military environments, and military systems.	9.920	8.273	7.473
Title: Multi-Threat Armor Formulations and Designs ***Description:*** This effort devises and matures multi-threat hybrid armor technologies incorporating both active and passive mechanisms for ground vehicle systems that are effective against future conventional weapons and evolving improvised threats. This research is coordinated with PE 0602601A (Armor Applied Research) and PE 0603005A (Combat Vehicle Survivability). ***FY 2016 Accomplishments:***	22.545	21.649	18.795

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602618A / *Ballistics Technology*	**Project (Number/Name)** H80 / *Survivability And Lethality Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Developed understanding of limiting mechanics of multiple impacts from advanced KE threats and expanded our functional library of defeat mechanisms that are independent of size, severity, or configuration regarding shaped charge equipped warheads; developed defeat concepts that greatly expanded protection from vast array of kinetic energy and shaped charge weapons; and continued support for transitions to the United States (U.S.) Army Tank Automotive Research, Development and Engineering Center (TARDEC) through PE 0602601A (Combat Vehicle and Automotive Technology) / Project C05 (Armor Applied Research) and PE 0603005A (Combat Vehicle and Automotive Advanced Technology) / Project 441(Combat Vehicle Mobility) as KE armors and warhead defeat mechanisms are matured. ***FY 2017 Plans:*** Develop novel passive and reactive armor protection concepts, including the use of promising materials technologies, to defeat a variety of current and future large caliber KE penetrators through further development of computational modeling and simulation capabilities and validation experiments; mature understanding and predictive multi-physics modeling capabilities of electromagnetic armor (EMA) and explosive reactive armor (ERA) to improve associated design tools and accelerate development; investigate stress wave propagation at dissimilar material interfaces through a combined experimental and computational approach to improve understanding of hybrid protection systems, in particular, multi-hit capabilities; and support transitions to the U.S. Army TARDEC through PE 0602601A / Project C05 and PE 0603005A / Project 441. ***FY 2018 Plans:*** Will develop hybrid armor concepts that optimize multiple mechanisms to include EMA and ERA, as well as new novel designs, to provide multi-threat defeat; experimentally validate promising passive and reactive armor concepts based on modeling and simulation efforts; conduct experiments using emerging threats against existing mechanistic designs; further develop experimental and computational modeling capabilities to enable multi-threat, multi-hit armor mechanism design and validation; determine physical mechanisms that contribute to multi-material armor design by increasing imaging and velocimetry diagnostic capability (i.e., measuring velocity) and design of novel experiments.			
Title: Adaptive and Cooperative Protection Technologies ***Description:*** This effort pursues a holistic approach toward achieving significant weight reduction and defeat of future threats by utilizing real-time information, combined with threat knowledge, to provide ever-increasing protection. This approach includes integrating individual vehicle capabilities of armor, underbody blast protection, active protection systems (APS), and advanced soft kill methods into one solution to maximize survivability and minimize weight for combat and tactical vehicles. This research is coordinated with PE 0602601A (Armor Applied Research) and PE 0603005A (Combat Vehicle Survivability). ***FY 2017 Plans:***	-	2.795	6.393

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602618A / *Ballistics Technology*	**Project (Number/Name)** H80 / *Survivability And Lethality Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Assess current sensor/warner/tracker technologies that can warn of attack and identify threats of interest (such as Rocket-Propelled Grenades (RPGs)) and anti-tank guided missile (ATGM)); and explore multiple actuation technologies including mechanical actuation, energetic materials, and pulsed power in conjunction with selected counter measures. ***FY 2018 Plans:*** Will assess current sensor/warner/tracker technologies that can warn of attack and identify threats of interest (such as RPGs and ATGMs); and explore multiple actuation technologies including mechanical actuation, energetic materials, and pulsed power in conjunction with selected counter measures.			
Title: Ballistic and Blast Protection for Dismounted Soldiers ***Description:*** This effort develops unique physics-based models to understand the deflection and stress wave interactions with the human during the complex target interactions between threats and personal protective equipment (PPE). Use this knowledge framework to develop low technology readiness level (TRL) Personal Protective Equipment (PPE) concepts that are informed by the human effects during impact and blast events. ***FY 2016 Accomplishments:*** Explored novel helmet concepts that provide both ballistic and blunt trauma protection by incorporating understanding of ballistic impact on curved structures fabricated from structural composites; explored light fabric solutions for protection from secondary blast fragments; explored novel ceramic configurations for protection against advanced kinetic energy rounds; and developed computational methodologies to support development of these technologies. ***FY 2017 Plans:*** Develop computational models for hard and soft tissue to improve capabilities to develop new personnel protection concepts; develop improved biofidelic materials to improve experimental capabilities to assess Soldier protective systems; explore novel helmet concepts with new understanding of ballistic impact on curved structures; conduct experiments and develop models that combine protective helmet material concepts with human head models to improve fidelity of and validate helmet concepts. ***FY 2018 Plans:*** Will perform computational/experimental analysis of disruption mechanisms against legacy bullet technologies; simulate helmet/pad/head interaction for various loading scenarios; will investigate soft tissue and hard tissue injury mechanisms; will explore new concepts in limb protection from blast events.	3.653	6.561	6.700
Title: Soldier Lethality Technologies ***Description:*** This effort focuses on development of advanced lethal mechanisms, improved accuracy approaches, and leverages state-of-the-art materials to enable a single small arms cartridge for defeat of hard and soft targets and enable the defeat of combatants in defilade out to 2 km.	3.207	0.797	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602618A / *Ballistics Technology*	**Project (Number/Name)** H80 / *Survivability And Lethality Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
FY 2016 Accomplishments: Investigated concepts and validated models to achieve significantly higher muzzle velocities in small caliber weapons; and matured deeper understanding of novel concepts such as gun tube geometries, weapon dynamics, blast attenuation, impulse management, and transitional ballistics to enhance accuracy and lethality of small caliber weapons. ***FY 2017 Plans:*** Investigate concepts to enable high muzzle energies and multi-platform single-round warhead technologies in a light weapon system.			
Title: Warrior Injury Assessment Manikin (WIAMan) ***Description:*** This work develops an improved demonstrator blast test manikin, data acquisition system, and injury prediction methods and tools that incorporate new medical research and which provides an improved capability to measure and predict skeletal injuries for vehicle occupants during under-body blast events. Transfer of responsibilities and funding from PE 0602787A (Medical Technology)/Project 869 (Warfighter Health Protection & Performance Standards, Army Medical Research and Materiel Command (MRMC) to ARL effective Fiscal Year (FY) 2015. This effort is coordinated with PE 0602601A (Armor Applied Research) and PE 0603005A (Combat Vehicle Survivability). ***FY 2016 Accomplishments:*** Completed validation and verification testing of the first whole-body WIAMan demonstrator; fabricated and integrated the WIAMan data acquisition system into the manikin; revised prototype manikin design and prepared technical data package for fabrication of the next generation prototype manikin and awarded fabrication contract; conducted program assessment milestone review; conducted injury medical research in a blast driven environment; transferred knowledge and tools for use in Live Fire Test and Evaluation and other under-body blast survivability efforts; and conducted research to establish human tolerance to the under-body blast loading environment and development of human injury probability curves. ***FY 2017 Plans:*** Validate data acquisition system/instrumentation suite for fabrication of next generation WIAMan technology demonstrator; assess biofidelity compliance; refine and validate finite element analysis model of the WIAMan technology demonstrator; and conduct biomechanical research for human injury probability curves for all body regions under consideration, including foot/ankle, lower leg, femur, pelvis, ribs/sternum, and spine. ***FY 2018 Plans:*** Will mature and assess the first data acquisition system components; will conduct design iterations to mature the WIAMan efforts from the Technology Demonstrator to a fully-integrated Generation-1 Prototype; begin to assess biofidelity, strength of design, and	14.076	8.808	6.446

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602618A / *Ballistics Technology*	**Project (Number/Name)** H80 / *Survivability And Lethality Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
technology readiness level of the Generation-1 Prototype; will commence injury biomechanics testing; and update and validate the finite element model.			
Title: Vulnerability Assessment of Technologies	8.390	8.706	8.840
Description: This effort reviews developmental technologies in the context of current and emerging threats, identifies tradeoffs, develops risk reduction and mitigation strategies, and promotes the development of technologies that are "threat ready". State-of-the-art vulnerability assessment methodology and tools are applied across a broad spectrum of threats in order to determine vulnerabilities. This effort investigates, designs, and develops methods and tools and provides the oversight and coordination required to execute this research across the Army enterprise. This work complements and is coordinated with PE 0603125A (Combating Terrorism-Technology Development)/Project DF5 (Agile Integration & Demonstration). ***FY 2016 Accomplishments:*** Conducted vulnerability assessments on critical 6.2 (Applied Research) technologies based on Army priorities. These assessments identified very early-on, possible vulnerabilities and shortcomings of emerging technologies and influenced future Science and Technology (S&T) investment decisions resulting in the fielding of more robust systems. Candidate technologies were considered across all Army S&T portfolios. ***FY 2017 Plans:*** Complete analysis and reporting of findings for completed technology vulnerability assessments, including assessments of advanced sensor protection against future threats, advanced tactical networking technology, survivability implications of novel flight control concepts, assured positioning, navigation and timing in electronic warfare environments, advanced video processing technique, and sensing/warning capability against emerging unmanned aerial system threats; and initiate approved set of FY17 technology vulnerability assessments that are prioritized based on coordination across the S&T, intelligence, requirements and acquisition communities. ***FY 2018 Plans:*** Will conduct analysis and report findings of technology vulnerability assessments of developmental technologies that have high likelihood for maturation into future Army systems. Specific technologies for assessment in FY18 will be determined in FY17 and prioritized by a rigorous process based on coordination across the S&T, intelligence, requirements and acquisition communities. Findings will make systems employing these technologies more survivable and less expensive to acquire.			
Title: Active Protection Modeling and Technologies	6.782	3.217	5.407
Description: This effort supports the development of Active Protection System (APS) technologies and common architecture to reduce vehicle weight while significantly increasing protection against current and emerging advanced threats by reducing reliance on armor through other means such as sensing, warning, and active countermeasures. The APS common architecture will provide adaptable APS solutions that can be integrated across Army vehicle platforms as required. This research includes			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
the development of new modeling and simulation capabilities along with supporting experimental and theoretical approaches to enable active protective systems. This effort includes integrated information (e.g., battlefield geography, threat launch detection and tracking) and intelligence to inform protection optimization, requiring collaboration across multiple Army organizations. This effort complements and is coordinated with PE 0602601A (Combat Vehicle and Automotive Technology)/Project C05 (Armor Applied Research), PE 0603004A (Weapons and Munitions Advanced Technology)/Project 232 (Advanced Lethality & Survivability Demo), PE 0603005A (Combat Vehicle Survivability and Automotive Advanced Technology)/Project 221 (Combat Vehicle Survivability), PE 0603270A (Electronic Warfare Technology)/Project K16 (Non-Commo ECM Technology Demo), and PE 0603313A (Missile and Rocket Advanced Technology) / Project 263 (Future Missile Technology Integration). ***FY 2016 Accomplishments:*** Developed ATGM flight models; conducted warhead damage experiments into larger threats with different warhead explosives; developed softkill countermeasure models; completed integration of softkill and hardkill components and controller algorithms into an overarching softkill/hardkill simulation; integrated results into Research, Development, and Engineering Command (RDECOM)-level APS simulations suite. ***FY 2017 Plans:*** Integrate warhead damage experimental data into more complex damage mechanisms to study ATGM threats; incorporate threat counter measures into simulations to assess potential counter-counter measures; and examine softkill/hardkill performance, modifying simulations as necessary. ***FY 2018 Plans:*** Will compare simulation and experimental results of softkill physical demonstrations; computationally investigate performance of layered hardkill concepts with adaptive protection mechanisms; and simulate counter-counter measures against specific hard-kill/ soft kill solutions.			
Title: Swarming Weapons Technologies ***Description:*** This effort develops concepts for simultaneous and assured delivery of multiple lethal payloads at extended ranges to challenging (e.g., moving) targets in constrained and contested environments (such as highly dynamic and mixed personnel environments, and Global Positioning System (GPS) denied environments) through the use of highly collaborative teaming and distributed intelligence, perception, estimation, and control theories and technologies. ***FY 2017 Plans:*** Develop new modeling and simulation capabilities to capture complex flight physics, such as non-linear flow phenomena, flight body dynamics for complex shape bodies, and rapid, extreme maneuvers; and develop novel nonlinear Guidance, Navigation, and Control (GNC) capabilities to enable cooperative control and extreme maneuverability. ***FY 2018 Plans:***	-	4.675	4.772

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Will produce realistic models for targets in complex environments; will determine reduced-bandwidth communications strategy between vehicles; implement these navigation technologies in simple experiments (e.g., ground or air robots).			
Title: Multi-scale Materials Modeling for Force Protection ***Description:*** This effort develops computational tools for the design of terminal ballistic concepts and material-specific properties to enable novel penetrator-target interactions. Multi-scale materials models developed in previous 6.1 (Basic Research) programs are transitioned to simulation framework suitable for impact and penetration modeling. This approach includes fusing materials and mechanisms to maximize survivability and minimize weight for combat and tactical vehicles. ***FY 2018 Plans:*** Will develop models to enable ability to perform concurrent armor concept and armor-material design.	-	-	1.005
Accomplishments/Planned Programs Subtotals	93.221	85.436	85.309

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: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602618A / *Ballistics Technology*	Project (Number/Name) HB1 / *SURVIVABILITY AND LETHALITY TECHNOLOGIES (CA)*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
HB1: *SURVIVABILITY AND LETHALITY TECHNOLOGIES (CA)*	-	25.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

These are Congressional Interest Items

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Program Increase ***FY 2016 Accomplishments:*** This is a Congressional Interest Item	20.000	-
Congressional Add: Improved Armor Technologies ***FY 2016 Accomplishments:*** This is a Congressional Interest Item	5.000	-
Congressional Adds Subtotals	25.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A