Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 4: *Advanced Component Development & Prototypes (ACD&P)*					R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*							
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	-	70.745	84.381	121.207	-	121.207	144.629	146.620	146.708	146.728	0.000	861.018
CF4: *Robotic Combat Vehicle (RCV) NGCV-CFT*	-	0.000	78.559	114.889	-	114.889	139.867	141.868	141.868	141.878	0.000	758.929
FD2: *Soldier Robotics Systems*	-	2.056	2.771	3.258	-	3.258	1.753	1.791	1.834	1.836	0.000	15.299
FD3: *Battery Modernization & Interface Standardization*	-	0.821	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.821
FD9: *Robotics Systems*	-	67.868	3.051	3.060	-	3.060	3.009	2.961	3.006	3.014	0.000	85.969

A. Mission Description and Budget Item Justification

The Robotic Combat Vehicle (RCV) Prototyping effort will produce unmanned combat vehicle prototypes with the purpose of providing vehicles that Soldiers will use to develop new Concepts of Operations (CONOPS) and new requirements for unmanned combat vehicles to support Army Modernization priorities. RCV efforts will be executed in three (3) phases focused on increasing the complexity of RCV soldier maneuvers and expanding prototype platform capability. These efforts provide the basis for the Army to make the decision to move forward with a Robotic Combat Vehicle program transitioning from Technology Demonstrations to a Program of Record through Modeling and Simulation (M&S) development, initial prototype testing and iterative Soldier evaluations. This will stress the autonomy systems developed within the Science and Technology (S&T) base, assist the Next Generation Combat Vehicles Cross Functional Team (NGCV CFT) with refining RCV requirements, and develop the CONOPS and Tactics, Techniques and Procedures (TTPs) for Manned / Unmanned Teaming (MUM-T) in combat relevant missions.

Soldier Robotics Systems for Robotics Development (RD) improves robotic and autonomous program acquisition schedules by supporting the development of integrated and synchronized capability documents (e.g. Joint Capabilites Integration and Development System, Department Directed, etc.) and by maturing/transitioning technology. Activities include studies, assessments, and document development such as Technology Readiness Levels, Manufacturing Readiness Levels, Analysis of Alternatives/Letter of Sufficiency determinations, draft acquisition documents, and draft contract documents. Efforts include robotics and autonomous systems technology maturation/transition from S&T projects, Milestone Decision Documentation (MDD), and activities leading up to formal program initiation at Milestone B or C. The pre-acquisition activities conducted under this line intend to reduce acquisition cost, schedule, and performance risk by conducting market surveys, technical risk assessments, developing performance specifications, scopes of work, acquisition strategies, systems engineering plans, test and evaluation master plans, lifecycle sustainment plans, engaging in early test planning, and prototype development activities. This line is for robotic systems that are transported by vehicle and maneuver under their own power.

The Battery Modernization & Interface Standardization (BMIS) program was established to help bring greater power efficiency and effectiveness to the dismounted Soldier and reduce the proliferation of proprietary batteries across the Army. BMIS will develop the Army Standard Family of Batteries (SFoB), a central acquisition management authority, and reduce 38 Communications-Electronics (C-E) battery types, currently in use, to just 3. Battery standardization and policy enforcement will support Operational Readiness at a reduced cost to the Army while maintaining configuration management, life cycle support, safety standards, and technological upgrades.

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 4: *Advanced Component Development & Prototypes (ACD&P)*	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*

Robotics Systems for Applique and Large Unmanned Ground Systems (ALUGS) RD improves robotic and autonomous program acquisition schedules by supporting the development of integrated and synchronized capability documents (e.g. JCIDS, Department Directed, etc.) and by maturing/transitioning technology. Activities include studies, assessments, and document development such as Technology Readiness Levels, Manufacturing Readiness Levels, Analysis of Alternatives/Letter of Sufficiency determinations, market research, draft acquisition documents, and draft contract documents. Efforts include robotics and autonomous systems technology maturation/transition from S&T projects, MDD, and activities leading up to formal program initiation at Milestone B or C. The pre-acquisition activities conducted under this line intend to reduce acquisition cost, schedule, and performance risk by conducting market surveys, technical risk assessments, developing performance specifications, scopes of work, acquisition strategies, systems engineering plans, test and evaluation master plans, lifecycle sustainment plans, engaging in early test planning, and prototype development activities. This line is for large robotic systems that are transported by vehicle, maneuver under their own power, or are installed as robotic applique kits. Research Development Technology Evaluation (RDTE) funds enable support to capability development of emerging systems currently including Tactical Wheeled Vehicle - Leader Follower (TWV-LF), Assault Breacher Vehicle (ABV), Dismounted Engineer Mobility System (DEMS), and Modular Mission Payloads (MMP). Funds prepare these capabilities for entrance into the Defense Acquisition System (i.e. Milestone decision). RDTE Product Manager Applique and Large Unmanned Ground Systems funding supports Leader Follower and ABV program transitions from Technology Demonstrations to Program of Record through Modeling and Simulation (M&S) development and initial prototype testing. This will stress the autonomy systems and ultimately reduce Program of Record testing requirements, technical risks, and costs through studies and validated simulations. Funding also supports the exploration and development of Expedient Leader Follower (ExLF) Applique on additional systems (Heavy Expanded Mobility Tactical Truck (HEMTT), Family of Medium Tactical Vehicles (FMTV), and 915 truck fleets) beyond the Palletized Load System (PLS) and applique kits on existing Tactical Wheeled Vehicles.

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	74.368	115.222	105.332	-	105.332
Current President's Budget	70.745	84.381	121.207	-	121.207
Total Adjustments	-3.623	-30.841	15.875	-	15.875
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-30.841			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-3.623	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	15.875	-	15.875

Change Summary Explanation

FY 2021 increase of $15.992 million aligns program requirements with Army modernization priorities for Project CF4 Robotic Combat Vehicle (RCV) NGCV-CFT.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*	

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
CF4: *Robotic Combat Vehicle (RCV) NGCV-CFT*	-	0.000	78.559	114.889	-	114.889	139.867	141.868	141.868	141.878	0.000	758.929
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Robotic Combat Vehicle (RCV) Prototyping effort will produce unmanned combat vehicle prototypes with the purpose of providing vehicles that Soldiers will use to develop new Concepts of Operations (CONOPS) and new requirements for unmanned combat vehicles to support Army Modernization priorities. RCV efforts will be executed in three (3) phases focused on increasing the complexity of RCV soldier maneuvers and expanding prototype platform capability. These efforts provide the basis for the Army to make the decision to move forward with a Robotic Combat Vehicle program transitioning from Technology Demonstrations to a Program of Record through Modeling and Simulation (M&S) development, initial prototype testing and iterative Soldier evaluations. This will stress the autonomy systems developed within the Science and Technology (S&T) base, assist the Next Generation Combat Vehicles Cross Functional Team (NGCV CFT) with refining RCV requirements, and develop the CONOPS and Tactics, Techniques and Procedures (TTPs) for Manned / Unmanned Teaming (MUM-T) in combat relevant missions.

In order to accelerate user involvement with RCV platform capabilities, an RCV Prototyping effort will be executed through a three (3) phase activity. The RCV surrogate platform build (Phase 1) was initiated in Fiscal Year (FY) 2019 under 0604017A Robotics Development, Project FD9 Robotics Systems and will conclude in this project with test and demonstration. This project will finalize Phase 1's rapid prototype build of surrogate RCV platforms using existing robotized vehicles and conduct Soldier evaluations at the platoon level (4 RCVs) through MUM-T evaluations. In order to conduct larger scale MUM-T maneuvers and to continue to advance the autonomous performance of the robotic platforms, two additional platoons of RCVs will be built leveraging existing contractor unmanned platforms for a total of a company set (12) RCVs. The company of RCVs (Phase 2) will be used for a second round of Soldier experimentation building off of the platoon exercises and providing additional refinement of CONOPs/TTPs.

The RCV Phase 3 prototyping will build off lessons learned in Phases 1 and 2 and develop and produce innovative, unmanned platforms that investigate different approaches to solving challenges and building on opportunities in Phases 1 and 2 to include looking at different weight class RCV platform and new modular mission payloads for RCV platforms. The intent is to award a minimum of two contracts to design and build up to a company set (12) RCV platforms for user evaluation and experimentation starting at the end of FY 2024. The RCV platforms will incorporate mature technology capabilities transitioned from S&T as they become available to include the latest autonomous mobility capability, improved user control interfaces and advanced sensing and aided target recognition. The Phase 3 RCV platform requirements will be informed by the initial platoon and company experimentation (Phase 1 and 2) and Soldier feedback.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Robotic Combat Vehicle (RCV) ? Prototype Platforms	-	65.534	86.227
Description: RCV ? Prototype Platforms effort will produce unmanned combat vehicle prototypes with the purpose of creating an experimental unit that Soldiers will use to create new CONOPS and new requirements for unmanned combat vehicles to			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
support Army Modernization priorities. Several variants of prototypes will be created, starting first with surrogate platforms which adapt existing platforms into surrogate RCVs for early experimentation in several different weight classes. Based off of lessons learned from the surrogate vehicle builds, platforms optimized to be RCVs will be built which maximize the capability advantages that unmanned platforms can offer such as reduced platform size and weight. The platforms will be built with the purpose of going through Army Test & Evaluation Center (ATEC) safety release and ultimately for Soldier evaluation through iterative User experimentation. ***FY 2020 Plans:*** In FY 2020, contracts for surrogate RCVs (Phase 2) using existing platforms were awarded to up to two (2) contractors based off of requirements generated from a platform evaluation funded under Program Element (PE) 0605053A Ground Robotics, Project FB7 Robotics Enhancement Program (REP). Surrogate RCV platforms focused on reconnaissance and decisive lethality mission roles. Direct fire, missile systems and advanced sensors were integrated on to the platforms designed for remote operation. Remote mobility functions were improved and autonomy sensor suite were integrated to ensure safety critical operation for ATEC safety assessment in FY 2021. These platforms were combined with M113 surrogates built under PE 0604017A Robotics Development, Project FD9 Robotics Systems in FY 2019 for company level RCV Surrogate Experimentation scheduled in FY 2021. ***FY 2021 Plans:*** Phase 2 light and medium RCV prototype integration of autonomy software, sensors, and lethality systems, delivering prototypes for test and evaluation will be completed. This will transition updated aided-target-recognition and navigation algorithms to Phase 1 and Phase 2 surrogate systems for Phase 2 experimentation. The concept and detailed design of the Phase 3 RCV prototypes will begin and as well as the fabrication and purchase of long-lead components and sub-systems including powertrain, energy storage, sensors, and lethality systems. Phase 3 prototype platforms will focus on decisive lethality mission roles, will be designed for remote operation and the integration of direct fire, missile systems and advanced sensors. Remote control software for modular mission packages including obscuration, electronic warfare, chemical-biological and other reconnaissance sensors will be matured and integrated. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** In FY 2021, prototyping activities are primarily in support of Phase 3 prototypes, with increased operational performance requirements in areas of lethality, survivability, and operational mobility driving increases in platform non-recurring engineering and prototyping costs in comparison to Phase 2 platforms primarily funded in FY 2020.			
Title: Robotic Combat Vehicle ? Modeling and Simulation	-	2.017	7.542
Description: RCV Modeling and Simulation effort will produce the ability to experiment in a virtual environment to conduct data collection and results that will form the physical testing desires. This will provide the initial data set to inform the operational			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
experimentation in the RCV Campaign of Learning as well as feed initial data to the Requirements Community as they build new MUM-T, CONOPs and TTPs. As test data is collected, high fidelity simulations for unmanned operation of combat platforms will be refined in a virtual test environment to enable virtual test ? fix ? test cycles in a virtual developmental space. ***FY 2020 Plans:*** This effort conducted a series of virtual experiments of multiple RCV concepts in different weight-class designs that factor in the mobility, lethality, and aided target recognition systems (AiTR) capabilities using accurate technology models simulated in an operational environment and tested with trained soldiers to provide a RCV understanding for future Brigade Combat Team (BCT) formations. The models were based upon input from industry science advisory groups to inform near-term art-of-the-possible. Soldier feedback on how to implement that was assessed to help inform the purpose built prototype and evaluate capability sets in platoon level force-on-force simulation experimentation. ***FY 2021 Plans:*** This effort will continue the series of virtual experiments for Phase 3 RCV concepts, evaluating initial designs that factor in the mobility, lethality, and AiTR capabilities using accurate technology models simulated in an operational environment and tested with trained soldiers to provide a RCV understanding for future BCT formations. The models will inform the soldier-operational experiment and the tactics, techniques, and procedures employed. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase of funding in FY 2021 is due to delayed start of RCV Phase 3 which delays start of Phase 3 simulation activities until FY2021.			
Title: Robotic Combat Vehicle ? Testing and Evaluation ***Description:*** RCV Testing effort will perform system verification testing and system safety testing on the RCV surrogate platforms and purpose-built platforms. This will expose unexpected issues and ensure that the RCV systems are safe for Soldier operation prior to conducting Field Experimentation. ***FY 2020 Plans:*** RCV Risk Reduction effort completed safety testing on the integrated Phase 1 surrogate platforms. Following safety testing, the surrogate platforms began the Soldier MUM-T Experimentation to receive User assessment on the performance of the vehicles and to begin CONOP and TTP development based on actual system performance. Surrogate RCV platforms are controlled by manned fighting control vehicles developed under PE 0603645A Armored Systems Modernization Adv Dev, Project EV7 Combat Vehicle Prototyping during the Soldier MUM-T Experimentation. ***FY 2021 Plans:***	-	2.552	14.071

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Phase 2 platforms will conduct system verification testing and go through a full range of shakedown tests to ensure platforms are ready to begin safety testing. Platforms will then move into safety release testing at Army Test and Evaluation Command to begin the evaluation process for a Safety Release for Soldier use of the RCV vehicles. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in the FY 2021 funding is due to the increase in the number of RCV systems being tested. It will increase from quantity four (4) to twelve (12), requiring additional test personnel, field-service representatives, maintenance, and logistics. System lethality capabilities will progress from small-caliber to medium-caliber, requiring increased levels of safety qualification testing.			
Title: Robotic Combat Vehicle ? Program Management ***Description:*** RCV Program Management effort will enable RCV concepting, modeling and simulation, detailed design, system integration and build, testing, and all Manned Unmanned Teaming Field Experimentation. ***FY 2020 Plans:*** This effort managed all activity under the RCV line of effort to include but not limited to government and contractor labor, travel, supplies, equipment and facilities. Managed RCV concept development, analysis, and modeling and simulation of RCV concepts. Managed detailed design, build integration, and evaluation of the RCV platform solutions. Managed the execution of the Phase 1 testing and operational experimentation. ***FY 2021 Plans:*** Funding supports the Program Management Office (PMO) acquisition, analysis of alternatives, development of the request for proposal, and initiation of milestone documentation. This funding also includes risk assessment, mitigation efforts, contract preparation, industry analysis, and feedback sessions, to include government and contractor labor, travel, supplies, equipment and facilities. This will also manage detailed design, build, integration, and evaluation of the RCV platform solutions and the execution of the Phase 2 testing and operational experimentation and Phase 3 systems engineering, design and integration. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in the FY 2021 funding will continue to support conclusion of Phase 2 and the increase in additional personnel required to support the RCV Phase 3 systems concept development, engineering, detailed design for the RCV purpose-built vehicles and the PM acquisition support.	-	4.889	7.049
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC 638 ***FY 2020 Plans:***	-	3.567	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Funding transferred in accordance with Title 15 USC 638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC 638			
Accomplishments/Planned Programs Subtotals	-	78.559	114.889

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

The RCV program will provide unmanned combat vehicles to enable users to assess the capability of the platforms and create new CONOPS and doctrine for manned/unmanned teaming based operations. Efforts will inform new ways to fight, identify system limitations and benefits, and provide an analytically backed basis for future RCV requirements documents to drive future acquisition programs.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*	

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Robotic Combat Vehicle - Program Management	MIPR	Various : Various	-	-		4.889	Oct 2019	7.049	Oct 2020	-		7.049	Continuing	Continuing	Continuing
FY 2020 SBIR/STTR Transfer	TBD	Various : Various	-	-		3.567		-		-		-	0.000	3.567	-
		Subtotal	-	-		8.456		7.049		-		7.049	Continuing	Continuing	N/A

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
RCV Phase 2 Platform (Company Set)	C/FFP	TBD : TBD	-	-		65.534	Feb 2020	20.908	Nov 2020	-		20.908	Continuing	Continuing	Continuing
RCV Phase 3 Platform (Company Set)	C/CPFF	TBD : TDB	-	-		-		65.319	Mar 2021	-		65.319	Continuing	Continuing	Continuing
		Subtotal	-	-		65.534		86.227		-		86.227	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
RCV Modeling and Simulation	MIPR	TBD : TBD	-	-		2.017	Oct 2019	7.542	Nov 2020	-		7.542	Continuing	Continuing	Continuing
RCV Test and Evaluation	MIPR	TBD : TBD	-	-		2.552	Oct 2019	14.071	Oct 2020	-		14.071	Continuing	Continuing	Continuing
		Subtotal	-	-		4.569		21.613		-		21.613	Continuing	Continuing	N/A

	Prior Years	FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	-	-		78.559		114.889		-		114.889	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*

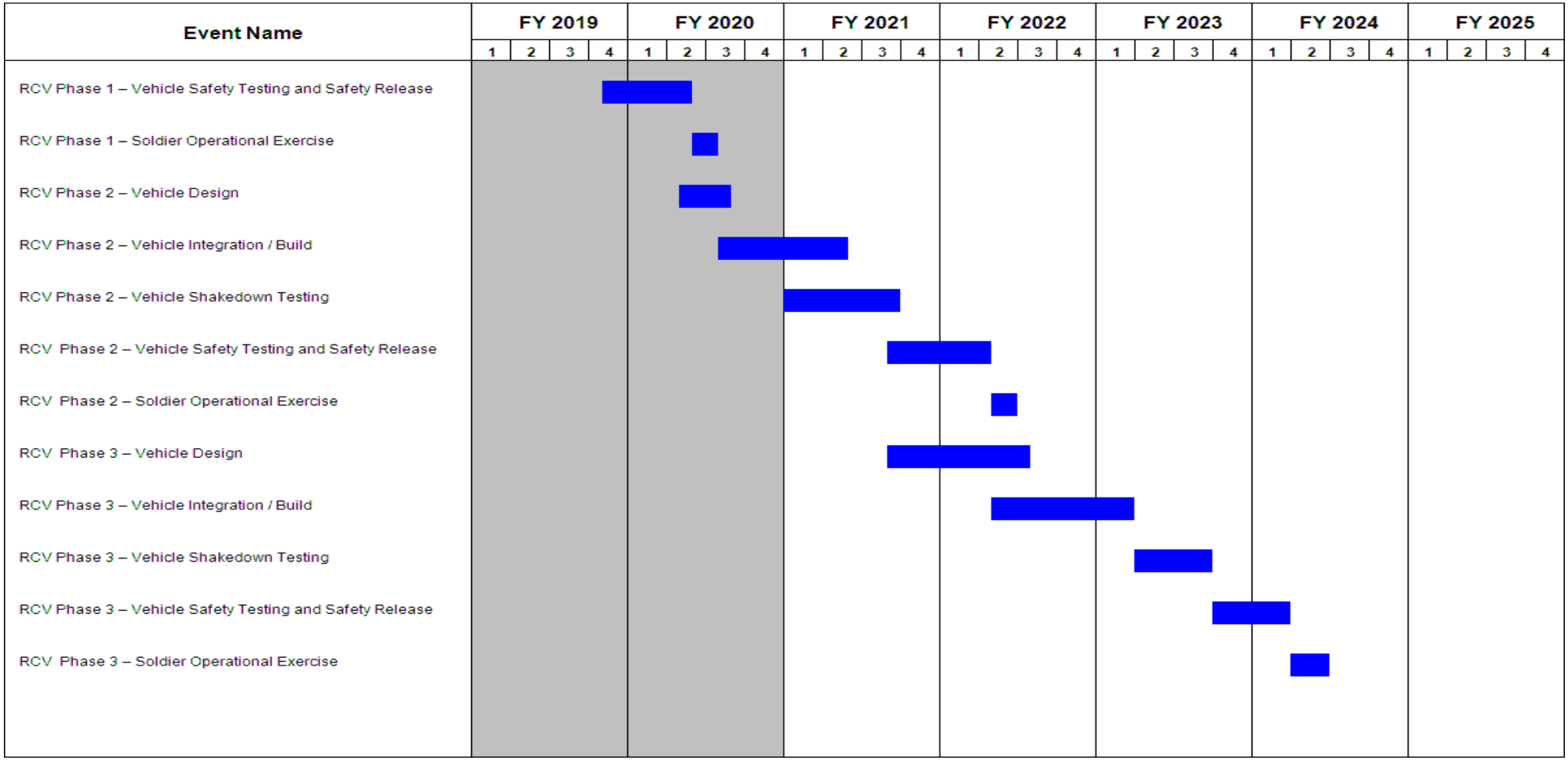

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** CF4 / *Robotic Combat Vehicle (RCV) NGCV-CFT*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
RCV Phase 1 ? Vehicle Safety Testing and Safety Release	4	2019	2	2020
RCV Phase 1 ? Soldier Operational Exercise	2	2020	3	2020
RCV Phase 2 ? Vehicle Design	2	2020	3	2020
RCV Phase 2 ? Vehicle Integration / Build	3	2020	2	2021
RCV Phase 2 ? Vehicle Shakedown Testing	1	2021	3	2021
RCV Phase 2 ? Vehicle Safety Testing and Safety Release	3	2021	2	2022
RCV Phase 2 ? Soldier Operational Exercise	2	2022	2	2022
RCV Phase 3 ? Vehicle Design	3	2021	3	2022
RCV Phase 3 ? Vehicle Integration / Build	2	2022	1	2023
RCV Phase 3 ? Vehicle Shakedown Testing	2	2023	3	2023
RCV Phase 3 ? Vehicle Safety Testing and Safety Release	4	2023	1	2024
RCV Phase 3 ? Soldier Operational Exercise	2	2024	2	2024

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 4					R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*				Project (Number/Name) FD2 / *Soldier Robotics Systems*			
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**
FD2: *Soldier Robotics Systems*	-	2.056	2.771	3.258	-	3.258	1.753	1.791	1.834	1.836	0.000	15.299
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Pre-acquisition program activities funded by this line is expected to transition to a separate Program Element and Project prior to their first program acquisition Milestone (B or C).

A. Mission Description and Budget Item Justification

Soldier Robotics Systems for Robotics Development (RD) improves robotic and autonomous program acquisition schedules by supporting the development of integrated and synchronized capability documents (e.g. JCIDS, Department Directed, Robotic & Autonomous Strategy (RAS), etc.) and by maturing/transitioning technology. Activities include studies, assessments, and document development such as Technology Readiness Levels, Manufacturing Readiness Levels, Analysis of Alternatives/ Letter of Sufficiency determinations, draft acquisition documents, and draft contract documents. Efforts include robotics and autonomous systems technology maturation/ transition from Science & Technology (S&T) demonstration projects, Milestone Decision Documentation (MDD), and activities leading up to formal program initiation at Milestone B or C. The pre-acquisition activities conducted under this line intend to reduce acquisition cost, schedule, and performance risk by conducting market surveys, technical risk assessments, developing performance specifications, scopes of work, acquisition strategies, systems engineering plans, test and evaluation master plans, lifecycle sustainment plans, engaging in early test planning, and prototype development activities. This line is for robotic systems that are transported by vehicle and maneuver under their own power.
Funding supports modernization of the current Ground Robotic fleets by investigating technology insertions including, but not limited to: condition based maintenance, vetronics, Robotic Architecture, autonomous operations and other emerging technologies. Funding also supports developing initial prototypes to enable refinement of Operational Requirements and early user feedback to support future sustainment and operational movement operating concepts."

FY 2021 funding in the amount of $1.738 million supporting Unmanned Ground Vehicles program management activities including inter-service support, travel, conducting Analysis of Alternatives (AoA), draft performance specifications, prototype demonstrations, acquisition documents and request for proposal documentation on Enhanced Robotic Payload (ERP) programs, Chemical Biological Radiological and Nuclear (CBRN), Common Robotic System (Light Reconnaissance) Robot (LRR) (CRS(LR)), and payload technology maturation efforts.

Funding supports modernization of the current Ground Robotic fleets by investigating technology insertions including, but not limited to: condition based maintenance, vetronics, Robotic Architecture, autonomous operations and other emerging technologies. Funding also supports developing initial prototypes to enable refinement of Operational Requirements and early user feedback to support future sustainment and operational movement operating concepts.

FY 2021 funding in the amount of $1.520 will support the analysis of the Soldier Exoskeleton technology that amplifies the strength, endurance, and mobility of its operator, the Soldier. The Soldier Exoskeleton capabilities provide the Army with a deployable, personal tactical performance enhancer. Soldier Exoskeleton variants will be capable of operating in a wide range of environments enhancing combat operations.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD2 / *Soldier Robotics Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Soldier Borne Sensor (SBS) / Exoskeleton	1.484	1.450	1.520
Description: The SBS provides the small unit a "quick look" capability with improved Situational Awareness of routes, buildings, tunnels, obstacles blocking line of sight, and similar concealed threat locations. The budget activity enables payload improvements including camera enhancements, target identification algorithms, display/controller improvements and user notifications for specific items of interest. Soldier Exoskeleton variants, ranging from Commercial-Off-The-Shelf solutions, will be capable of operating in a wide range of environments enhancing combat operations. ***FY 2020 Plans:*** Will continue to provide for the capability of transitioning and continuing development of Industry and DoD Exoskeleton efforts to augment the warfighter strengths and human performance to reduce Soldier load. Continue to provide for the integration and evaluation of potential exoskeleton solutions and completion of initial technical and programmatic data to inform capability requirement generation and subsequent materiel development decision. ***FY 2021 Plans:*** Will continue to provide for the transitioning and continuing development of Industry and DoD efforts to augment the warfighter strengths and human performance to reduce Soldier load into a program of record. Evaluate potential exoskeleton solutions to refine operational requirements to inform capability requirement generation, Analysis of Alternatives and technical risk assessments to engage in early Soldier evaluations/feedback to reduce acquisition cost, schedule, and performance risk. Conduct key pre-acquisition activities to include initial document development such as; draft performance specifications, draft acquisition documents and draft contract documents and early development activities. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** FY 2021 increase supports continued evaluation of capabilities.			
Title: UGV Soldier Robotics Development	0.572	1.196	1.738
Description: Soldier Robotics Development is designed to facilitate the transition of robotics and autonomous systems technology into Programs of Record. It informs the acquisition process beforehand allowing the Maneuver Center of Excellence, Sustainment Center of Excellence, Maneuver Support Center of Excellence, and the Cyber Center of Excellence the ability to make integration decisions and affordability trades while writing requirements. UGV Robotics Development will fund Common Robotics System (Vehicle), Common Robotic System (Light Reconnaissance) Robot (LRR) (CRS(LR)), Common Robotic System (Communication Link) (CRS(CL)), Common Robotic System (Mission Command/Artificial Intelligence) (CRS(MS/AI)), Render Safe - Sets, Kits and Outfits (RS-SKO), Enhanced Robotics Payload (ERP), payload technology maturation efforts, Chemical, Biological, Radiological, and Nuclear (CBRN); small, pocket sized, airborne sensors, etc. ***FY 2020 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD2 / *Soldier Robotics Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Funding is provided for program management matrix support to include salaries and travel, conduct Analysis of Alternatives (AoA) on Enhanced Robotic Payload (ERP) programs, Chemical, Biological, Radiological, and Nuclear (CBRN), Common Robotic System (Light Reconnaissance) Robot (LRR) (CRS(LR)), and payload technology maturation efforts. ***FY 2021 Plans:*** Funding is provided for program management matrix support to include salaries and travel, draft performance specifications, acquisition documents, prototype demonstrations, technology maturation, request for proposal documentations and conduct Analysis of Alternatives (AoA) on Enhanced Robotic Payload (ERP) programs, Chemical, Biological, Radiological, and Nuclear (CBRN), Common Robotic System (Light Reconnaissance) Robot (LRR) (CRS(LR)), and payload technology maturation efforts. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Increase due to adjustments for cost in support of continued evaluation of capabilities.			
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC 638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC 638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC 638	-	0.125	-
Accomplishments/Planned Programs Subtotals	2.056	2.771	3.258

C. Other Program Funding Summary ($ in Millions)

Line Item	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
• FB8: *Soldier Borne Sensor (SBS)*	3.354	-	0.000	-	0.000	-	-	-	-	Continuing	Continuing
• W63798: *Soldier Borne Sensor (SBS)*	24.437	23.362	18.907	-	18.907	18.141	19.081	19.273	19.168	Continuing	Continuing

Remarks

Pre-acquisition program activities funded by this line transition to a separate Program Element and Project prior to their first program acquisition Milestone (B or C).

D. Acquisition Strategy

Soldier Robotics Systems will utilize a Robotics Development funding for internal systems engineering, requirements and architecture analysis, AoAs and Technology Readiness Assessments with PdM UGV S&T partners, technology maturation efforts, and studies and analysis in support of program initiation with industry.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD2 / *Soldier Robotics Systems*

Initial exoskeleton efforts will continue to assess Industry's and DoD emerging exoskeleton initiatives performance through Soldier demonstrations/feedback to inform capability requirement generation, technology maturation, studies and analysis to support acquisition activities leading to program initiation.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) FD2 / *Soldier Robotics Systems*	

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
UGV Program Management Support	MIPR	Multiple : Multiple	0.418	0.390	Feb 2019	0.368	Oct 2019	0.500	Oct 2020	-		0.500	0.000	1.676	Continuing
SBS and Exoskeleton Program Management Support	Various	Various : Multiple	0.330	1.484	Jun 2019	1.482	Mar 2020	1.520	Mar 2021	-		1.520	0.000	4.816	Continuing
FY 2020 SBIR/STTR Transfer	TBD	Various : Various	-	-		0.125		-		-		-	0.000	0.125	-
		Subtotal	0.748	1.874		1.975		2.020		-		2.020	0.000	6.617	N/A

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
AoA CRS(H)	MIPR	Multiple : Various	0.258	-		-		-		-		-	0.000	0.258	-
AoA ERP	MIPR	Multiple : Various	0.421	0.085	Feb 2019	-		-		-		-	0.000	0.506	-
AoA CRS(LR)	MIPR	Multiple : Various	-	0.049	Feb 2019	-		-		-		-	0.000	0.049	-
Payload maturation and integration Studies	Various	Various : Multiple	-	-		0.398	Dec 2019	-		-		-	0.000	0.398	-
Capability Development Studies, Demonstration	Various	Various : Multiple	-	-		0.398	Dec 2019	-		-		-	0.000	0.398	-
JCAUS IOP V4	MIPR	ARDEC : Picatinny, NJ	0.050	-		-		-		-		-	0.000	0.050	-
FY 2019 SBIR /STTR Transfer	TBD	TBD : TBD	-	0.048	Oct 2018	-		-		-		-	0.000	0.048	-
		Subtotal	0.729	0.182		0.796		-		-		-	0.000	1.707	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Performance Spec Dev	MIPR	Various : Multiple	-	-		-		0.619	Feb 2021	-		0.619	0.000	0.619	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) FD2 / *Soldier Robotics Systems*	

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
RFP and Acq Documentation	MIPR	Various : Multiple	-	-		-		0.619	Apr 2021	-		0.619	0.000	0.619	-
		Subtotal	-	-		-		1.238		-		1.238	0.000	1.238	N/A

	Prior Years	FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	1.477	2.056		2.771		3.258		-		3.258	0.000	9.562	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD2 / *Soldier Robotics Systems*

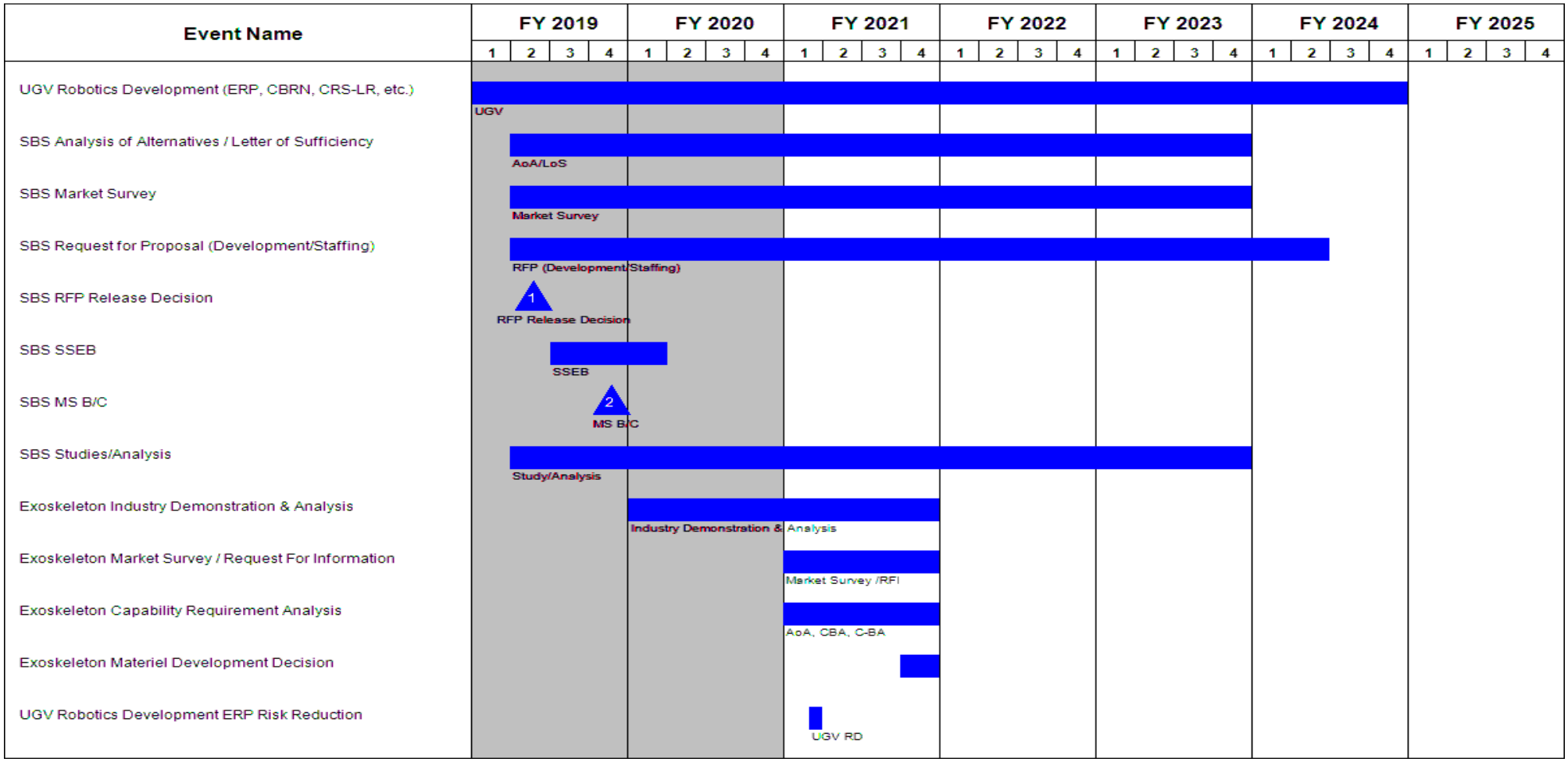

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD2 / *Soldier Robotics Systems*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
UGV Robotics Development (ERP, CBRN, CRS-LR, etc.)	1	2018	4	2024
SBS MDD	1	2018	1	2018
SBS Analysis of Alternatives / Letter of Sufficiency	1	2018	4	2023
SBS Market Survey	1	2018	4	2023
SBS Request for Proposal (Development/Staffing)	1	2018	2	2024
SBS RFP Release Decision	2	2019	2	2019
SBS SSEB	3	2019	1	2020
SBS MS B/C	4	2019	4	2019
SBS Studies/Analysis	1	2018	4	2023
Exoskeleton Industry Demonstration & Analysis	1	2020	4	2021
Exoskeleton Market Survey / Request For Information	1	2021	4	2021
Exoskeleton Capability Requirement Analysis	1	2021	4	2021
Exoskeleton Materiel Development Decision	4	2021	4	2021
UGV Robotics Development ERP Risk Reduction	1	2021	1	2021

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) FD3 / *Battery Modernization & Interface Standardization*	

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
FD3: *Battery Modernization & Interface Standardization*	-	0.821	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.821
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Project FD3 efforts complete in FY 2019.

A. Mission Description and Budget Item Justification

The Battery Modernization & Interface Standardization (BMIS) program was established to help bring greater power efficiency and effectiveness to the dismounted Soldier and to reduce the proliferation of proprietary batteries across the Army. BMIS will develop the Army Standard Family of Batteries (SFoB), a central acquisition management authority, and reduce 38 Communications-Electronics (C-E) battery types, currently in use, to just 3. Expand to include batteries for generators and hybrids, robotics, vehicles, and low density/usage systems. Battery standardization and policy enforcement will support Operational Readiness at a reduced cost to the Army while maintaining configuration management, life cycle support, safety standards, and technological upgrades.

Funding supports modernization of the current battery types. Funding also supports developing initial prototypes to enable refinement of Operational Requirements and early user feedback to support future sustainment and operational movement operating concepts.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Acquisition Strategy ***Description:*** Complete advanced development pre-milestone B assessments and analysis.	0.210	-	-
Title: BMIS Standard Family of Batteries (SFoB) Design ***Description:*** Finalize research and complete assessment of technology and portfolios. Once the SFoB has been established, maintenance and updates will be made as technology advances.	0.611	-	-
Accomplishments/Planned Programs Subtotals	0.821	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD3 / *Battery Modernization & Interface Standardization*

D. Acquisition Strategy

BMIS will expand the Army Standard Family of Batteries to include C-E, batteries for generators and hybrids, robotics, vehicles, and low density/usage systems. BMIS will continue to investigate technology advancements of batteries for these systems and provide information and recommendations to applicable Program Managers.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD3 / *Battery Modernization & Interface Standardization*

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
BMIS Design	Various	Various : Fort Belvoir	0.269	0.255		-		-		-		-	0.000	0.524	-
		Subtotal	0.269	0.255		-		-		-		-	0.000	0.524	N/A

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
BMIS SFoB Prototype Development	Various	Various : Fort Belvoir, VA	0.332	0.356		-		-		-		-	0.000	0.688	-
		Subtotal	0.332	0.356		-		-		-		-	0.000	0.688	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
BMIS Program Support	Various	Various : Fort Belvoir	0.212	0.210		-		-		-		-	0.000	0.422	-
		Subtotal	0.212	0.210		-		-		-		-	0.000	0.422	N/A

	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.813	0.821		0.000		-		-		-	0.000	1.634	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD3 / *Battery Modernization & Interface Standardization*

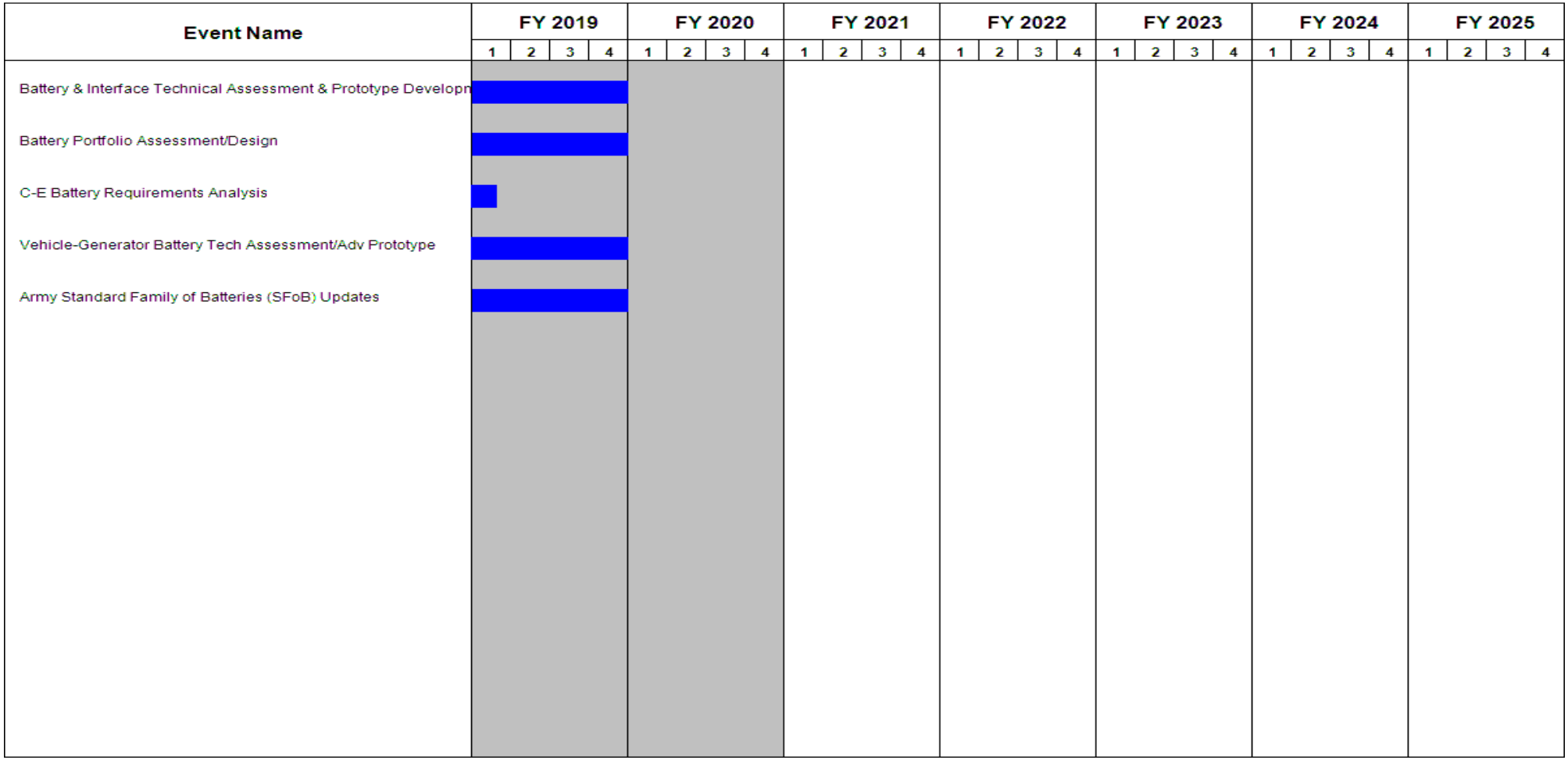

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD3 / *Battery Modernization & Interface Standardization*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
Battery & Interface Technical Assessment & Prototype Development	1	2018	4	2019
Battery Portfolio Assessment/Design	1	2018	4	2019
C-E Battery Tech Assessment/Adv Prototype	1	2018	4	2018
C-E Battery Requirements Analysis	1	2018	1	2019
Vehicle-Generator Battery Tech Assessment/Adv Prototype	4	2018	4	2019
Army Standard Family of Batteries (SFoB) Updates	1	2018	4	2019

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) FD9 / *Robotics Systems*	

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
FD9: *Robotics Systems*	-	67.868	3.051	3.060	-	3.060	3.009	2.961	3.006	3.014	0.000	85.969
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Robotics Systems for Applique and Large Unmanned Ground Systems (ALUGS) Robotics Development (RD) improves robotic and autonomous program acquisition schedules by supporting the development of integrated and synchronized capability documents (e.g. JCIDS, Department Directed, etc.) and by maturing / transitioning technology. RDTE funds enable support to capability development of emerging systems currently including Tactical Wheeled Vehicle - Leader Follower (TWV-LF), Assault Breacher Vehicle (ABV), Dismounted Engineer Mobility System (DEMS), and Modular Mission Payloads (MMP). Activities include studies, assessments, and document development such as Technology Readiness Levels, Manufacturing Readiness Levels, Analysis of Alternatives / Letter of Sufficiency determinations, draft acquisition documents, and draft contract documents. Efforts include robotics and autonomous systems technology maturation / transition from Science & Technology (S&T) projects and Robotic Enhancement Program (REP) initiatives, Milestone Decision Documentation (MDD), and activities leading up to formal program initiation at Milestone B or C. The pre-acquisition activities conducted under this line intend to reduce acquisition cost, schedule, and performance risk by conducting market surveys, technical risk assessments, developing performance specifications, scopes of work, acquisition strategies, systems engineering plans, test and evaluation master plans, lifecycle sustainment plans, engaging in early test planning, and prototype development activities. This line is for large robotic systems that are transported by vehicle, maneuver under their own power, or are installed as robotic applique kits.

Funding will expand Modeling and Simulation (M&S) including Continuous Autonomy Simulation Test Laboratory Environment (CASTLE) capability to test and evaluate Manned Unmanned teaming, combat scenarios or other emerging Robotics program needs. RD funding will utilize the M&S environment to mature and evaluate S&T for inclusion to program requirements, Engineering Change Proposals (ECPs) and/or technical insertions, utilize gaming technology in conjunction with Autonomy Software to develop Training, Tactics and Procedures (TTPs), requirements and CONOPS. In addition, RD funds exploration and development of the Expedient Leader Follower (ExLF) Applique on additional systems (Heavy Expanded Mobility Tactical Truck (HEMTT), Family of Medium Tactical Vehicles (FMTV) and 915 truck fleets) beyond the Palletized Load System (PLS).

Funding also supports modernization of the current Ground Robotic fleets and current Army vehicles by investigating technology insertions including, but not limited to: condition based maintenance, vetronics, Robotic Architecture, autonomous operations and other emerging technologies. Funding will also support developing initial prototypes to enable refinement of Operational Requirements and early user feedback to support future sustainment and operational movement operating concepts.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Tactical Wheeled Vehicle - Leader Follower (TWV-LF) - RD for PdM Applique & Large Unmanned Ground Systems (ALUGS)	5.424	-	-
Description: Tactical Wheeled Vehicle (TWV) Leader Follower (LF) Program in PdM Applique & Large Unmanned Ground Systems (ALUGS) builds upon the Combat Capabilities Development Command (CCDC) Ground Vehicle Systems Center (GVSC) Expedient Leader Follower (ELF) Operational Technology Demonstration (OTD) to provide automation capability to the			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD9 / *Robotics Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Palletized Load System (PLS) A1. Current PdM efforts will lay the groundwork for future Program of Record (PoR) capability, expanding the CCDC GVSC efforts to include up to seven (7) unmanned Follower vehicles. Funding will support cost, schedule and performance risk reduction efforts to include Capabilities Document input, close analysis of ELF OTD activities that feed cost estimates, capture technical and test data, provide test support, develop Modeling and Simulation (M&S) use cases, and develop a Software Integration Lab (SIL).			
Title: Emerging Robotics Systems ***Description:*** Validation and verification of incremental system software capability upgrades for emerging robotic systems through M&S Software-in-the-loop (SIL) and Hardware-in-the-loop (HIL) allowing for transition into Program of Record. ***FY 2020 Plans:*** FY 2020 funding will expand Modeling and Simulation including CASTLE capabilities to test and evaluate Manned Unmanned Teaming, combat scenarios or other emerging program needs. RD funding will utilize the M&S environment to mature and evaluate S&T for inclusion to program requirements, Engineering Change Proposals (ECPs) and/or technical insertions and various mission payload development, utilize gaming technology in conjunction with Autonomy Software to develop Training, Tactics and Procedures (TTPs), requirements and CONOPS and continue validating simulation scenarios to expand test capability. Funding will support Rapid prototyping to inform emerging programs with a Buy, Try, Decide strategy. ***FY 2021 Plans:*** FY 2021 funding will expand Modeling and Simulation including CASTLE capabilities to test and evaluate Manned Unmanned Teaming, combat scenarios or other emerging program needs. RD funding will utilize the M&S environment to mature and evaluate S&T for inclusion to program requirements, Engineering Change Proposals (ECPs) and/or technical insertions and various mission payload development, utilize gaming technology in conjunction with Autonomy Software to develop Training, Tactics and Procedures (TTPs), requirements and CONOPS and continue validating simulation scenarios to expand test capability. Funding will support Rapid prototyping to inform emerging programs with a Buy, Try, Decide strategy. In addition, funds support the exploration and development of Expedient Leader Follower (ExLF) Applique on additional systems (Heavy Expanded Mobility Tactical Truck (HEMTT), Family of Medium Tactical Vehicles (FMTV) and 915 truck fleets) beyond the PLS and providing an autonomous capability to existing Army vehicles. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Minimal increase from FY 2020 to FY 2021 due to inflation.	1.574	2.912	3.060
Title: Tactical Wheeled Vehicle - Leader Follower - Combat Capabilities Development Command Ground Vehicle Systems Center (CCDC GVSC) Tech Demo ***Description:*** Tactical Wheeled Vehicle - Leader Follower (TWV-LF) provides a limited autonomous vehicle software and applique kit to 10 ALUGS test Palletized Load System (PLS) A1s. For the CCDC GVSC Tech Demo, the applique kit provides a designated	42.302	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD9 / *Robotics Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
manned Leader vehicle which leads a line of 3 optionally manned Follower vehicles. The Leader vehicle wirelessly provides directional and speed guidance to the Follower vehicles to follow the Leader vehicle with no driver input or unmanned. The primary purposes for Leader Follower is to improve Force Protection and increase logistics throughput. Funding allows the Army to demonstrate and operationally assess an unmanned vehicle capability with operational units and users to validate the technology. The Army will build, and test prototype systems for safety release, Soldier use, and further technology maturation.			
Title: Robotic Combat Vehicle ? Experimental Unit Prototypes - Combat Capabilities Development Command Ground Vehicle Systems Center (CCDC GVSC) ***Description:*** Robotic Combat Vehicle (RCV) Experimental Unit Prototyping effort will produce unmanned combat vehicle prototypes with the purpose of creating an experimental unit that Soldiers will use to create new Concepts of Operations (CONOPS), and new requirements for unmanned combat vehicles to support Army Modernization priorities. Effort will leverage a three phase approach to promote multiple industry partners to provide innovative, armed unmanned platforms for soldier experimentation with the intent of defining requirements for future RCV program of record. The first two phases will focus on surrogate RCV platforms to get armed unmanned systems into Soldier?s hands for experimentation as quickly as possible. Phase 1 delivers a platoon set of modified M113s with remote weapons stations in order to start to define how an RCV can augment combat capability and to help refine requirements based on user feedback for a follow-on purpose built RCV effort which will start in Phase 3. Phase 2 adds an additional two platoons of surrogate RCVs to enable soldiers to execute company level maneuvers to better understand how RCVs will be used in the future fight and to refine software behaviors and control strategies of the RCVs.. Lessons learned from the phase 1 soldier experimentation will directly shape the requirements for the Phase 3 purpose built RCV effort which will competitively deliver up to a company set of RCVs through at least 2 industry partners for an extended Soldier evaluation. CONOPs and TTPS developed under Phase 2 will inform extended operations experiment in phase 3 and ultimately form the basis for a decision point to move forward with a procurement of RCVs.	18.540	-	-
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun (CCDC GVSC) ***Description:*** FY 2018 NDAA SEC 825 MDAP Cost Overrun (CCDC GVSC)	0.028	-	-
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC 638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC 638 ***FY 2020 to FY 2021 Increase/Decrease Statement:***	-	0.139	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD9 / *Robotics Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Funding transferred in accordance with Title 15 USC 638			
Accomplishments/Planned Programs Subtotals	67.868	3.051	3.060

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Pre-acquisition program activities funded by this line transition to a separate Program Element and Project prior to their first program acquisition Milestone (B or C).

D. Acquisition Strategy

Robotics Development (RD) is designed to facilitate the transition of robotics and autonomous systems technology from Science and Technology (S&T) projects into emerging programs of record. It informs the acquisition process early in the development cycle allowing key stakeholders the ability to make integration decisions and affordability trades while writing requirements.

Product Manager Applique and Large Unmanned Ground Systems (PdM ALUGS) builds upon the CCDC GVSC Expedient Leader Follower (ExLF) Operational Technology Demonstration (OTD) to provide a limited autonomous vehicle capability to Tactical Wheeled Vehicles including the Palletized Load System (PLS) A1, Heavy Expanded Mobility Tactical Truck (HEMTT), Family of Medium Tactical Vehicle (FMTV). Efforts include Capabilities Document input, close analysis of OTD activities that feed cost estimates, capture technical and test data, provide test support, develop Modeling and Simulation (M&S) capabilities, and develop a Software Integration Lab (SIL). Efforts may support Rapid prototyping to inform emerging programs and other Army systems. A "buy/lease, try and inform" methodology may be used to evaluate Commercial Off the Shelf (COTS), Government Off the Shelf (GOTS) and Non-Developmental Item (NDI) robotics products that have the potential to enhance Soldier combat effectiveness. Actual operational user feedback and evaluation results obtained will inform emerging capabilities and requirements documents in support of a return on investment to support future Army decision making.

Robotic Combat Vehicle (RCV) funding supports Systems Engineering, Requirements, Cost Analysis, Joint Capabilities Technology Demonstration (JCTD) support, and technology transition plans.

Combat Capabilities Development Command (CCDC) Ground Vehicle Systems Center (GVSC) funding allows the Army to demonstrate and operationally assess an unmanned vehicle capability with operational units and users to validate the technology. The Army will build, and test prototype systems for safety release, Soldier use, and further technology maturation.

Robotic Combat Vehicle (RCV) Experimental Unit Prototyping will provide unmanned combat vehicles to enable users to assess the capability of the platforms and created new CONOPS and doctrine for manned/unmanned teaming based operations. Efforts will inform new CONOPS, identified system limitations and benefits and provide an achievable, analytically backed basis for future RCV requirements documents to drive future acquisition programs.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) FD9 / *Robotics Systems*	

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
PM FP PdM ALUGS	Allot	PM FP : Warren, MI	2.350	1.025	Nov 2018	0.454	Oct 2019	0.500	Oct 2019	-		0.500	0.000	4.329	-
FY 2018 NDAA SEC 825 MDAP Cost Overrun	TBD	N/A : N/A	-	0.028		-		-		-		-	0.000	0.028	-
FY 2020 SBIR/STTR Transfer	TBD	Various : Various	-	-		0.139		-		-		-	0.000	0.139	-
		Subtotal	2.350	1.053		0.593		0.500		-		0.500	0.000	4.496	N/A

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
RCV/ACO M&S SIL ALUGS	MIPR	CCDC GVSC : Warren, MI	-	1.100	Dec 2018	-		-		-		-	0.000	1.100	-
SMET Modular Mission Payloads ALUGS	TBD	TBD : TBD	-	1.000	Dec 2018	-		-		-		-	0.000	1.000	-
Leader Follower (CCDC GVSC) Tech Demo A Kit	C/CPFF	Robotic Research : Baltimore, MD	10.400	15.544	Oct 2018	-		-		-		-	0.000	25.944	-
Leader Follower (CCDC GVSC) Tech Demo B Kit	C/CPFF	Oshkosh : Oshkosh, WI	9.402	12.021	Dec 2018	-		-		-		-	0.000	21.423	-
Leader Follower (CCDC GVSC) Integrated System Integrator	C/CPFF	Lockheed Martin : Dallas, TX	4.500	3.199	Oct 2018	-		-		-		-	0.000	7.699	-
Leader Follower (CCDC GVSC) Warfighter Machine Interface	C/CPFF	DCS Corp : Boston, MA	2.500	4.477	Nov 2018	-		-		-		-	0.000	6.977	-
RCV Risk Reduction Platform Development (CCDC GVSC)	C/CPFF	To Be Determined : To Be Determined	-	18.540	Nov 2018	-		-		-		-	0.000	18.540	-
RD M&S SIL ALUGS	MIPR	CCDC GVSC and various : Warren, MI	-	-		1.494	Oct 2019	1.160	Oct 2019	-		1.160	0.000	2.654	-
		Subtotal	26.802	55.881		1.494		1.160		-		1.160	0.000	85.337	N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) FD9 / *Robotics Systems*	

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
PdM ALUGS Support	MIPR	Various : Multiple locations	4.109	3.173	Oct 2018	0.964	Oct 2019	1.000	Oct 2019	-		1.000	0.000	9.246	-
SMET Modular Mission Payloads ALUGS	MIPR	PdM ALUGS : Warren, MI	-	0.550	Oct 2018	-		-		-		-	0.000	0.550	-
Technology Demo support (CCDC GVSC)	MIPR	CCDC GVSC : Warren, MI	1.000	1.978	Oct 2018	-		-		-		-	0.000	2.978	-
		Subtotal	5.109	5.701		0.964		1.000		-		1.000	0.000	12.774	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Leader Follower (CCDC GVSC) Tech Demo Testing	MIPR	ATEC : Aberdeen, MD	0.500	0.200	Oct 2018	-		-		-		-	0.000	0.700	-
Leader Follower (CCDC GVSC) Tech Demo Data Logger	MIPR	ATEC : Aberdeen, MD	0.500	0.200	Oct 2018	-		-		-		-	0.000	0.700	-
Leader Follower (CCDC GVSC) Testing	MIPR	Army Test and Evaluation Command (ATEC) : Aberdeen Proving Ground, MD	-	3.933	Dec 2018	-		-		-		-	0.000	3.933	-
Leader Follower (CCDC GVSC) Data Logger	MIPR	Army Test and Evaluation Command (ATEC) : Aberdeen Proving Ground, MD	-	0.750	Dec 2018	-		-		-		-	0.000	0.750	-
PdM ALUGS RD ATEC support	MIPR	ATEC : Aberdeen, MD	-	0.150	Nov 2018	-		0.400	Nov 2020	-		0.400	0.000	0.550	-
		Subtotal	1.000	5.233		-		0.400		-		0.400	0.000	6.633	N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0604017A / *Robotics Development*	Project (Number/Name) FD9 / *Robotics Systems*	

	Prior Years	FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	35.261	67.868		3.051		3.060		-		3.060	0.000	109.240	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD9 / *Robotics Systems*

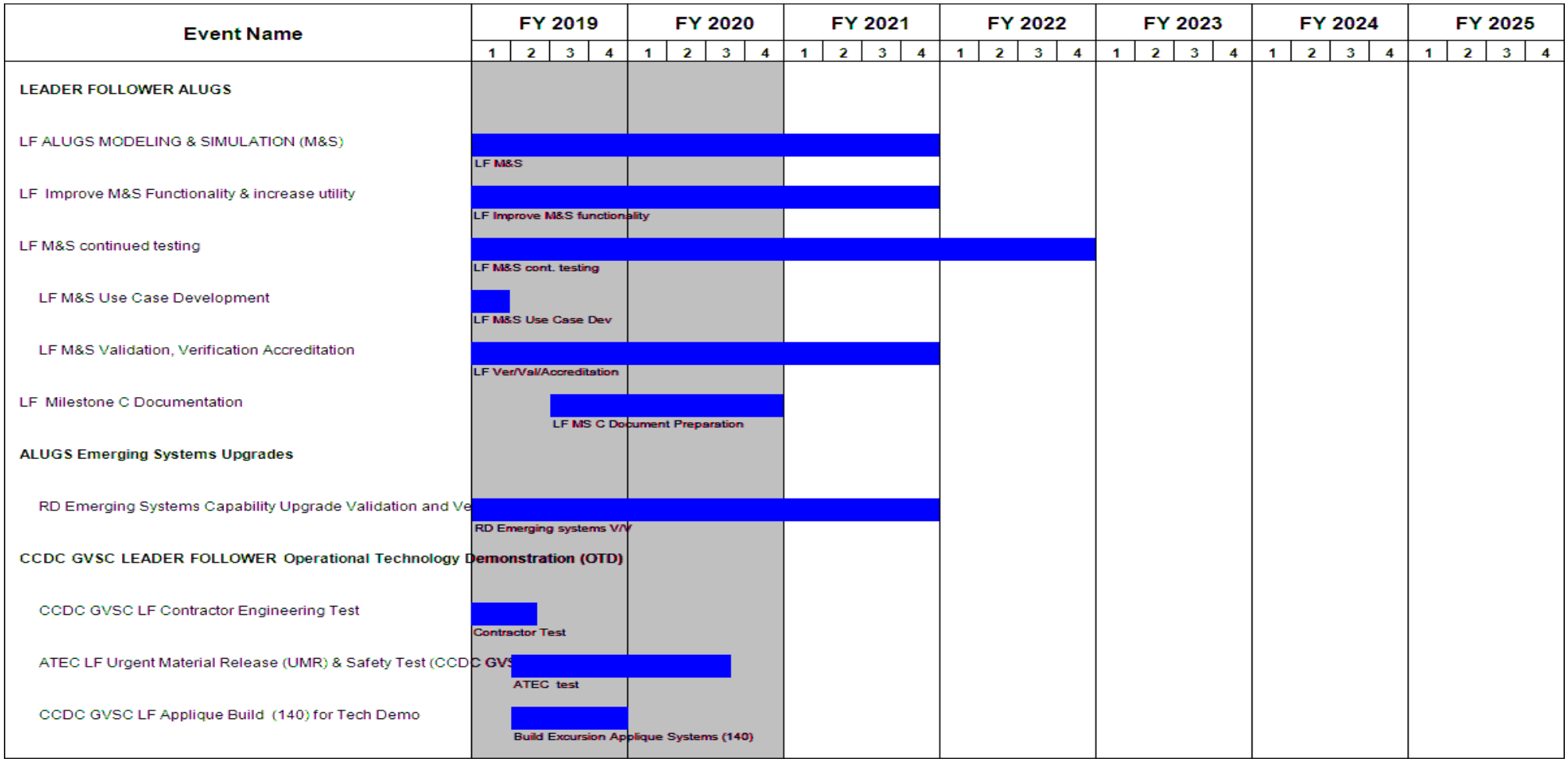

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD9 / *Robotics Systems*

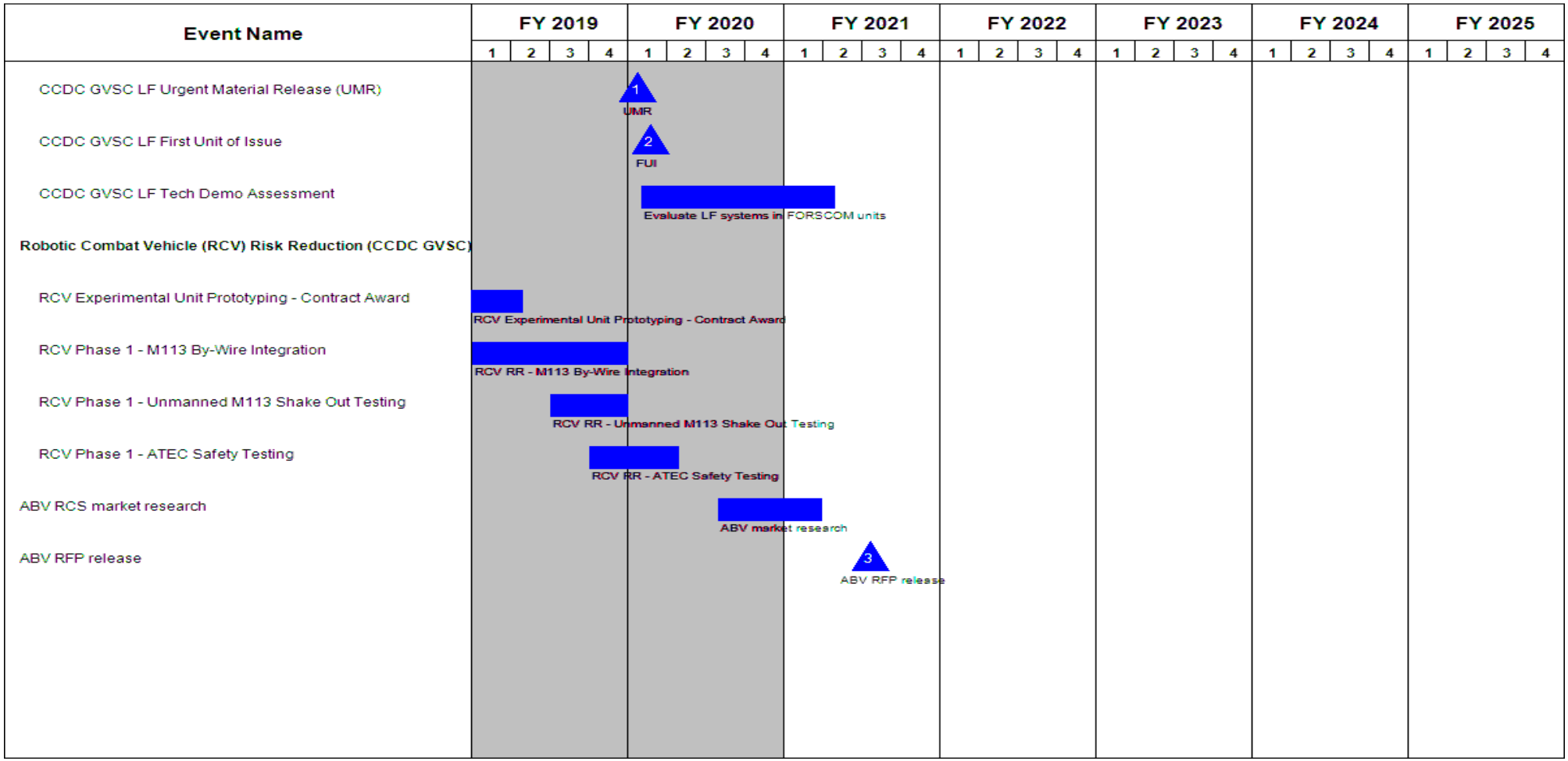

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD9 / *Robotics Systems*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
LEADER FOLLOWER ALUGS	1	2017	4	2022
LF ALUGS MODELING & SIMULATION (M&S)	1	2017	4	2021
LF M&S Data Source Matrix Development	1	2017	4	2017
LF M&S Initial Capability Development	4	2017	2	2018
LF Improve M&S Functionality & increase utility	3	2018	4	2021
LF M&S continued testing	2	2018	4	2022
LF M&S Use Case Development	1	2018	1	2019
LF M&S Validation, Verification Accreditation	4	2018	4	2021
LF Milestone C Documentation	3	2019	4	2020
ALUGS Emerging Systems Upgrades	1	2017	4	2022
RD Emerging Systems Capability Upgrade Validation and Verification	1	2019	4	2021
CCDC GVSC LEADER FOLLOWER Operational Technology Demonstration (OTD)	3	2018	3	2022
CCDC GVSC LF Applique Prototype Build (10) for test	3	2018	4	2018
CCDC GVSC LF Order Items for 140 Applique Systems	3	2018	4	2018
CCDC GVSC LF Contractor Engineering Test	3	2018	2	2019
ATEC LF Urgent Material Release (UMR) & Safety Test (CCDC GVSC)	2	2019	3	2020
CCDC GVSC LF Applique Build (140) for Tech Demo	2	2019	4	2019
CCDC GVSC LF Urgent Material Release (UMR)	1	2020	1	2020
CCDC GVSC LF First Unit of Issue	1	2020	1	2020
CCDC GVSC LF Tech Demo Assessment	1	2020	2	2021
Robotic Combat Vehicle (RCV) Risk Reduction (CCDC GVSC)	4	2019	4	2021
RCV Experimental Unit Prototyping - Contract Award	1	2019	1	2019
RCV Phase 1 - M113 By-Wire Integration	1	2019	4	2019

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	**R-1 Program Element (Number/Name)** PE 0604017A / *Robotics Development*	**Project (Number/Name)** FD9 / *Robotics Systems*

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
RCV Phase 1 - Unmanned M113 Shake Out Testing	3	2019	4	2019
RCV Phase 1 - ATEC Safety Testing	4	2019	2	2020
ABV RCS market research	3	2020	1	2021
ABV RFP release	3	2021	3	2021