Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					**R-1 Program Element (Number/Name)** PE 0602308A *I Advanced Concepts and Simulation*							

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
Total Program Element	-	27.662	28.470	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	56.132
C90: *Advanced Distributed Simulation*	-	22.451	26.841	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.292
D02: *Modeling & Simulation For Training And Design*	-	5.211	1.629	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.840

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is realigned with continuity of effort from the following PEs:
* PE 0602143A Soldier Lethality Technology
* PE 0602145A Next Generation Combat Vehicle Technology

A. Mission Description and Budget Item Justification

This PE investigates and designs enabling technologies to create effective training capabilities for the Warfighter and supports the underpinning technologies and understanding to establish architecture standards and interfaces necessary for realizing the Army vision of creating a realistic synthetic "electronic battlefield" environment for use across the spectrum of doctrine, organization, training, leader development, materiel, personnel, and facilities (DOTLM-PF). Project C90 focuses on advancing component technologies required for real time interactive linking within and among constructive, virtual, and live simulation and training by refining technologies for advanced distributed interactive simulation. Project D02 further develops concepts for immersive training and learning environments with the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California.

Work in this PE complements and is fully coordinated with PE 0601104A (University and Industry Research Centers), PE 0602785A (Manpower/Personnel/Training Technology), PE 0602786A (WarfighterTechnology), PE 0602787A (Medical Technology), PE 0603001A (Warfighter Advanced Technology), PE 0603007A (Manpower, Personnel and Training Advance Technology), PE 0603015A (Next Generation Training & Simulation Systems) and PE 0603710A (Night Vision Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army			**Date:** March 2019	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* I BA 2: *Applied Research*		**R-1 Program Element (Number/Name)** PE 0602308A *I Advanced Concepts and Simulation*		

B. Program Change Summary ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**
Previous President's Budget	28.650	28.500	28.765	-	28.765
Current President's Budget	27.662	28.470	0.000	-	0.000
Total Adjustments	-0.988	-0.030	-28.765	-	-28.765
• Congressional General Reductions	-0.020	-0.030			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.968	-			
• Adjustments to Budget Years	-	-	-28.765	-	-28.765

Change Summary Explanation

FY20 decrease related to Science & Technology financial restructuring.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army										Date: March 2019	

Appropriation/Budget Activity 2040 I 2				R-1 Program Element (Number/Name) PE 0602308A I Advanced Concepts and Simulation					Project (Number/Name) C90 I Advanced Distributed Simulation		

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
C90: Advanced Distributed Simulation	-	22.451	26.841	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.292

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0602143A Soldier Lethality Technology
* Project BC3 Soldier Decision Making & Comms Performance Tech
* Project BC7 Training Technology (Other than STE)
* Project BE8 Synthetic Training Environment (STE) Technology)
PE 0602145A Next Generation Combat Vehicle Technology
* Project BF6 Crew Augmentation and Optimization Tech

A. Mission Description and Budget Item Justification

This Project investigates and designs enabling technologies for advancing distributed simulation and training (live, virtual and constructive) environments. This includes networking of models representing complex human behavior, complex data interchange between simulations, synthetic natural environments, medical training simulations, ground platform training, adaptive tutoring for individuals and teams, and collaborative training. The Project researches the ability to create a virtual representation of combined arms environments, with the Warfighter-in-the-loop that constructive (event driven) simulations cannot simulate.

Efforts in this Project support the Under Secretary of Defense for Research and Engineering Science and Technology priorities and the Army Modernization Strategy.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Live and Medical Training Technologies Description: Included in this effort will be the development of new medical training simulations to train medical personnel across all levels of care and the development of live training technology that can be applied across all military levels and training environments. FY 2019 Plans: Investigate components such as artificial intelligence algorithms to aid in target recognition, next generation magnetometers, high resolution simulated three dimension terrain and weapon orientation to enhance live training technology research; research in live training technologies will support the Army?s capability need to provide live simulations that accurately replicate and realistically represent the effects of current weapons systems during force-on-force and force-on-target training; design and develop capabilities to improve the accuracy and fidelity of medical simulations for training; investigate and characterize gross	6.500	5.800	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 I 2	**R-1 Program Element (Number/Name)** PE 0602308A I *Advanced Concepts and Simulation*	**Project (Number/Name)** C90 I *Advanced Distributed Simulation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
and subtle tissue behaviors necessary for higher levels of medical understanding; investigate and develop medical simulation environments that accurately represent the operational environment both inside and outside of the body. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC7 (Training Technology (Other than STE)) in FY20 as part of financial restructuring.			
Title: Adaptive Tutoring ***Description:*** This effort investigates adaptive tutoring and immersive learning environments with social simulations to conduct kinetic and non-kinetic training for individuals and teams. ***FY 2019 Plans:*** Extend models for individual learners, instructional management, and Army task domains to increase the complexity of adaptive training for individuals to enable future adaptive training; validate a base authoring concept for individual adaptive training; expand concepts for authoring tools, team modeling, team instruction, and Army team domains to support development of team (unit level) tutoring systems; mature training strategies for autonomous software systems; develop recommended systems to reinforce experiential learning of autonomous systems via machine learning techniques. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC3 (Soldier Decision Making & Comms Performance Tech), Project BC7 (Training Technology (Other than STE), and PE 0602143A (Soldier Lethality Technology) / Project BE8 Synthetic Training Environment (STE) Technology) in FY20 as part of the financial restructuring.	5.200	2.800	-
Title: Soldier System Architecture ***Description:*** Research and develop simulation architecture to represent the Soldier as a System considering physiological effects, cognitive load, and Soldier culture in the context of Soldier-materiel interactions supporting training effectiveness, experimentation, and materiel development. The architecture will advance computational strategies to enable the integration and interaction of new and existing Soldier models into a seamless Soldier as a System simulation.	1.275	-	-
Title: Training Effectiveness Research ***Description:*** This effort will research and develop simulation architectures, tools, and models that can represent current and future semi and fully autonomous systems. The architecture, tools and models will enable the evaluation of the training impacts (i.e., cognitive, physiological, and team coordination) of future autonomous systems and technologies on individual, crew, and unit tasks. The training demands of systems that are increasingly complex, intelligent, and self-adaptive far exceed those of	1.276	1.333	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019	
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602308A / *Advanced Concepts and Simulation*	**Project (Number/Name)** C90 / *Advanced Distributed Simulation*	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
legacy systems that require training of primarily procedural tasks. This is compounded by parallel increases in autonomy and responsibility at lower echelons. ***FY 2019 Plans:*** Investigate methods and techniques to optimize individual and team training outcomes (cognitive, physiological, physical) for autonomous systems; extend development of techniques to improve recommender systems that will maximize training for teams using complex, adaptive, and intelligent autonomous systems. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This effort ends in FY19.			
Title: Rapid Soldier Capability Enhancement - Training ***Description:*** Research the relationship of augmentation agents and Soldier performance & behavior. Investigate the effects of augmentation agents (perceptual, cognitive, and/or physical), used either individually or coupled as a system of agents, on Soldier performance, resilience, and training during operationally relevant tasks. Development of guidelines and models for designing and employing augmentation agents. Implementation of guidelines will enhance augmented Soldier performance. ***FY 2019 Plans:*** Explore augmentation technologies with potentially broad applications, to include adaptive training applications to increase Soldier performance and reduce time-to-proficiency in mounted and dismounted Soldier tasks; investigate novel approaches for integrating advanced metrics of factors related to individual variability into adaptive training technologies to enable augmentation techniques in complex training applications. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC3 (Soldier Decision Making & Comms Performance Tech), Project BC7 (Training Technology (Other than STE), and PE 0602143A (Soldier Lethality Technology) / Project BE8 Synthetic Training Environment (STE) Technology) in FY20 as part of the financial restructuring.	2.000	2.100	-
Title: Synthetic Natural Environments ***Description:*** This effort investigates and develops tools and methods to improve the speed, fidelity and delivery of synthetic terrain and environmental data to support Training Aid Devices (TADs), simulation and mission rehearsal systems. This effort is coordinated with and complements PE 0603015A/Project S28. ***FY 2019 Plans:*** Research in synthetic natural environments supports the Army capability need to rapidly and accurately collect, develop, digitize, store, and access detailed terrain information from a single correlated terrain database that is easily scalable from soldier	6.200	2.200	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 I 2	**R-1 Program Element (Number/Name)** PE 0602308A I *Advanced Concepts and Simulation*	**Project (Number/Name)** C90 I *Advanced Distributed Simulation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
level to global level views of the world. This is part of the Army future synthetic training environment and One World Terrain representation; develop dynamic terrain /updates that dynamically change the synthetic environment based on simulated and real world events; investigate data exploitation and advanced rendering techniques for geospatial data at runtime to produce realistic human interactions; research advanced synthetic generation techniques as to the scalability required for detail and quantity needed for complete data/content coverage of the globe. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BE8 (Synthetic Training Environment (STE) Technology) in FY20 as part of the financial restructuring.			
Title: Mixed Reality Research ***Description:*** This effort investigates and develops enabling virtual and augmented reality simulation and training technologies to support future training environments and Army senior leader initiatives in Decide Faster, Asymmetric Vision, and Manned-Unmanned Teaming capabilities. These technologies support the Army capability needs for enhanced dismounted Soldier performance in complex urban environments. Identification of future technologies will be done in concurrence with the core modeling and simulation enablers for megacities. ***FY 2019 Plans:*** Examine how interfaces for virtual training systems affect user interactions with those systems and thereby impact training and performance outcomes; examine how different interfaces for virtual training systems can be used to more seamlessly integrate live and virtual training to improve training transfer from virtual to live; investigate and design the synthetic framework, architecture, and technologies to enable a manned/unmanned teaming training and rehearsal simulation environment. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC3 (Soldier Decision Making & Comms Performance Tech), Project BC7 (Training Technology (Other than STE), and PE 0602143A (Soldier Lethality Technology) / Project BE8 Synthetic Training Environment (STE) Technology) in FY20 as part of the financial restructuring.	-	4.000	-
Title: Cyber for Training Simulations ***Description:*** This effort investigates and develops analytical capabilities to more accurately characterize, model, and predict human behavior related to Cyber Electromagnetic Activities (CEMA) events from the tactical to the strategic level. ***FY 2019 Plans:***	-	2.750	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 I 2	**R-1 Program Element (Number/Name)** PE 0602308A I *Advanced Concepts and Simulation*	**Project (Number/Name)** C90 I *Advanced Distributed Simulation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Investigate analytical capabilities and methodologies for generating models from empirical data and social and psychological theory to describe CEMA-related human attributes (e.g., intent, posture, and capability); and design initial simulation environment integrating new human models with existing and developing CEMA representations. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC3 (Soldier Decision Making & Comms Performance Tech), Project BC7 (Training Technology (Other than STE), and PE 0602143A (Soldier Lethality Technology) / Project BE8 Synthetic Training Environment (STE) Technology) in FY20 as part of the financial restructuring.			
Title: Artificial Intelligence ***Description:*** This effort investigates artificial intelligence techniques to develop intelligent, human-like, virtual characters to maximize and accelerate Soldier learning in future simulation and training applications. This effort also develops novel methods for joint human/intelligent agent learning and decision making. ***FY 2019 Plans:*** Investigate capabilities for data mining to better predict individualized degradation in task performance after completion of training; and design initial capabilities for identifying appropriate training resources to mitigate this degradation using individualized intelligent training technologies. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC3 (Soldier Decision Making & Comms Performance Tech), Project BC7 (Training Technology (Other than STE), PE 0602143A (Soldier Lethality Technology) / Project BE8 Synthetic Training Environment (STE) Technology), and PE 0602145A (Next generation Combat Vehicle Technology) / Project BF6 (Crew Augmentation and Optimization Tech) in FY20 as part of the financial restructuring.	-	1.500	-
Title: Synthetic Training Environment Acceleration ***Description:*** This effort designs and develops technologies that will transition to advanced technology development in order to enable a Synthetic Training Environment which is a single, interconnected training system in which units from squad through ASCC can train in the most appropriate domain - live, virtual, constructive, and gaming, or in all four simultaneously. ***FY 2019 Plans:*** Mature artificial intelligence (AI) representation of simulated forces to model relevant aspects of the Multi Domain Operations (MDO), increase simulated entity scalability and increase concurrent role-players to enable synthetic collective training; investigate the automated generation of high fidelity synthetic natural environment data in support of the Army?s future synthetic training environment global terrain requirement; determine techniques to automate the attribution of terrain, procedurally extract building extents and apply surface features utilizing point cloud, texture, crowd-sourced and other emerging sources of data; design and	-	3.500	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 2	**R-1 Program Element (Number/Name)** PE 0602308A *I Advanced Concepts and Simulation*	**Project (Number/Name)** C90 *I Advanced Distributed Simulation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
develop terrain resolution algorithms which encompass the ability to embed Human Terrain (cultural attributes, infrastructure, social media) in the synthetic environment. *FY 2019 to FY 2020 Increase/Decrease Statement:* This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BE8 (Synthetic Training Environment (STE) Technology) in FY20 as part of the financial restructuring.			
Title: FY 2019 SBIR / STTR Transfer *Description:* FY 2019 SBIR / STTR Transfer *FY 2019 Plans:* FY 2019 SBIR / STTR Transfer *FY 2019 to FY 2020 Increase/Decrease Statement:* FY 2019 SBIR / STTR Transfer	-	0.858	-
Accomplishments/Planned Programs Subtotals	22.451	26.841	-

C. Other Program Funding Summary ($ in Millions)
 N/A
Remarks

D. Acquisition Strategy
 N/A

E. Performance Metrics
 N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army										Date: March 2019	
Appropriation/Budget Activity 2040 I 2				**R-1 Program Element (Number/Name)** PE 0602308A I Advanced Concepts and Simulation						**Project (Number/Name)** D02 I Modeling & Simulation For Training And Design	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
D02: Modeling & Simulation For Training And Design	-	5.211	1.629	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.840

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0602143A Soldier Lethality Technology
* Project BC7 Training Technology (Other than STE)
* Project BE8 Synthetic Training Environment (STE) Technology

A. Mission Description and Budget Item Justification

This Project transitions basic research into applied research. This Project investigates and designs training applications to enable the Army to train any time and any place. Efforts include designing virtual humans that embody natural language, speech recognition in noisy environments, gesture, gaze, and conversational speech. Techniques and methods are assessed for integrating different sensory cues into virtual environments that result in enhanced training and leader development. The project leverages the capabilities of industry and the research and development community through the synthesis of creativity and technology, including work at the Army Research Institute and the Army Research Laboratory.

Efforts in this Project support the Under Secretary of Defense for Research and Engineering Science and Technology (S&T) priorities and the Army Modernization Strategy.

Developed technologies and techniques are transitioned for maturation and demonstration to PE 0603015A (Next Generation Training & Simulation Systems) / Project S28 (Immersive Learning Environments).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Immersive Technology Environments **Description:** Conduct applied research that enables responsive and reconfigurable environments that immerse human senses such as sight, sound, and touch in mixed reality environments to include physical elements providing touch and feel to simulate objects such as obstacles and walls. **FY 2019 Plans:**	2.606	1.052	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 2	**R-1 Program Element (Number/Name)** PE 0602308A *I Advanced Concepts and Simulation*	**Project (Number/Name)** D02 *I Modeling & Simulation For Training And Design*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Utilize brain imaging studies, such as magnetic resonance imaging (MRI), to identify specific regions and networks of the brain affected by virtual reality, related to empathy and decision making which will help reveal neurological mechanisms of how virtual reality can aid military personnel in making better decisions. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC7 (Training Technology (Other than STE)), and Project BE8 Synthetic Training Environment (STE) Technology) in FY20 as a result of the S&T financial restructuring.			
Title: Immersive Technology Techniques *Description:* This effort develops tools, techniques and technologies for improving the immersion of human senses within simulation environments and therefore creating enhanced realism. ***FY 2019 Plans:*** Conduct research to enable Soldiers to train in simulated environments using applied research to provide technology options for development and transition. These technologies derived from this research will address the complex operational environment elements and multi-domain interactions in order to provide accelerated, adaptable, flexible, and sustained unit readiness for the full range of Army missions. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602143A (Soldier Lethality Technology) / Project BC7 (Training Technology (Other than STE)), and Project BE8 Synthetic Training Environment (STE) Technology) in FY20 as a result of the S&T financial restructuring.	2.605	0.525	-
Title: FY 2019 SBIR / STTR Transfer *Description:* FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.052	-
Accomplishments/Planned Programs Subtotals	5.211	1.629	-

C. Other Program Funding Summary ($ in Millions)
 N/A
Remarks

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 2	**R-1 Program Element (Number/Name)** PE 0602308A *I Advanced Concepts and Simulation*	**Project (Number/Name)** D02 *I Modeling & Simulation For Training And Design*

D. Acquisition Strategy

 N/A

E. Performance Metrics

 N/A