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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603005A / Combat Vehicle and Automotive Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	171.448	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	171.448
221: Combat Veh Survivabltly	-	56.726	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	56.726
441: Combat Vehicle Mobilty	-	25.773	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	25.773
497: Combat Vehicle Electro	-	6.993	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.993
515: Robotic Ground Systems	-	24.956	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	24.956
533: Ground Vehicle Demonstrations (CA)	-	57.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	57.000

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PEs:
 ? 0603119A Ground Advanced Technology
 ? 0603462A Next Generation Combat Vehicle Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures, integrates and demonstrates combat and tactical vehicle automotive technologies that enable a lighter, more mobile and more survivable force. This PE executes the Army's Combat Vehicle Prototyping program to mature, integrate and demonstrate ground vehicle leap ahead technologies in support of future combat vehicles. Project 221 (Combat Vehicle Survivability) matures, integrates and demonstrates protection and survivability technologies such as active protection systems, advanced vehicle armors, blast mitigation and occupant safety devices to address both current and emerging advanced threats to ground vehicles. Project 441 (Combat Vehicle Mobility) matures and demonstrates advanced ground vehicle power and mobility technologies such as powertrains, power generation and storage, water and fuel logistics, and running gear subsystems for military ground vehicles to enable a more efficient, mobile and deployable force. Project 497 (Combat Vehicle Electro) matures, integrates, and demonstrates vehicle electronics hardware (computers, sensors, communications systems, displays, and vehicle command/control/driving mechanisms) and software that result in increased crew efficiencies, vehicle performance, reduced size, weight, and power (SWaP) burdens and vehicle maintenance costs. Project 515 (Robotic Ground Systems) matures and demonstrates unmanned ground vehicle (UGV) technologies with a focus on sensors, perception hardware and software, and robotic control algorithms that enable UGV systems to maneuver on and off road at speeds which meet mission requirements with minimal human intervention.

Work in this PE is coordinated with, PE 0602105A (Materials Technology), 0602120A (Sensors and Electronic Survivability), 0602601A (Combat Vehicle and Automotive Technology), 0602618A (Ballistics Technology), 0602624A (Weapons and Munitions Technology), 0602705A (Electronics and Electronic Devices), 0602784 (Military Engineering Technology), 0603001A (Warfighter Advanced Technology), 0603004A (Weapons and Munitions Advanced Technology), 0603005 (Combat Vehicle and Automotive Advanced Technology), 0603125A (Combating Terrorism Technology Development), 0603270A (Electronic Warfare Technology), 0603313A (Missile and Rocket Advanced Technology), 0603734 (Military Engineering Advanced Technology), 0604115A (Technology Maturation Initiatives), and 0708045A (Manufacturing Technology).

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>
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Beginning in FY20, work in this PE is related to, and fully coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), 0603119A (Ground Advanced Technology), and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

Work in this PE is performed by the United States Army Futures Command.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	176.622	0.000	0.000	-	0.000
Current President's Budget	171.448	0.000	0.000	-	0.000
Total Adjustments	-5.174	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.600	-			
• SBIR/STTR Transfer	-3.574	-			

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 533: *Ground Vehicle Demonstrations (CA)*

- Congressional Add: *Program increase - lightweight technology for ground combat and tactical vehicles*
- Congressional Add: *Program increase - advanced water harvesting technology*
- Congressional Add: *Program increase - fuel cell research*
- Congressional Add: *Program increase - airless tire technology demonstration*
- Congressional Add: *Program increase - HMMWV automotive enhancements*
- Congressional Add: *Program increase - HMMWV autonomy*
- Congressional Add: *Program increase - HMMWV power system*
- Congressional Add: *Program increase - HMMWV torque monitoring*
- Congressional Add: *Program increase - multi-sensor augmented reality system*
- Congressional Add: *Program increase - combat vehicle weight reduction initiative*

	FY 2019	FY 2020
	10.000	-
	5.000	-
	5.000	-
	4.000	-
	10.000	-
	3.000	-
	2.000	-
	3.000	-
	5.000	-
	10.000	-

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>
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<u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u>	FY 2019	FY 2020
Congressional Add Subtotals for Project: 533	57.000	-
Congressional Add Totals for all Projects	57.000	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 221 / <i>Combat Veh Survivablty</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
221: <i>Combat Veh Survivablty</i>	-	56.726	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	56.726

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech
 * Project BH1 Survivability Systems Controls Advanced Technology
 * Project BH4 Ground Vehicle Holistic Defense Adv Tech
 * Project BI5 Materials Application & Integration Adv Tech

A. Mission Description and Budget Item Justification

This Project matures, integrates, and demonstrates protection and survivability technologies such as active protection systems (APS), advanced vehicle armors, blast mitigation and occupant safety devices to address both current and emerging advanced threats to ground vehicles. This Project integrates complimentary survivability technologies to enable advanced protection suites, providing greater survivability and protection against emerging threats. This Project executes the Army's APS program to mature and demonstrate APS technologies in order to increase protection against current and emerging advanced threats while maintaining or reducing vehicle weight by reducing reliance on armor through the use of other means such as sensing, warning, hostile fire detection and active countermeasures. This Project develops an APS Common Architecture that defines the component interface standards and component specifications enabling adaptable APS solutions that can be integrated across Army vehicle platforms as required.

Work in this Project supports the Army Science and Technology Ground Maneuver Portfolio.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2019	FY 2020	FY 2021
Title: Advanced Armor Technologies	14.964	-	-
Description: This effort matures, fabricates, integrates, and evaluates advanced ground vehicle armor systems such as advanced passive kinetic energy armor, explosive reactive armor, electromagnetic armor, and adaptive armor. The goal is to optimize armor system technologies and integration methodologies to reduce overall armor system weight; create and mature scalable / modular / common armor system integration standards for the advanced armor technologies; create armor system test & evaluation standards for advanced armor technologies and leverages the standards for armor component and armor system maturation; refine armor modeling and simulation system engineering process to incorporate advances in armor technologies.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 221 / <i>Combat Veh Survivablty</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Title: Blast Mitigation</p> <p>Description: This effort fabricates and matures advanced survivability and protection components, tools, and subsystems for enhanced protection against vehicle mines, improvised explosive devices (IEDs) and other underbody blast threats, and vehicle collision and rollover events that result from blast events. This effort also integrates and improves occupant protection technologies such as seats and restraints. This effort creates the laboratory capability needed to enable expeditious performance evaluation through modeling & simulation (M&S), experimentation, and instrumented test of blast mitigating technologies in such areas as active and passive exterior/hull/cab/kits, interior energy absorbing capabilities for seats, floors, restraints, and sensors for active blast mitigating technologies.</p>		7.174	-	-
<p>Title: Vehicle Fire Protection</p> <p>Description: This effort matures, integrates, and demonstrates technologies to minimize vehicle and crew vulnerabilities to fires in current and future military ground vehicles. Supporting technologies include modeling & simulation, sensor systems, software, chemical agents, fire-resistant materials, and hardware components.</p>		2.628	-	-
<p>Title: Hit Avoidance Technologies</p> <p>Description: This effort matures, integrates, and demonstrates hard-kill (physical countermeasure) and soft-kill (non-kinetic countermeasure such as electronic jamming or spoofing) Active Protection System (APS) components and integrated systems to verify the APS Common Architecture and reduce integrating risk on current systems. In demonstrating hard-kill and soft kill-active protection technologies, requirements, and specifications will be matured for future integration onto tactical and combat vehicle platforms.</p>		28.365	-	-
<p>Title: System Design Optimization for Lightweighting</p> <p>Description: This effort will focus on optimization of platform design to reduce weight in both traditional and novel methods. This effort will demonstrate best practices in cost-conscious, multi-material design for components to reduce ground vehicle weight, as well as demonstrate holistic weight reduction with informed system and component-level design decisions. This will be accomplished by using and evaluating design tools, advanced materials, manufacturing processes and assembly technologies to design lightweight systems, develop lightweight components and enhance the ability to use novel approaches for lightweighting. This effort leverages lessons learned from prior and ongoing individual component efforts within industry, academia and Department of Defense (DoD).</p>		3.465	-	-
<p>Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p> <p>Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p>		0.130	-	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 221 / <i>Combat Veh Survivablty</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Accomplishments/Planned Programs Subtotals	56.726	-	-

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>				Project (Number/Name) 441 / <i>Combat Vehicle Mobilty</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
441: <i>Combat Vehicle Mobilty</i>	-	25.773	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	25.773

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603119A Ground Advanced Technology
 * Project BK9 Ground System Fluids and Fuels Adv Tech
 PE 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BF7 Crew Augmentation and Optimization Adv Tech
 * Project BG4 Adv Mobility Experimental Prototype Adv Tech Demo
 * Project BH6 Platform Electrification and Mobility Adv Tech
 * Project B18 All-Electric Combat Powertrain Advanced Technology
 * Project BJ1 Vehicle System Security Advanced Technology
 * Project BJ6 Hydrogen Based Combat System Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced mobility and onboard electrical power technologies for combat and tactical vehicles to enable lightweight, agile, deployable, fuel efficient and survivable ground vehicles. Technologies include advanced propulsion, engines, transmissions, power, and electrical components and subsystems. This Project will also mature and demonstrate advanced mechanical and electrical power generation systems to increase available onboard electrical power to enable future capabilities such as next generation communications and networking, improvised explosive device jamming systems and next generation sensor devices can be supported on combat and tactical vehicles. This Project also matures and demonstrates water and fuel logistics technologies.

Work in this Project supports the Army Science and Technology Ground Maneuver portfolio.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY 2020 realignments are due to financial restructuring in support of Army Modernization Priorities.

B. Accomplishments/Planned Programs (\$ in Millions)

Title: Onboard Vehicle Electric Power Component Development:	FY 2019	FY 2020	FY 2021
Description: This effort focuses on meeting the Army's demand for more onboard vehicle electric power (OBVP) to enable technologies such as advanced survivability systems, situational awareness systems and the Army network. This effort matures, integrates, and demonstrates onboard vehicle power components to include electrical power generation machines and associated power converters such as high temperature inverters and converters, advanced control algorithms, and high efficiency power conversion (mechanical to electrical) components. Additionally, it matures and integrates advanced electric machines such	2.838	-	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 441 / <i>Combat Vehicle Mobilty</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
as Integrated Starter Generator and their controls for mild hybrid (System that integrated electric machines to assist internal combustion engines for propulsion) electric propulsion and high power electric generation.				
Title: Advanced Running Gear: Description: This effort matures and demonstrates running gear components and advanced suspension technologies to increase vehicle mobility and durability in response to increased ground vehicle platform weights. Components and subsystems include new elastomer compounds, lightweight, survivable track systems and road wheels, advanced compensating track tensioners, advanced damping suspension technologies, Electronic Stability Control (ESC) systems, and preview sensing technologies linked to advanced suspension designs.		2.140	-	-
Title: Combat Vehicle Subsystem Demonstrations Description: This effort contributes to the Army's ground platform risk reduction efforts which seek to address technical and integration challenges in the areas of mobility, survivability, and vehicle architecture and systems integration. The primary focus of this activity is to mature and demonstrate a series of subsystem demonstrators building off of previous investment in ground combat acquisition and technology programs with the purpose of maturing key technologies to refine and inform future platform requirements and reduce risks in critical ground combat vehicle technology areas. Specifically, this effort focuses on maturing and demonstrating ground combat vehicle mobility technologies such as powertrain subsystems and systems integration technologies such as vehicle structures and concept demonstrators. This effort seeks to optimize platform efficiency and growth potential to ensure the combat fleet is able to accept new technologies as they are developed to bring advanced capability for the Warfighter.		8.112	-	-
Title: Energy Storage Systems Development: Description: The goal of this work is to mature energy storage systems to both enable silent watch capability and increased survivability through power brick energy storage components for pulse power electromagnetic armor. This is accomplished through the maturation and demonstration of advanced ground vehicle energy storage devices such as advanced chemistry batteries, high energy density capacitors, and power brick batteries for pulse power. This effort leverages commercial industry battery development efforts to reduce battery volume and weight while improving their energy and power densities. This effort also matures and optimizes a common specification for battery management systems to improve the battery state of charge indicator accuracy and battery state of health information to reduce the frequency of battery replacement and optimize starting, lighting, and ignition functions.		3.137	-	-
Title: Propulsion and Thermal Technologies: Description: This effort matures high power density engines and transmission systems needed to offset increasing combat vehicle weights (armor), increased electrical power generation needs (onboard communications, surveillance and exportable		4.793	-	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 441 / <i>Combat Vehicle Mobilty</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
power), improved fuel economy (fuel cost and range), enhanced mobility (survivability), and reduced cooling system burden (size and heat dissipation). This effort also matures thermal management including heat energy recovery, propulsion and cabin thermal management sub-systems to utilize waste heat energy and meet objective power and mobility requirements on combat and tactical vehicles. Lastly, this effort maximizes efficiencies within propulsion and thermal systems to reduce thermal burden on the vehicle while providing the same or greater performance capability.				
Title: Force Projection: Description: This effort focuses on reducing the logistics footprint, improving fuel efficiency, and ensuring mobility by maturing and demonstrating technologies in areas such as water purification, generation, quality monitoring, storage and distribution and wastewater treatment and reuse; petroleum quality monitoring, filtration, storage and distribution, hydraulic fluids; alternative fuels and fuel additives; lubricants, oil, powertrain fluids and coolants.		2.206	-	-
Title: Crew Augmentation Description: This effort focuses on optimizing crew station technologies while reducing crew sizes that will provide the same overall performance by exploiting human interaction technologies, automations, machine intelligence and customization to permit soldiers to achieve performance beyond today?s constrained ground vehicle environment.		2.547	-	-
Accomplishments/Planned Programs Subtotals		25.773	-	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 497 / <i>Combat Vehicle Electro</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>497: Combat Vehicle Electro</i>	-	6.993	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.993

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BH8 Enhanced VETRONICS Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures, integrates, and demonstrates vehicle electronics hardware such as computers, sensors, communications systems, displays, and vehicle command/control/driving mechanisms as well as vehicle software to enhance crew performance, increase vehicle fuel efficiency, reduced Size, Weight, and Power (SWaP) burdens and reduce vehicle maintenance costs. This Project also advances open system architectures (power and data) for military ground vehicles to enable common interfaces, standards and hardware implementations. The overall vehicle system architecture is known as the Vehicle Integration for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance / Electronic Warfare (C4ISR/EW) Interoperability (VICTORY), which is a long term technology effort that provides an open architecture that will allow platforms to accept future technologies without the need for significant re design as new technologies are developed and integrated. Additionally this Project matures autonomy architectures that enable the ease of integration of autonomous subsystem technologies into future and existing tactical and combat vehicle architectures. Technical challenges include: software and algorithm development for increased levels of automation for both manned and unmanned systems, secure vehicle data networks, interoperability of intra vehicle systems, and implementation of advanced user interfaces. Overcoming these technical challenges enables improved and increased span of collaborative vehicle operations, efficient workload management, commander's decision aids, embedded simulation for battlefield visualization and fully integrated virtual test/evaluation.

Work in this Project supports the Army Science and Technology Ground Maneuver portfolio.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY 2020 realignments are due to financial restructuring in support of Army Modernization Priorities.

B. Accomplishments/Planned Programs (\$ in Millions)

Title: Vehicle Electronics Integration Technologies:	FY 2019	FY 2020	FY 2021
Description: This effort matures, demonstrates and implements next generation military ground vehicle electronics and electrical power open architectures for future ground combat and tactical vehicle systems. Mature and demonstrate technologies to include: next generation video/data networking and computing equipment, Silicon Carbide high voltage power electronics and low voltage smart power distribution. Technologies will reduce currently fielded vehicle overall size, weight and power concerns for vehicle electronics.	2.803	-	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 497 / <i>Combat Vehicle Electro</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Title: Vehicle Electronics Architecture and Standards: Description: This effort matures technologies and standards for existing and future combat and tactical ground vehicles. Open commercial standards will be evaluated and modified for use in military ground vehicles and possible inclusion in the Army's open, non-proprietary intra-vehicle data network e.g., VICTORY. This effort will also evaluate standards and components for suitability of integration into vehicle platforms. This effort also supplements the design of electronic architectures to support the efficient integration of electronic components into vehicle systems through the use of open standards. Additionally, this effort matures and expands the VICTORY effort to interface with the Modular Active Protection System (MAPS) Architecture.		3.015	-	-
Title: Autonomous Vehicle Architecture: Description: This project matures, integrates, and demonstrates an improved, optimized autonomy-enabled distribution architecture that eases integration of new and emerging technologies across the full spectrum of operational and tactical supply movement operations. This project addresses systems integration challenges by providing the appropriate fault tolerant architecture design artifacts that will allow ease of integration for autonomy enablement kits, autonomy enablement software, and end-to-end sustainment and tactical ground resupply capability through use of open systems interfaces.		1.175	-	-
Accomplishments/Planned Programs Subtotals		6.993	-	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>				Project (Number/Name) 515 / <i>Robotic Ground Systems</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
515: <i>Robotic Ground Systems</i>	-	24.956	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	24.956

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BF2 Autonomous Ground Resupply (AGR) Adv Tech
 * Project BF4 Combat Vehicle Robotics Adv Tech
 * Project BK1 Autonomous Mobility Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies to enable Unmanned Ground Vehicles (UGV) including sensor technologies, perception hardware and software, and control technologies that allow the Soldier to perform mission tasks more efficiently. Challenges addressed include: obstacle avoidance, overcoming perception limitations, intelligent situational behaviors, command and control by Soldier operators, frequency of human intervention, operations in adverse weather, and autonomy enabled vehicles protecting themselves and their surroundings from intruders. Mature technologies are incorporated onto existing, Army owned UGV technology demonstrators so that performance of the enabling technologies can be evaluated.

The approach builds upon, complements, and does not duplicate previous and ongoing investments conducted under the Joint Robotics Program Office. Work in this Project supports the Army Science and Technology Ground Maneuver Portfolio. Ground Maneuver Portfolio investments are greatly improving logistics throughput and surge capability supporting maneuver forces (Leader Follower technology) and allow experimentation with manned and unmanned teams to develop the advantages that inform/protect the maneuver force (Robotic Wingman JCTD).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2019	FY 2020	FY 2021
Title: Unmanned Ground Systems Technology:	8.955	-	-
Description: This effort matures, integrates, and demonstrates advanced robotic and autonomous technologies for the tactical and combat vehicle fleets. Unmanned ground systems technologies can be employed to overcome critical Army challenges to include automated resupply and sustainment, and reduced physical and cognitive burden. Challenges can be met by utilizing relevant technologies such as behavior algorithms, autonomy kits, sensor integration, advanced navigation and planning, object and local environment manipulation, local situational awareness, advanced perception, vehicle and pedestrian safety, and robotic command and control.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 515 / <i>Robotic Ground Systems</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Autonomous Ground Vehicle Architecture Integration and Demonstration</p> <p>Description: This effort matures, integrates, and demonstrates advanced robotic and autonomous foundational architecture and the technologies to enable tactically relevant unmanned ground systems. Technologies focused on creating an open Autonomous Ground Vehicle Reference Architecture for all future unmanned platforms, improved tactical and maneuver intelligence and behavior algorithms based off the architecture, sensor integration and advanced perception for off road, manned and unmanned teaming for the tactical environment, and enabling the integration of weapons and vehicle self-protection capabilities.</p>	16.001	-	-
Accomplishments/Planned Programs Subtotals	24.956	-	-

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>				Project (Number/Name) 533 / <i>Ground Vehicle Demonstrations (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
533: <i>Ground Vehicle Demonstrations (CA)</i>	-	57.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	57.000

A. Mission Description and Budget Item Justification

These are Congressional Interest Items

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2019	FY 2020
Congressional Add: Program increase - lightweight technology for ground combat and tactical vehicles	10.000	-
FY 2019 Accomplishments: Program increase - lightweight technology for ground combat and tactical vehicles		
Congressional Add: Program increase - advanced water harvesting technology	5.000	-
FY 2019 Accomplishments: Program increase - advanced water harvesting technology		
Congressional Add: Program increase - fuel cell research	5.000	-
FY 2019 Accomplishments: Program increase - fuel cell research		
Congressional Add: Program increase - airless tire technology demonstration	4.000	-
FY 2019 Accomplishments: Program increase - airless tire technology demonstration		
Congressional Add: Program increase - HMMWV automotive enhancements	10.000	-
FY 2019 Accomplishments: Program increase - HMMWV automotive enhancements		
Congressional Add: Program increase - HMMWV autonomy	3.000	-
FY 2019 Accomplishments: Program increase - HMMWV autonomy		
Congressional Add: Program increase - HMMWV power system	2.000	-
FY 2019 Accomplishments: Program increase - HMMWV power system		
Congressional Add: Program increase - HMMWV torque monitoring	3.000	-
FY 2019 Accomplishments: Program increase - HMMWV torque monitoring		
Congressional Add: Program increase - multi-sensor augmented reality system	5.000	-
FY 2019 Accomplishments: Program increase - multi-sensor augmented reality system		
Congressional Add: Program increase - combat vehicle weight reduction initiative	10.000	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 533 / <i>Ground Vehicle Demonstrations (CA)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020
<i>FY 2019 Accomplishments:</i> Program increase - combat vehicle weight reduction initiative		
Congressional Adds Subtotals	57.000	-

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A